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AUSTRIA'S NATIONAL INVENTORY REPORT 2010

Submission under the United Nations Framework Convention on Climate Change and under the Kyoto Protocol

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PREFACE

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 2008. With the submission of 2008 inventory data, this report delivers the first results to be accounted for under the Kyoto Protocol.

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 largely an update of the NIR submitted in 2009[2]. However, as this report is the first one under the first commitment period under the Kyoto Protocol, the structure has been adapted to include all information required for reporting under the Protocol.

This report is based on data submitted to the UNFCCC in the common reporting format (CRF submission 2010). 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 2010 and as submitted to the UNFCCC in the data submission 2010 replaces all previous versions of data submissions.

The structure of this year's NIR follows the new outline for the NIR for reporting of supplementary information required under Article 7, paragraph 1, of the Kyoto Protocol which has been prepared by the UNFCCC secretariat[3]: The report consists of two parts – Part I for reporting the annual inventory submission under the Convention, and Part II for reporting supplementary information required under Article 7, paragraph 1, of the Kyoto Protocol. 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, both including information on activities according to Article 3.3 of the Kyoto Protocol. 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. Finally, Chapters 10–14, which form Part II of this report, entail supplementary information required under Article 7, paragraph 1, of the Kyoto Protocol regarding changes to the national system and registry, information on Kyoto Protocol Units[4], methodological information concerning activities under Article 3.3 of the Kyoto Protocol and information on minimization of adverse impacts in accordance with Article 3, paragraph 14.

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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 2009 – Submission under the United Nations Framework Convention of Climate Change. Reports, Bd. REP-0188; Umweltbundesamt, Vienna.

[3] http://unfccc.int/files/national_reports/annex_i_ghg_inventories/reporting_requirements/application/pdf/annotated_nir_outline.pdf

[4] 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 Annex presents detailed information on the methodology of emission estimates for the fuel combustion sector, the CO_2 reference approach and the National Energy Balance, detailed results from the key category analysis as well as information on gas specific recalculations and the uncertainty assessment. Furthermore underlying emission data for the year 2008 as reported in the tables of the common reporting format of the data submission 2010 under the Convention and Tables for reporting emissions and removals of greenhouse gases from acitivities under Article 3.3 under the Kyoto Protocol are included.

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.

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Annex 8	Katja Pazdernik
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EXECUTIVE SUMMARY

ES.1 Background Information on greenhouse gas inventories, climate change and supplementary information under Article 7, paragraph 1, of the Kyoto Protocol

ES.1.1 Background information on climate change

Climate in a narrow sense is usually defined as the average weather, or more rigorously, as the statistical description in terms of the mean and variability of relevant quantities over a period of time ranging from months to thousands or millions of years. It undergoes natural variability. Since industrialisation started some 150 years ago, mankind has been influencing the climate via the emission of greenhouse gases. In 1992, by adopting the United Nations Convention on Climate Change, the countries of the world came together to prevent dangerous effects of climate change. However, the Convention did not include binding commitments to limit GHG emissions. To go this step further the Kyoto Protocol was adopted in 1997: it sets binding emission limits for 37 industrialized countries.

ES.1.2 Background information on greenhouse gas inventories

To be able to evaluate the trend of greenhouse gas emissions, especially the progress in achieving the emission reduction goal, it is necessary to regularly compile an inventory of GHG emissions. The compilation of these inventories follows rules as agreed under the respective bodies of the UNFCCC and the Kyoto Protocol.

ES.1.3 Background information on supplementary information under Article 7, paragraph 1, of the Kyoto Protocol

Supplementary information to be submitted annually under the UNFCCC is necessary to determine compliance with the regulations of the Kyoto Protocol. This is in particular

(i) information on emissions and removals from the land use, land use change and forestry (LULUCF) sector under the Kyoto Protocol,
(ii) information on the national registry which is responsible for accounting of the emission and removal units of each Party.
(iii) information on any changes that have occurred in the national system compared with the information reported in the last submission, and
(iv) information on the minimization of adverse impacts in accordance with Article 3, paragraph 14.

Emissions and removals from the KP-LULUCF sector as well as land- and activity-related information and specific information to be reported with regard to activities under Art. 3 paragraph 3 is given in Chapter 10. Information on changes in the national registry since submission 2009 is provided in Chapter 13. Changes basically relate to the implementation of the 1st Amendment of the Registry Regulation 917/2007/EC and the altered requirements of publicly accessible information. With regard to the Austrian national system there were no major changes compared to last years' inventory. Information on how Austria is striving, under Art. 3 paragraph 14 of the Kyoto Protocol, to implement its commitments (Art. 3 paragraph 1) in such a way as to minimize adverse effects on developing country Parties is provided in Chapter 14, covering measures undertaken to minimize negative impacts (according to paragraph 23 of the Annex to decision

15/CMP) – for example with reference to the Austrian JI/CDM programme – as well as information on how priority is given pursuant to paragraph 24 of the Annex to decision 15/CMP. How Austria strives to phase out market imperfections that run counter to the objectives of the Convention and what other actions have been taken in the context of Article 3 paragraph 14 respectively paragraph 24 of Decision 15/CMP is described in Chapter 14.

ES.2 Summary of National Emission and Removal Related Trends, and emission and removals from KP-LULUCF activities

ES.2.1 GHG inventory

Total GHG emissions (excluding land-use change and forestry (LULUCF)) amounted to 86 641 Gg CO_2 equivalents in 2008 and increased by 10.8% compared to 1990. The base year for all greenhouse gases is 1990.

The most important GHG in Austria is carbon dioxide (CO_2), it contributed 85.0% to the total national GHG emissions expressed in CO_2 equivalents in 2008, followed by CH_4, 6.6% and N_2O, 6.6%. PFCs, HFCs and SF_6 amounted together to 1.9% of the overall GHG emissions in the country. The energy sector accounted for 74.7% of the total GHG emissions followed by Industrial Processes 13.7%, Agriculture 8.8%, Waste 2.3% and Solvent 0.4%.

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

GHG		Total	CO_2	CH_4	N_2O	HFCs	PFCs	SF_6
1990*	[Gg CO_2 equivalent]	**78 170.92**	62 068.13	8 305.59	6 197.36	26.32	1 079.24	494.28
1991		**82 222.52**	65 656.02	8 272.24	6 532.88	29.56	1 087.08	644.74
1992		**75 521.32**	60 211.55	7 993.50	6 132.73	32.31	462.32	688.92
1993		**75 506.24**	60 527.94	7 945.51	5 955.79	243.56	52.57	780.89
1994		**76 394.22**	60 914.87	7 721.63	6 434.51	293.06	58.30	971.85
1995		**79 821.72**	63 951.18	7 633.77	6 599.54	411.89	71.27	1 154.06
1996		**82.905.91**	67 393.60	7 416.88	6 257.64	531.94	71.70	1 234.15
1997		**82 489.04**	67 187.80	7 114.22	6 290.91	651.70	105.15	1 139.26
1998		**81 876.79**	66 762.96	6 964.58	6 410.77	769.33	55.95	913.21
1999		**80 271.46**	65 352.56	6 796.19	6 380.26	876.64	78.63	787.19
2000		**80 296.44**	65 799.05	6 640.53	6 274.65	901.88	84.79	595.54
2001		**84 532.75**	70 190.98	6 506.19	6 162.45	924.92	95.91	652.28
2002		**86 270.14**	72 040.46	6 359.63	6 168.32	969.22	97.70	634.81
2003		**91 930.97**	77 840.32	6 363.68	6 094.35	949.55	116.44	566.62
2004		**90 926.17**	77 723.12	6 219.86	5 394.06	955.14	136.65	497.35
2005		**92 915.91**	79 772.95	6 085.71	5 429.69	986.41	133.82	507.33
2006		**89 687.53**	76 687.06	5 955.58	5 471.40	962.62	145.72	465.15
2007		**86 957.35**	73 972.29	5 861.10	5 497.31	1.061.99	190.12	374.54
2008		**86 641.21**	73 630.23	5 716.62	5 681.28	1.058.10	173.53	381.44

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

NOTE: Emissions without LULUCF

Over the period 1990–2008 CO_2 emissions increased by 18.6%, mainly due to increased emissions from transport. Methane emissions decreased during the same period by 31.2% mainly due to lower emissions from solid waste disposal; N_2O emissions decreased by 8.3% over the same period due to lower emissions from agricultural soils and from chemical industry. HFC emissions are 39 times higher in 2008 than in the base year, whereas PFC and SF_6 emissions decreased by 83.9% and 22.8% from the base year to 2008.

ES.2.2 KP-LULUCF activities

In 2008 Article 3.3 activities were a net sink in Austria: Net CO_2 removals amounted to 1 307 Gg CO_2.

Removals from afforestation amounted to 2 531 Gg CO_2. About 2/3 of these gains were caused by the C stock increases in soil and litter, 1/3 was due to biomass growth at the AR areas. Approximately 40 % of these removals occurred on AR areas from grassland, 20% at each, AR areas from cropland and settlement, and 10% at each, AR areas from wetlands and other land.

In the same year, emissions from deforestation amounted to 1 224 Gg CO_2. A bit more than 2/3 were due to C stock losses in litter and soil, and 1/3 due to biomass losses at the D areas. Approximately 35% of these losses happened at D areas to other land, 30% at D areas to grassland, 25% at D areas to settlement and the rest at D areas to cropland and wetlands.

Due to the nature and permanence of ARD areas, from 1990 on there is a steady increase in ARD areas (see chapter 10.2.1) and related to that a steady increase of removals and emissions, respectively, at these areas.

A revision of these estimates will be carried out with the availability of the data from the NFI 2007/09. Due to the high impact of activities in the Kyoto-Period 2008-2012 (particularly of D activities) on the net figures, these preliminary results may change considerably with the availability of the data from this new NFI.

ES.3 Overview of Source and Sink Category Emission Estimates and Trends, including KP-LULUCF activities

ES.3.1 GHG inventory

The dominant sector regarding GHG emissions in Austria is the energy sector (74.4%), followed by Industrial Processes (13.7%).

Table 2: 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]	65 031.53	**78 170.92**	55 403.93	10 110.94	511.80	8 558.03	-13 139.39	3 586.22
1991		63 037.06	**82 222.52**	59 301.11	10 133.05	465.98	8 747.46	-19 185.46	3 574.92
1992		61 457.84	**75 521.32**	54 369.50	8 978.97	417.65	8 284.53	-14 063.48	3 470.69
1993		57 529.78	**75 506.24**	54 782.71	8 829.32	418.48	8 050.63	-17 976.46	3 425.09
1994		59 711.61	**76 394.22**	54 816.14	9 352.32	403.26	8 555.15	-16 682.61	3 267.35
1995		63 696.90	**79 821.72**	57 671.32	9 896.87	422.45	8 718.84	-16 124.81	3 112.23
1996		71 818.90	**82 905.91**	61 475.43	9 813.74	405.66	8 244.26	-11 087.01	2 966.81
1997		62 457.46	**82 489.04**	60 555.92	10 450.73	424.37	8 220.97	-20 031.57	2 837.04
1998		63 779.91	**81 876.79**	60 528.76	9 971.94	406.32	8 223.45	-18 096.88	2 746.32
1999		57 711.85	**80 271.46**	59 280.18	9 849.23	392.26	8 098.73	-22 559.62	2 651.07
2000		63 142.93	**80 296.44**	59 076.02	10 322.18	425.12	7 904.40	-17 153.51	2 568.72
2001		64 650.95	**84 532.75**	63 566.65	10 174.17	424.82	7 855.62	-19 881.80	2 511.49
2002		70 347.58	**86 270.14**	64 814.11	10 792.03	434.79	7 751.63	-15 922.57	2 477.59
2003		74 556.27	**91 930.97**	70 687.24	10 744.18	428.48	7 543.49	-17 374.70	2 527.58
2004		73 402.31	**90 926.17**	70 633.66	10 054.07	384.10	7 438.55	-17 523.86	2 415.79
2005		75 584.39	**92 915.91**	72 182.73	10 627.52	384.65	7 398.79	-17 331.51	2 322.22
2006		72 370.54	**89 687.53**	68 604.68	10 990.48	411.97	7 432.89	-17 316.99	2 247.51
2007		69 569.46	**86 957.35**	65 463.08	11 465.65	387.23	7 497.40	-17 387.89	2 143.99
2008		69 304.05	**86 641.21**	64 727.07	11 870.01	388.41	7 631.33	-17 337.16	2 024.40

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

In 2008, 64 727 Gg CO_2 equivalents, that is 74.4% of total national emissions, arose from the energy sector. In 2008, 99.3% of these emissions arose from fuel combustion activities. The most important fuel combustion sub-sector in 2008 was transport with a share of 35.1%. From 1990 to 2008, emissions from the energy sector increased by 16.8%.

Industrial processes was the second largest sector in Austria with 13.7% of total GHG emissions in 2008 (11 870 Gg CO_2 equivalents). The main source of greenhouse gas emissions from industrial processes was metal production, which caused 48.8% of the emissions from this sector in 2008. From the base year to 2008, emissions from industrial processes increased by 17.4%.

In 2008, 0.4% of total GHG emissions in Austria (388 Gg CO_2 equivalent) arose from solvent and other product use. From 1990 to 2008, emissions from this category decreased by 24.1%.

Emissions from agriculture amounted to 7 631 Gg CO_2 equivalent in 2008, which corresponded to 8.8% of total national emissions. In 2008 the most important sub-sector enteric fermentation contributed with 42.2% to total greenhouse gas emissions from the agriculture sector. In 2008 emissions from this category were 10.8% below the level of the base year.

In 2008 greenhouse gas emissions from the waste sector amounted to 2 024 Gg CO_2 equivalents, which corresponded to 2.3% of the total national emissions. The main source of greenhouse gas emissions in this sector was solid waste disposal on land, which caused 76.9% of emissions. In 2008 emissions from this category were 43.6% below emissions in the base year.

ES.3.1 KP-LULUCF activities

In 2008 Article 3.3 activities were a net sink in Austria: Net CO_2 removals amounted to 1 307 Gg.

CO_2 removals from AR in Austria amounted to 2 531 Gg CO_2. 517 Gg CO_2 resulted from cropland converted to forest land, 978 Gg CO_2 from grassland 221 Gg CO_2 from wetland, 549 Gg CO_2 from settlement and 265 Gg CO_2 from other land. Emissions from Deforestation activities were approximately 1 224 Gg CO_2 in 2008. Forest land converted to cropland amounted to 71 Gg CO_2, to grassland 350 Gg CO_2, to other land 432 Gg CO_2, to settlement 294 Gg CO_2 and to wetland 76 Gg CO_2.

Due to the nature and permanence of ARD areas, there is a steady increase from 1990 on in ARD areas (see chapter 10.2.1) and related to that a steady increase of removals and emissions, respectively, at these areas.

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

Except for NO_x, emissions of indirect greenhouse gases decreased in the period from 1990 to 2008: NMVOCs by 40.3%, CO by 51.5% and SO_2 emissions by 69.8%. NO_x emissions however increased by 6.0% over the considered period.

Table 3: Emissions of indirect GHGs and SO_2 1990–2008.

		NO_x	CO	NMVOC	SO_2
1990	[Gg]	195.22	1 435.27	273.84	74.37
1991		204.40	1 505.50	265.34	71.47
1992		193.65	1 471.93	239.78	55.08
1993		187.85	1 438.95	239.91	53.44
1994		181.80	1 387.21	223.52	47.82
1995		181.88	1 276.40	223.50	47.40
1996		203.84	1 253.42	215.22	44.66
1997		191.75	1 159.36	200.84	40.20
1998		206.60	1 115.18	185.57	35.60
1999		198.87	1 040.08	172.06	33.86
2000		207.28	966.09	176.84	31.67
2001		217.86	930.09	177.43	33.05
2002		226.53	891.32	182.14	31.63
2003		237.59	885.14	181.55	32.39
2004		236.14	841.62	162.39	27.71
2005		241.64	831.99	167.81	27.54
2006		227.12	785.52	176.20	28.30
2007		220.67	741.97	164.56	24.71
2008		206.90	696.10	163.37	22.44

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.

PART 1:
ANNUAL INVENTORY SUBMISSION

1 INTRODUCTION

1.1 Background Information on greenhouse gas inventories, climate change and supplementary information under Article 7, paragraph 1, of the Kyoto Protocol

1.1.1 Background information on climate change

1.1.1.1 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.

1.1.1.2 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.

1.1.1.3 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[5]: 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.

During an extensive review process in 2007 – the so called Pre-commitment period review – the emissions of the base year were identified and fixed in order to establish the so called assigned amounts.

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.

1.1.2 Background information on 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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[5] 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 Emissions and Climate Change* 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, 2008 and 2009. In February 2007 the in-country review of the initial report of Austria took place (the Pre-commitment period review), 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[6].

1.1.3 Background information on supplementary information under Article 7, paragraph 1, of the Kyoto Protocol

Besides the information Parties to the Convention have to report annually, Parties to the Kyoto Protocol are also required to report supplementary information necessary to determine compliance with the regulations of the Kyoto Protocol. This information is generally referred to as "supplementary information under Article 7, paragraph 1 of the Kyoto Protocol". Main elements of this information are the reporting on Kyoto Protocol 3.3 and 3.4 activities, reporting on national registries and Kyoto Protocol units, reporting on information on any changes that have occurred in the national system compared with the information reported in the last submission, and reporting on information on the minimization of adverse impacts in accordance with Article 3, paragraph 14.

Article 3.3 and 3.4 activities

Austria reports only the mandatory Art. 3.3 activities. They include emissions/removals from direct human-induced Afforestation/Reforestation/Deforestation activities since 1990. In addition, Parties may elect to include emissions/removals from any of the following human-induced activities since 1990 (Art. 3.4): Forest management, Cropland management, Grazing-land management and Revegetation. Despite its significant sink in sector 5.A Austria has not elected any Article 3.4 activities for several reasons (e.g. under the provisions of the Kyoto-Protocol removals from forest management reduce the reduction targets under the Kyoto-Protocol in other sectors while from the perspective of the atmospheric GHG balance there may not be any contribution of forest management in reaching the KP reduction target; no permanence of sinks and related risks; uncertainty of the estimates).

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[6] 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

Furthermore, Parties had to elect the accounting frequency for 3.3 and 3.4 activities: annual or at the end of the Commitment Period (for all other sectors the accounting frequency is annually). For the mandatory 3.3 activities Austria has chosen accounting at the end of the Commitment Period.

National registry and Kyoto Protocol Units

Each Party to the Kyoto Protocol has to operate a national registry following the standards as defined in the Data Exchange Standards for Registry Systems under the Kyoto Protocol. The registry is an electronic database for the administration of Kyoto units that are used to account for greenhouse gas emissions under the commitments of the Kyoto Protocol. Like banks record balances and transactions of money in accounts belonging to individuals or other entities, registries record balances of units of greenhouse gas emissions, so called Kyoto units, which are allocated to countries or other entities. The registry ensures the precise tracking of holdings, issuances, transfers, cancellations and retirements of allowances and Kyoto units.

Different types of Kyoto units exist, e.g. depending on the source of emissions/removals:

- Assigned Amount Units (AAUs) are the tradable units of the Assigned Amount (AA), which a country with a reduction commitment (Annex B country) gets allocated.
- Removal Units (RMUs) are Kyoto units which Annex B Parties can generate e.g. through national afforestation and other sink projects.
- Emissions Reduction Units (ERUs) are generated by Joint Implementation projects.
- Certified Emissions Reductions (CERs) are generated from Clean Development Projects.

Additionally, registries of EC and EEA countries administrate the European Emissions Trading Scheme, the traded units are EU Allowances (EUAs).

Changes in the national system

The national system remains unchanged compared to the description given in the Austrian Initial Report under the Kyoto Protocol[7].

Information on the minimization of adverse impacts (Article 3, paragraph 14)

Information on how Austria is striving, under Art. 3 paragraph 14 of the Kyoto Protocol, to implement its commitments (Art. 3 paragraph 1) in such a way as to minimize adverse effects on developing country Parties is provided in Chapter 14, covering measures undertaken to minimize negative impacts (according to paragraph 23 of the Annex to decision 15/CMP) – for example with reference to the Austrian JI/CDM programme – as well as information on how priority is given pursuant to paragraph 24 of the Annex to decision 15/CMP. How Austria strives to phase out market imperfections that run counter to the objectives of the Concention and what other actions have been taken in the context of Article 3 paragraph 14 respectively paragraph 24 of Decision 15/CMP is described in Chapter 14.

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[7] http://unfccc.int/files/national_reports/initial_reports_under_the_kyoto_protocol/application/pdf/at-initial-report-200611-corr.pdf

1.2 Institutional Arrangements for Inventory Preparation, including the legal and procedural arrangements for inventory planning, preparation and management

1.2.1 Overview of institutional, legal and procedural arrangements of compiling GHG inventory and supplementary information required under Article 7, paragraph 1, of the Kyoto Protocol

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.

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

One task of the Umweltbundesamt 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 other air pollutants. More information on the National Inventory System in Austria (NISA) is provided in Annex 6.1).

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

Within the Umweltbundesamt the department of *Emissions 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).

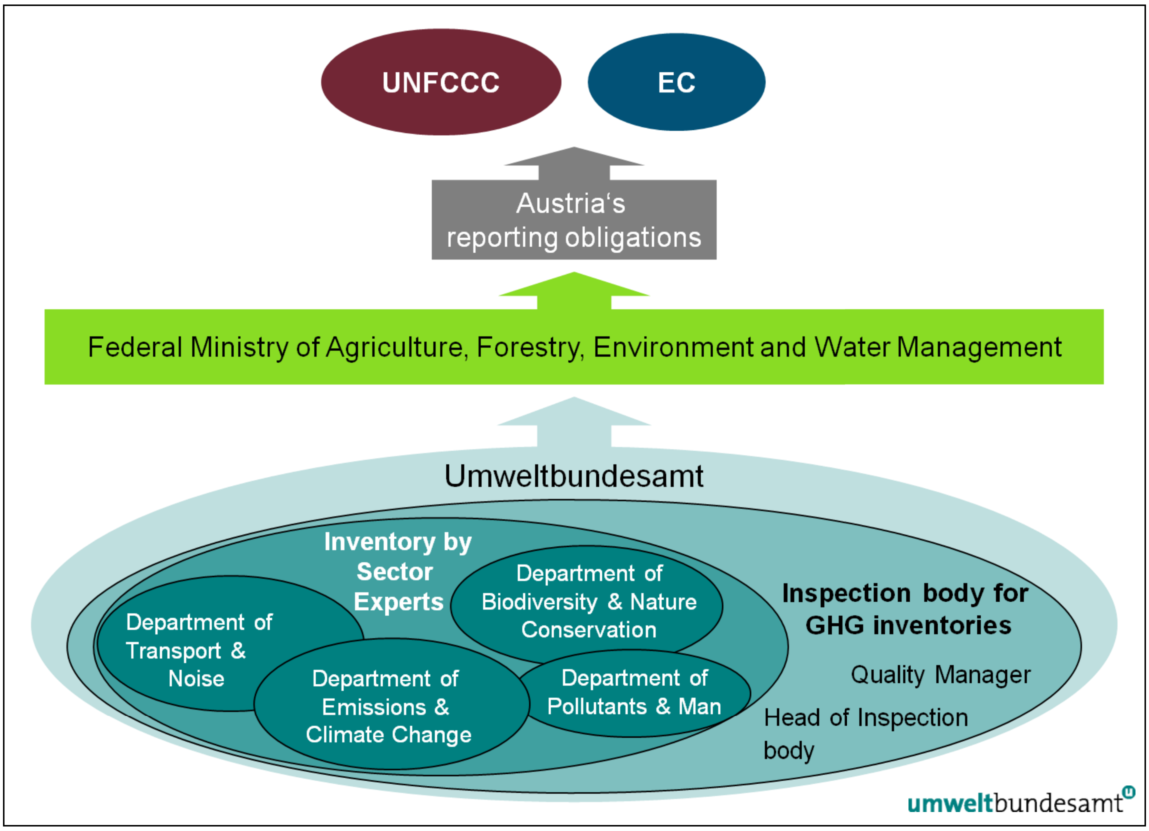

Figure 1: Responsibilities in the Austrian National System for greenhouse gas inventories.

In addition, the Austrian emissions trading registry is managed by the Umweltbundesamt on behalf of the Federal Ministry of Agriculture, Forestry, Environment and Water Management. This mandate was given to the Umweltbundesamt in the Registry Ordinance (Registerstellenverordnung) Federal Law Gazette II no. 308/2004. Umweltbundesamt has contracted Emissions Certificate Austria (ECRA) GmbH to support in running the registry. Umweltbundesamt GmbH has the overall responsibility for the management of the registry and serves as a contact point for national and international authorities. ECRA GmbH, on the other hand, is responsible for the software and operational management of the registry.

The Austrian emissions trading registry has been operational since 2005 and serves both as registry for the EU Emissions Trading scheme and as the national registry for Austria as a party of the Kyoto Protocol.

The "*Inspection body for GHG inventory*" within the Umweltbundesamt is responsible for the compilation of the greenhouse gas inventory.

Since 2005, the Umweltbundesamt is accredited as inspection body for emission inventories (Id.No. 241) in accordance with the Austrian Accreditation Law (AkkG)[8], by decree of the Minister of Economics and Labour[9]. The requirements of EN ISO/IEC 17020 (Type A) are fulfilled. For more information on the accreditation please refer to Annex 6.3.

Figure 2: Official emblem of an Austrian accredited inspection body.

The quality system is maintained and updated under the responsibility of the quality manager, he is directly responsible to the CEO.

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[10]
- This ordinance pertains to the Austrian Emissions Certificate Trading Act[11] 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 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[12]), 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*.

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[8] Federal Law Gazette No. 468/1992 last amended by federal law gazette I No. 85/2002

[9] No. BMWA-92.715/0036-I/12/2005, issued on 19 January 2006, valid from 23 December 2005

[10] „*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

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

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

- 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"[12] (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)[13] 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)[14], 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[15] 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*).

1.2.2 Overview of inventory planning

For the Austrian greenhouse gas inventory the main planning is performed once a year during summer at the so called Management Review: a meeting of the CEO of the Umweltbundesamt, the technical manager and the quality manager of the Inspection Body for Emission Inventories ("Überwachungsstelle Emissionsbilanzen" ÜSE).

It consists of three elements:

i. View back

ii. Evaluation

iii. Planning

Ad i.)

First, the quality manager presents a report on the previous reporting period to the technical manager and subsequently to the CEO. It includes i.a. an overview of activites at the ÜSE, information on audits and reviews and also a statement on the fulfilment of each item of last year's improvement plan.

Ad ii.)

On the basis of this report, the CEO, in collaboration with the technical manager of the inspection body and the quality manager, judges the quality management system. If required, measures to optimize the QMS are defined.

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

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

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

Ad ii.)

Finally, the improvement plan is defined. It is elaborated on the basis of the report on the previous reporting period and consists of two parts:

- **Quality management improvement plan:** bases in particular on findings of internal or external audits; it also includes a plan for training of the staff of the inspection body and internal and external audits.
- **Inventory improvement plan:** bases in particular on findings of reviews of the GHG inventory.

Specific responsibilities for the different emission source categories (“sector experts”) as well as for all activities related to the preparation of the inventory, including project-, quality- and data management are designated by the technical manager of the inspection body and finally approved by the CEO.

On the basis of the decisions at the management review, the project manager works out a detailed working plan including milestones, timelines and responsibilities.

1.2.3 Overview of inventory preparation and management, including for supplementary information required under Article 7, paragraph 1, of the Kyoto Protocol

The following table gives an overview on the tasks of inventory preparation together with a typical timeline.

Table 4: Overview Inventory related tasks.

Task	Description	Deadline
Management Review	Preparation of a report including evaluation of the fulfilment of the previous improvement plan Preparation of a plan for QMS and inventory improvement, i.a. based on audit and review findings.	Summer
Kick-Off	Meeting of sector experts, deputies, and project-/quality- and data managers of the inventory; definition of a working plan	End of Summer
Activity data collection	Collection of activity data, including contracting out studies.	November 15
Inventory preparation	Estimation of emissions for all sources, including collection of background data.	December 15
Compilation of national inventory	Updating the data base and conversion to the CRF reporter	December 23
Quality checks	Tier 1 and Tier 2 QA/QC activities	December
Compilation of report (Short-NIR)	Compilation of a inventory report “Short NIR” and submission to the European Commission (Decision 280/2004/EC)	January 15
Preparation of NIR	Compilation of the National Inventory Report	January–March
EU Submission NIR	Submission ot the National Inventory Report to the EC	March 15
UNFCCC Submission NIR	Submission ot the National Inventory Report to the UNFCCC	April 15

The following table gives an overview on the registry related tasks for providing the supplementary information required under Article 7, paragraph 1, of the Kyoto Protocol including a timeline.

Table 5: Overview registry related tasks.

Task	Description	Deadline
Standard Electronic Format (SEF)	Compilation of the SEF for the previous year	January 15
Information on changes in the national registry	Preparation of the chapter on the changes in the national registry, which is part of the NIR	April 15
Information on accounting of Kyoto Protocol units	Preparation of the chapter on information on the accounting of Kyoto Protocol units, which is part of the NIR. Compilation of the files for the Standard Independent Assessment Report (SIAR), which are submitted together with the NIR.	April 15

1.3 Inventory Preparation

1.3.1 GHG Inventory and KP-LULUCF inventory

The present Austrian greenhouse gas inventory for the period 1990 to 2008 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)[16] (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).

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.

During 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.

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

Supplementary information required under Article 7 of the Kyoto Protocol regarding KP-LULUCF is prepared by the same sector experts as information for UNFCCC-LULUCF. Other Article 7 supplementary information is requested from the Austrian registry, which is also managed by the Umweltbundesamt.

1.3.2 Data collection, processing and storage, including for KP-LULUCF 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^{TM} spreadsheets in combination with Visual Basic^{TM} 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.

1.3.3 Quality assurance/quality control (QA/QC) procedures and extensive review of GHG inventory and KP-LULUCF inventory

QA/QC procedures are performed as defined in the QMS plan (see Chapter 1.6).

As Austria is a small country, many of the experts regarding greenhouse gas inventories have been involved by some means or other e.g. in inventory preparation, in preparation of the uncertainty study, in national or regional task groups etc. The NIR is circulated after publication to all experts that are involved in the estimation of the greenhouse gas emissions in Austria as identified by the inspection body. These are in particular:

- 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),
- data supplier, which are considered as industrial stakeholders (e.g. industrial facilities or association of industries)

Any comment received from any expert is considered for the inventory improvement plan.

1.4 Methodologies and Data Sources Used

1.4.1 GHG inventory

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 6: 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 F-gases based on a study by: EcoEfficient Technologies, Vienna
Solvent	Short term statistics for trade and services Austrian foreign trade statistics Structural business statistics Surveys at companies and associations	Umweltbundesamt, based on studies by: Institut für industrielle Ökologie and Forschungsinstitut für Energie und Umweltplanung, Wirtschaft und Marktanalysen GmbH*
Agriculture	National Studies, national agricultural statistics obtained from Statistik Austria;	Umweltbundesamt, based on studies by: 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 (1998-2007), Electronic Data Management (from 2008 on)	Umweltbundesamt

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

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 8 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.

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).

1.4.1.1 Main Data Suppliers

The main data suppliers are also presented in Table 6.

- 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 Federal Ministry of Economy, Family and Youth, "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.
- 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[17]. 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.
- Until 2008, operators of landfill sites reported their activity data directly to the Austrian Ministry of Environment or the Umweltbundesamt, where they were – after a check – in turn incorporated into a database on landfills. Emissions for the years 1998–2007 are calculated on basis of these data. Since 2009 landfill operators have to register and report their waste input directly at the portal of the Electronic Data Mangement. These data are evaluated by the responsible body at federal level (BMLFUW) and are made available for emission calculation. This was done for reporting of the year 2008 for the first time.
- Activity data needed for the calculation of non-energetic emissions are based on several statistics collected by Statistik Austria and national and international studies.

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[17] "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.

1.4.1.2 Data from the EU Emission trading Scheme

The European Emissions Trading Scheme (EU ETS) has been established by Directive 2003/87/EC of the European Parliament and of the Council[18]. It includes heavy energy-consuming installations in power generation and manufacturing. The activities covered are energy activities, the production and processing of ferrous metals, the mineral industry and some other production activities. For more detailed information on the included activities please refer to Annex I of the above mentioned directive. At the moment, the greenhouse gases covered under the EU ETS in Austria are CO_2 (since 2005) and N_2O (since 2010). However, other greenhouse gases and activities will be included in the scope of the EU ETS from 2013 onwards. About one third of total Austrian GHG emissions currently result from installations under the EU-ETS (~32 Tg CO_2 in 2008).

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

General rules for reporting and verification of emissions in the EU ETS are defined in EU directive 2003/87/EG and specific rules can be found in Commission decision 2007/589/EC[19]. In Austria, member state specific regulations are defined in the Austrian Emissions Allowance Trading Act[20] and the Austrian Monitoring, Reporting and Verification Ordinance[21]. 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 into 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 Federal Ministry of Agriculture, Forestry, Environment and Water Management is in charge of granting the licence to independent verifiers. In addition, the Ministry has to fulfill a quality control function, which is implemented by the Umweltbundesamt on behalf of the Ministry.

1.4.1.3 Data from EPER/E-PRTR

The European Pollutant Emission Register (EPER) was the first Europe-wide register for emissions from industrial facilities both into air and water. The legal basis of EPER is Article 15 of the IPPC Directive (EPER Decision 2000/479/EG), which stipulates that information on environmental pollution has to be provided to the public[22]. The reporting years under EPER were 2001 or 2002 and 2004. EPER was replaced by the European Pollutant Release and Transfer Register (E-PRTR) in 2007, which was established by the E-PRTR Regulation (EC) No 166/2006.

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[18] 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

[19] 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

[20] Emissionszertifikate-Gesetz, Federal Law Gazette I No. 46/2004

[21] Überwachungs-, Berichterstattungs- und Prüfungs-Verordnung, Federal Law Gazette II No. 339/2007

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

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

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

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

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

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

1.4.2 KP-LULUCF inventory

A detailed description of the used methods is provided in Chapter 10 KP-LULUCF.

The National Forest Inventory (NFI) – obtained from the Austrian Federal Office and Research Centre for Forest – is the main data provider for the greenhouse gas reporting in the frame of the KP-LULUCF inventory.

Accordingly, the area of forest land reported for Afforestation/Reforestation and Deforestation (ARD) under the Kyoto Protocol has the same basis as the area reported for Land use changes from and to forests in the UNFCCC greenhouse gas inventory taking the different time frame (ARD areas starting with 1990) as well as the permanence of ARD areas into account.

Furthermore the methods used to estimate emissions/removals from ARD activities are of the same tier as those used for the UNFCCC reporting. These are described in detail in Chapter 7.

1.5 Brief description of key categories, including for KP-LULUCF

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 2010 to the UNFCCC and comprises a level assessment for the years 1990 and 2008 and a trend assessment for the trend of the year 2008 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.

The methodology for identifying the key categories is described in detail in Annex 1.

1.5.1 GHG inventory (including and excluding KP-LULUCF)

The method used to identify key source categories follows the Tier 1 approach. Due to a lack of resources a Tier 2 category analysis has not been performed so far.

The identified key categories are listed in Table 7 and Table 8. The key categories without LULUCF comprise 83 821 Gg CO_2e in the year 2008, which is a share of 96.7% of Austria's total greenhouse gas emissions (without LULUCF).

Table 7: Austrian key categories based on emission data submitted to the UNFCCC in 2010.

IPCC Category Description		**Gas**	**Emissions 2008 [Gg CO_2e]**	**Share in Total Emissions 2008**
1 A gaseous	Fuel combustion activities	CO_2	16 832.8	19.4%
1 A 3 b diesel oil	Road Transportation	CO_2	16 017.7	18.5%
1 A 4 stat-liquid	Other Sectors	CO_2	5 786.0	6.7%
2 C 1	Iron and Steel Production	CO_2	5 770.2	6.7%
1 A 2 solid	Manufacturing Industries and Construction	CO_2	5 453.5	6.3%
1 A 3 b gasoline	Road Transportation	CO_2	5 393.0	6.2%
1 A 1 a solid	Public Electricity and Heat Production	CO_2	4 439.8	5.1%
4 A 1	Cattle	CH_4	3 019.8	3.5%
1 A 1 b liquid	Petroleum refining	CO_2	2 403.4	2.8%
2 A 1	Cement Production	CO_2	2 133.0	2.5%
1 A 2 stat-liquid	Manufacturing Industries and Construction	CO_2	1 923.8	2.2%
4 D 1	Direct Soil Emissions	N_2O	1 878.3	2.2%
6 A	Solid Waste Disposal on Land	CH_4	1 557.5	1.8%
4 D 3	Indirect Emissions	N_2O	1 199.6	1.4%
1 A 2 mobile-liquid	Manufacturing Industries and Construction	CO_2	1 152.2	1.3%
2 F 1/2/3/4/5	ODS Substitutes	HFC, PFC	1 057.9	1.2%
1 A 4 mobile-diesel	Other Sectors	CO_2	797.8	0.9%
4 B 1	Cattle	N_2O	736.4	0.8%
1 A 1 a liquid	Public Electricity and Heat Production	CO_2	688.6	0.8%
1 A 2 other	Manufacturing Industries and Construction	CO_2	685.8	0.8%
2 A 2	Lime Production	CO_2	621.1	0.7%
1 A 1 a other	Public Electricity and Heat Production	CO_2	553.0	0.6%
2 B 1	Ammonia Production	CO_2	532.5	0.6%
1 A 4 solid	Other Sectors	CO_2	399.8	0.5%
2 A 7 b	Sinter Production	CO_2	332.0	0.4%
2 B 2	Nitric Acid Production	N_2O	325.8	0.4%
2 A 3	Limestone and Dolomite Use	CO_2	280.7	0.3%
2.F.7	Semiconductor Manufacture	FC	279.5	0.3%
6 B	Wastewater Handling	N_2O	260.1	0.3%
1 A 4 other	Other Sectors	CO_2	252.7	0.3%
2 F 9	Other Sources of SF6	SF6	250.0	0.3%
3	Solvent and other Product Use	CO_2	231.9	0.3%
4 B 1	Cattle	CH_4	216.8	0.3%
1 A 4 biomass	Other Sectors	CH_4	202.1	0.2%
4 D 2	Pasture, Range and Paddock Manure	N_2O	93.6	0.1%
1 A 3 a jet kerosene	Civil Aviation	CO_2	61.5	0.1%
2 C 4	SF6 Used in Al and Mg Foundries	SF6	0.3	0.0%
2 C 3	Aluminium production	PFC	0.0	0.0%
2 C 3	Aluminium production	CO_2	0.0	0.0%

Table 8: Austrian key categories based on emission and removal data submitted to the UNFCCC in 2010.

IPCC Category	Description	Gas	Emissions/Removals 2008 [Gg CO_2e]
5	Total land use categories	N_2O	318.1
5 A 1	Forest land remaining forest land	CO_2	-16 974.3
5 A 2	Land converted to forest land	CO_2	-2 537.8
5 B 1	Cropland remaining cropland	CO_2	-86.4
5 B 2	Land converted to cropland	CO_2	1 787.6
5 C 2	Land converted to grassland	CO_2	-1 330.3
5 D 2	Land converted to Wetlands	CO_2	377.0
5 E 2	Land converted to Settlements	CO_2	517.5
5 F 2	Land converted to Other land	CO_2	456.7

The key category with the highest contribution to the national total emissions in 2008 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 the national total emissions in the base year was 14.5 %, whereas in 2008 this contribution have increased to 19.4%.

The second most important source of greenhouse gas emissions in 2008 in Austria is *1.A.3.b Road Transportation – diesel oil (CO_2).* Its contribution to national total emissions is 18.5% in 2008 compared to 10.2% in 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 – diesel oil (CO_2)* is the most important category in terms of emission trends: Since 1990 emissions doubled.

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 largest category in the level assessment and ranks number three in the trend assessment as well. Removals from this category increased by 47.5% from 1990 to 2008.

Comparison to last years' submission

Except for 1.B.2.b Natural Gas (CH_4) and 4.B.8 Swine (CH_4) all key categories of last submission were identified as key in this years' submission according to the quantitative analysis. Nevertheless, according to the qualitative criteria applied, these categories remain key for this submission. Compared to last year's analysis N_2O emissions from total land use categories has been identified as key additionally.

1.5.2 KP-LULUCF inventory

According to the IPCC GPG for LULUCF the key categories for Kyoto Protocol activities can be derivated from the identified key categories in the UNFCCC inventory as follows: Whenever a category is identified as key in the UNFCCC inventory, the associated activity under the Kyoto-Protocol can be considered as key in reporting under the Kyoto-Protocol. In case of Austria according to this approach, all of the categories under Articles 3.3 of the Kyoto Protocol (afforestation and reforestation, deforestation) can be regarded as key (compare Table 8 in this NIR and Table 5.4.4 in GPG LULUCF).

Furthermore, according to the GPG-LULUCF countries should identify and sum up the emission estimates associated with forest conversion to any other land category (deforestation). 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 2008.

1.6 Information on the QA/QC plan

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 reviwe procedures as well as procedures regarding reporting, documentation and archiving. The implementation of these elements in the Austrian QMS is described in the following pages.

1.6.1 QA/QC procedures

The Umweltbundesamt is designated as single national entity responsible for Austria's GHG inventory by law, and is thus responsible for QA/QC activities. Responsibilities of the different functions – quality coordinator, sector expert and deputy, project manager, head of inspection body, CEO – are defined in the QMS

1.6.1.1 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, ...)

1.6.1.2 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.

1.6.1.3 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)

In the course of accreditation audits, the conformity of QMS with ISO/IEC 17020 and of (new) methodologies with requirements of IPCC GPG is checked.

The last audit of the accreditation body took place in 2009 and approved the conformity with the standard. Besides some improvements in the quality manual, it was noted that (excel-) files used for calculation have to be validated and then be protected in order to avoid any accidental change.

1.6.1.4 Audits of data suppliers

In 2007, the audit of the main data supplier Statistik Austria (energy balance) took place, followed by an audit of the administrators of the landfill data base and Statistik Austria with regard to agricultural statistical data in 2009. Furthermore the Institute for Industrial Ecology which developed and updated the solvent model has been audited.

1.6.1.5 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.

1.6.1.6 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

1.6.1.7 Focus of QA/QC activities in the year 2009

In addition to some further improvements of the quality manual and updates of procedure documents, audits of data suppliers as explained above took place.

1.6.2 Treatment of confidentiality issues

The inspection body ensures confidentiality of sensitive information – that is data declared as confidential – obtained in the course of its inspection activities. Compliance with confidentiality provisions is organized and documented in the QM manual, which contains specific quality system procedures. Staff of the inspection body are obliged to issue a written commitment stating their full compliance with all provisions.

- Confidentiality of statistics

The strict confidentiality provisions concerning handling of sensitive data relating to individuals and organisations are regulated by the Austrian Federal Statistics Act 2000[1].

- Security of data

Confidentiality of sensitive data used to calculate the emissions is a legal obligation: Ensuring confidentiality through technical and organisational measures is obligatory for the Umweltbundesamt and consequently also for the inspection body.

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[1] Federal Act on Federal Statistics (Federal Statistics Act 2000) no. 163/1999, as amended by BGBL. I, no. 136/2001, by BGBl. I, no. 71/2003, by BGBl. I, no. 92/2007 and by BGBl. I, no. 125/2009.

- Trust of respondents

Individuals, associations and organizations providing information to the Inspection body can be sure that the provided data are used exclusively for purposes of inspection activities. Data – either of official, private or of another nature – are treated confidentially and will not be passed on to third parties.

1.7 General uncertainty evaluation, including data on the overall uncertainty for the inventory totals

1.7.1 GHG inventory

Uncertainty calculation was performed according to the Tier 1 approach (IPCC 2000). As the uncertainties of the national total emissions estimated by Tier 2 analysis (the Monte Carlo approach) did not vary significantly over the last years, Austria decided to perform the Monte Carlo analysis every two-years instead of every year. The next Tier 2 analysis will be provided in submission 2011.

Data are presented in Table 9 for the key categories of the Austrian GHG inventory, except LULUCF categories. Uncertainty is presented for each category, and for the level of target year 2008 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 9, 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: 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	0.15	0.15
1 A 1 a solid: Public Electricity and Heat Production	CO_2	0.5	0.5	0.7	0.04	0.04
1 A 1 b liquid: Petroleum refining	CO_2	0.5	0.3	0.6	0.02	0.02
1 A 2 mobile-liquid: Manufacturing Industries and Construction	CO_2	3.0	0.5	3.0	0.04	0.06
1 A 2 other: Manufacturing Industries and Construction	CO_2	10.0	20.0	22.4	0.18	0.16
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	0.07	0.11

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 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	0.81	0.98
1 A 3 b gasoline: Road Transportation	CO_2	3.0	3.0	4.2	0.27	0.33
1 A 4 biomass: Other Sectors	CH_4	10.0	50.0	51.0	0.12	0.10
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	0.07	0.06
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	0.21	0.32
1 A gaseous: Fuel Combustion (stationary)	CO_2	2.0	0.5	2.1	0.41	0.63
1 B 2 b: Natural gas	CH_4	3.0	5.8	6.5	0.01	0.01
2 A 1: Cement Production	CO_2	5.0	2.0	5.4	0.14	0.20
2 A 2: Lime Production	CO_2	20.0	5.0	20.6	0.15	0.23
2 A 3: Limestone and Dolomite Use	CO_2	20.0	2.0	20.1	0.07	0.10
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	0.06
2 C 3: Aluminium production	CO_2	2.0	0.5	2.1	0.00	0.01
2 C 3: Aluminium production	PFC	2.0	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	0.68	0.79
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	0.17	0.14
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	0.80	0.61
4 B 1: Cattle	N_2O	10.0	100.0	100.5	0.88	0.20
4 B 1: Cattle	CH_4	10.0	50.0	51.0	0.13	0.08
4 B 8: Swine	CH_4	10.0	50.0	51.0	0.04	0.04
4 D 1: Direct Soil Emissions	N_2O	5.0	150.0	150.1	3.35	0.51
4 D 2: Pasture, Range and Paddock Manure	N_2O	5.0	150.0	150.1	0.17	0.19
4 D 3: Indirect Emissions	N_2O	5.0	150.0	150.1	2.14	0.61
6 A: Solid Waste Disposal on Land	CH_4	12.0	25.0	27.7	0.51	0.78
6 B: Wastewater Handling	N_2O	20.0	50.0	53.9	0.17	0.13
Total					**4.38**	**2.04**

1.7.2 KP-LULUCF inventory

A model based approach to assess the uncertainties of emissions/removals of the ARD units is planned for the submission 2011.

1.8 General assessment of the completeness

1.8.1 GHG inventory

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 2009 is compared to the values of 2010. 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 10: Transparency and completeness in UNFCCC submissions 2010 and 2009.

Sector	**Submission 2010**				**Submission 2009**			
	IE	**NE**	**Transparency**	**Completeness**	**IE**	**NE**	**Transparency**	**Completeness**
1 Energy	32	0	*91%*	*100%*	28	0	*92%*	*100%*
2 Industrial Processes	45	24	*92%*	*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%*	20	8	*92%*	*97%*
6 Waste	4	0	*89%*	*100%*	4	0	*89%*	*100%*
Total	**103**	**32**	***92%***		**103**	**32**	***92%***	***97%***
Total number of estimates*	**1 244**				**1 244**			

* *(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

1.8.2 KP-LULUCF inventory

All activities according to Article 3.3 of the Kyoto Protocol are estimated. Austria did not elect Article 3.4 activities.

2 TREND IN TOTAL EMISSIONS

Austria'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"[23] - 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 10.8% from the base year to 2008 (CO_2: +18.6%). The trend is dominated by the trend of the most important sector, the energy sector.

In 2008, Austria's total greenhouse gas emissions decreased by 0.4% compared to 2007, CO_2 emissions decreased by 0.5%. The key drivers for this slight downward trend 2007-2008 were the decreasing amount of fuel consumed in the sector transport (road transport) and the reduced use of liquid and solid fuels for electrical power and district heating production by energy industries. Those emission reductions were counterbalanced by increasing emissions especially from "other sectors", where GHG emissions rose by 9.6% compared to 2007 due to higher heat demand than in 2007.

Table 11: Summary of Austria's anthropogenic greenhouse gas emissions from 1990–2008 (emissions without LULUCF).

GHG		Total	CO_2	CH_4	N_2O	HFCs	PFCs	SF_6
1990*	[Gg CO_2 equivalent]	**78 170.92**	62 068.13	8 305.59	6 197.36	26.32	1 079.24	494.28
1991		**82 222.52**	65 656.02	8 272.24	6 532.88	29.56	1 087.08	644.74
1992		**75 521.32**	60 211.55	7 993.50	6 132.73	32.31	462.32	688.92
1993		**75 506.24**	60 527.94	7 945.51	5 955.79	243.56	52.57	780.89
1994		**76 394.22**	60 914.87	7 721.63	6 434.51	293.06	58.30	971.85
1995		**79 821.72**	63 951.18	7 633.77	6 599.54	411.89	71.27	1 154.06
1996		**82 905.91**	67 393.60	7 416.88	6 257.64	531.94	71.70	1 234.15
1997		**82 489.04**	67 187.80	7 114.22	6 290.91	651.70	105.15	1 139.26
1998		**81 876.79**	66 762.96	6 964.58	6 410.77	769.33	55.95	913.21
1999		**80 271.46**	65 352.56	6 796.19	6 380.26	876.64	78.63	787.19
2000		**80 296.44**	65 799.05	6 640.53	6 274.65	901.88	84.79	595.54

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[23] 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
2001	**84 532.75**	70 190.98	6 506.19	6 162.45	924.92	95.91	652.28
2002	**86 270.14**	72 040.46	6 359.63	6 168.32	969.22	97.70	634.81
2003	**91 930.97**	77 840.32	6 363.68	6 094.35	949.55	116.44	566.62
2004	**90 926.17**	77 723.12	6 219.86	5 394.06	955.14	136.65	497.35
2005	**92 915.91**	79 772.95	6 085.71	5 429.69	986.41	133.82	507.33
2006	**89 687.53**	76 687.06	5 955.58	5 471.40	962.62	145.72	465.15
2007	**86 957.35**	73 972.29	5 861.10	5 497.31	1.061.99	190.12	374.54
2008	**86 641.21**	73 630.23	5 716.62	5 681.28	1.058.10	173.53	381.44

* *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 3 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 of the Kyoto Protocol (as reported in Chapter 10) have to be considered, and also the use of flexible mechanisms under the Kyoto Protocol has to be accounted.

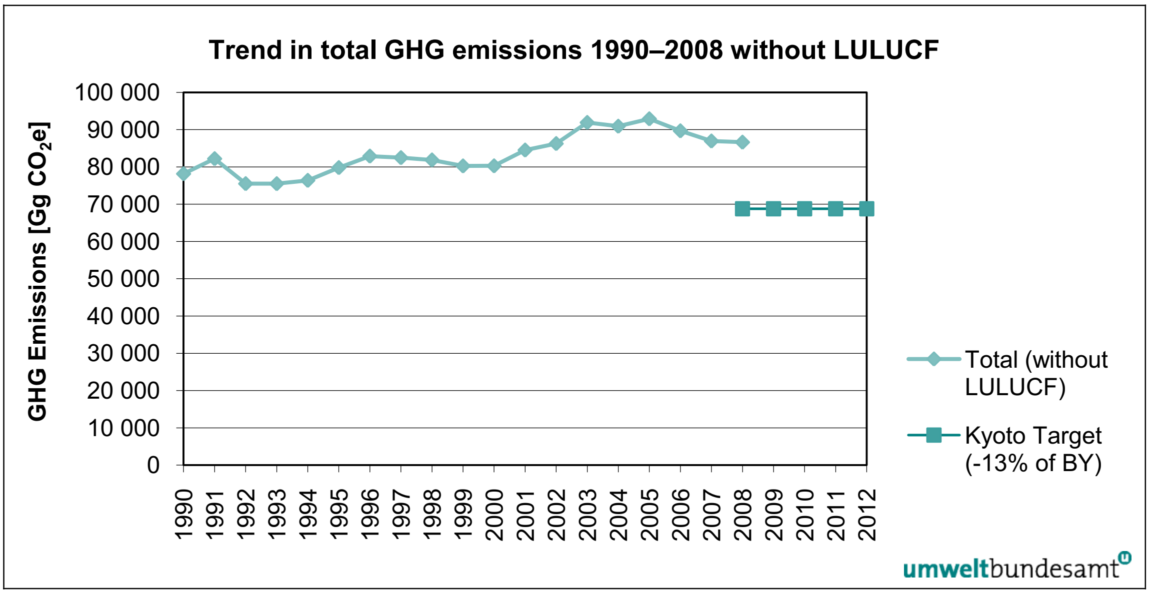

Figure 3: Trend in total GHG emissions 1990–2008 without LULUCF.

2.2 Emission Trends by Gas

The most important GHG in Austria is carbon dioxide (CO_2) with a share of 85.0% in 2008. The CO_2 emissions primarily result from combustion activities. Methane (CH_4), which mainly arises from stock farming and waste disposal, contributes 6.6% to national total GHG emissions, and nitrous oxide with agricultural soils as the main source adds another 6.6%. The remaining 1.9% 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 12: Austria's greenhouse gas emissions by gas in the base year and in 2008.

GHG	BY 1990	2008	BY 1990	2008
	CO_2 equivalent [Gg]		Share [%]	
Total	78 171	86 641	100.0	100.0
CO_2	62 068	73 630	79.4	85.0
CH_4	8 306	5 717	10.6	6.6
N_2O	6 197	5 681	7.9	6.6
F-Gases	1 600	1 613	2.0	1.9

Emissions without LULUCF

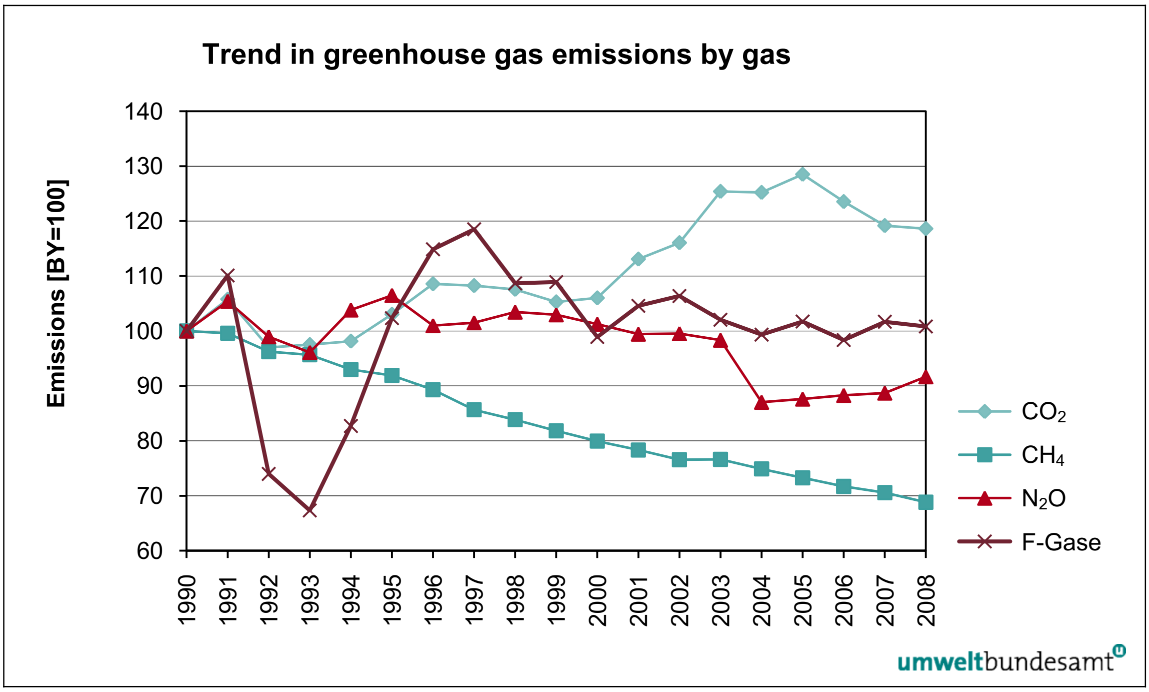

Figure 4: Trend in greenhouse gas emissions 1990–2008 by gas in index form (base year = 100).

CO_2

CO_2 emissions increased by 18.6% from 1990 to 2008. In absolute figures, CO_2 emissions increased from 62 068 to 73 630 Gg during the period from 1990 to 2008 mainly due to higher emissions from transport, which increased by 61.8%.

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 2008 from 8 306 to 5 717 Gg CO_2 equivalents. In 2008, CH_4 emissions were 31.2% 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 3.4% over this period. Since then emissions have shown a decreasing trend, resulting in 5 681 Gg CO_2 equivalents in 2008 compared to 6 197 in the base year (minus 8.3%). 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 56% 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 13%.

HFCs

HFC emissions increased remarkably during the period from 1990 to 2008 from 26 to 1 058 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 2008, from 1 079 to 174 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 2008 the main source of PFC emissions was semiconductor manufacture.

SF_6

SF_6 emissions in 1990 amounted to 494 Gg CO_2 equivalents. They increased steadily until 1996 reaching a maximum of 1 234 Gg CO_2 equivalents. Since then they have been decreasing, in 2008 SF_6 emissions amounted to 381 Gg CO_2 equivalents, which was 22.8% below the level of the base year (1990).

The main sources of SF_6 emissions in 2008 were semiconductor manufacture and disposal of noise insulating windows.

2.3 Emission Trends by Source

Table 13 presents a summary of Austria's anthropogenic greenhouse gas emissions by sector.

Table 13: Summary of Austria's anthropogenic greenhouse gas emissions by sector from 1990–2008.

		Total	Energy	Industrial processes	Solvents	Agriculture	LULUCF	Waste
1990	[Gg CO_2 equivalent]	78 170.92	55 403.93	10 110.94	511.80	8 558.03	-13 139.39	3 586.22
1991		82 222.52	59 301.11	10 133.05	465.98	8 747.46	-19 185.46	3 574.92
1992		75 521.32	54 369.50	8 978.97	417.65	8 284.53	-14 063.48	3 470.69
1993		75 506.24	54 782.71	8 829.32	418.48	8 050.63	-17 976.46	3 425.09
1994		76 394.22	54 816.14	9 352.32	403.26	8 555.15	-16 682.61	3 267.35
1995		79 821.72	57 671.32	9 896.87	422.45	8 718.84	-16 124.81	3 112.23
1996		82 905.91	61 475.43	9 813.74	405.66	8 244.26	-11 087.01	2 966.81
1997		82 489.04	60 555.92	10 450.73	424.37	8 220.97	-20 031.57	2 837.04
1998		81 876.79	60 528.76	9 971.94	406.32	8 223.45	-18 096.88	2 746.32
1999		80 271.46	59 280.18	9 849.23	392.26	8 098.73	-22 559.62	2 651.07
2000		80 296.44	59 076.02	10 322.18	425.12	7 904.40	-17 153.51	2 568.72
2001		84 532.75	63 566.65	10 174.17	424.82	7 855.62	-19 881.80	2 511.49
2002		86 270.14	64 814.11	10 792.03	434.79	7 751.63	-15 922.57	2 477.59
2003		91 930.97	70 687.24	10 744.18	428.48	7 543.49	-17 374.70	2 527.58
2004		90 926.17	70 633.66	10 054.07	384.10	7 438.55	-17 523.86	2 415.79
2005		92 915.91	72 182.73	10 627.52	384.65	7 398.79	-17 331.51	2 322.22
2006		89 687.53	68 604.68	10 990.48	411.97	7 432.89	-17 316.99	2 247.51
2007		86 957.35	65 463.08	11 465.65	387.23	7 497.40	-17 387.89	2 143.99
2008		86 641.21	64 727.07	11 870.01	388.41	7 631.33	-17 337.16	2 024.40

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 2008 (71% in 1990), followed by the Sector *Industrial Processes*, which caused 14% (2008) of greenhouse gas emissions. Both sectors show increasing emissions, while emissions from the other sectors have been decreasing.

Table 14: Austria's greenhouse gas emissions by sector in the base year (1990) and in 2008 as well as their share and trend.

GHG	1990	2008	Trend 1990-2008	1990	2008
	Emissions [Gg CO_2e]			Share [%]	
Total	**78 171**	**86 641**	**+10.8%**	**100.0%**	**100.0%**
Energy	55 404	64 727	+16.8%	70.9%	74.7%
Industrial processes	10 111	11 870	+17.4%	12.9%	13.7%
Solvents	512	388	-24.1%	0.7%	0.4%
Agriculture	8 558	7 631	-10.8%	10.9%	8.8%
LULUCF	-13 139	-17 337	+31.9%	-16.8%	-20.0%
Waste	3 586	2 024	-43.6%	4.6%	2.3%

Total emissions without emissions from LULUCF

The most significant increases in GHG emissions from 1990 to 2008 are shown by the sectors industry (+17%) and energy (+17%), whereas the sector with the strongest decline is *Waste* (-44%). A description and interpretation of emissions trends per sector is given in the following sub-chapters.

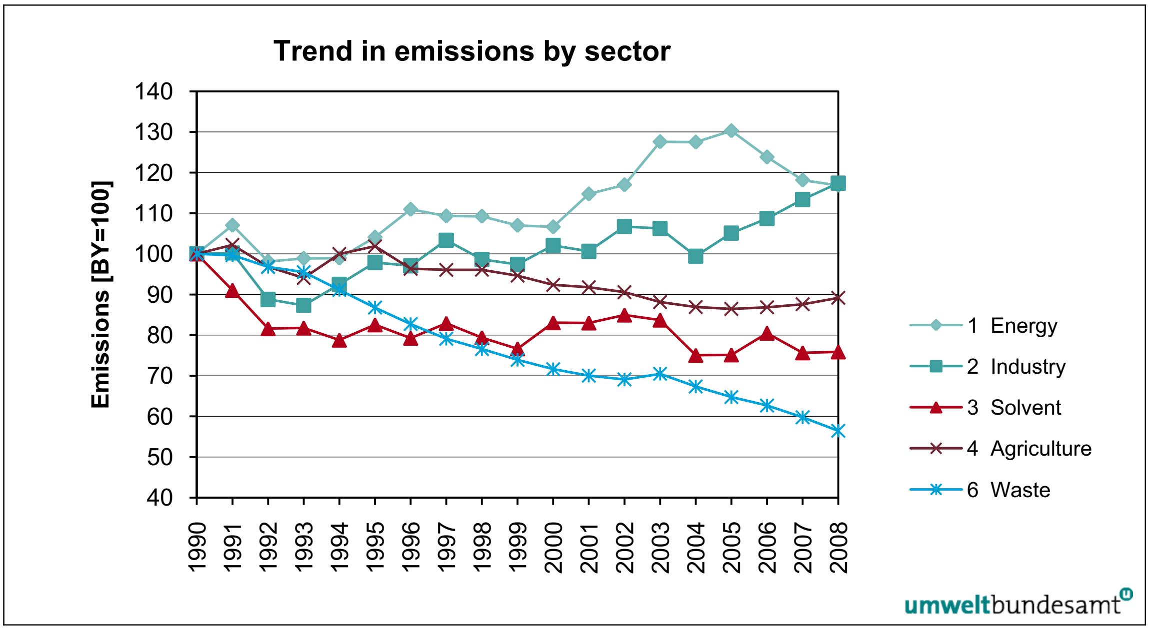

Figure 5: Trend in emissions 1990–2008 by sector in index form (base year 1990 = 100).

2.3.1 Energy

The overall trend in greenhouse gas emissions from the energy sector shows increasing emissions with a plus of 17% from 1990 to 2008. The main driver for this trend is the 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 2007 to 2008 emissions from the energy sector decreased slightly by 1.1%, mainly due to lower emissions from the categories transport and energy industries.

In 2008, greenhouse gas emissions from the energy sector amounted to 64 727 Gg CO_2 equivalent which correspond to 75% of the total national emissions. 99.3% of the emissions from this sector originate from fossil fuel combustion; fugitive emissions from fuels are of minor importance.

CO_2 contributed 98.1% to the total greenhouse gas emissions from the energy sector, CH_4 0.8% and N_2O 1.2%.

The most important sub-sector of energy in 2008 was transport with a share of 35%, followed by manufacturing industries and construction (25%), energy industries (21%), and "other sectors" (19%).

The increasing trend from 1990 to 2008 in this sector is mainly due to a strong rise in emissions from sub-sector transport (+61%) due to an increase of road performance (kilometres driven). In addition to the increase of road performance within Austria, the amount of fuel bought in Austria but driven elsewhere – an effect mainly caused by different fuel prices of neighbouring countries – increased considerably. However, from 2007 to 2008, total emissions from transport decreased by 5.4%.

Energy related emissions from manufacturing industries and construction increased by 26.5% from 1990 to 2008. Fuel consumption increased by +44% in that period, mainly due to increased use of gas and especially biomass. As gas has a lower carbon content and CO_2 emissions from biomass combustion is not accounted for under the UNFCCC reporting framework, the increase in GHG emissions is significantly smaller compared to the increase in fuel combustion. From 2007 to 2008 emissions increased slightly by 0.1%.

Emissions from sub-sector energy industries were in 2008 slightly below the level of the base year (-2.3%). The main drivers for emissions from this sector are total electricity production (which increased about 26% from 1990 to 2008) and an increase in heat production, which more than doubled over this period (+146%) 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 24% for the total fuel consumption of sector 1.A.1) and the contribution of hydro plants to total electricity production (68% in 2008 with a range 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 2007 to 2008, emissions from energy industries decreased by 3.5%. Total fuel consumption increased by 0.5%; while liquid and solid fuel consumption decreased by 9% and. 12%, natural gas consumption increased by 9% and biomass consumption increased by 15%, 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 variation in 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. Emissions in 2008 were 17% lower than in the base year, and 9.6% higher than in 2007: total fuel consumption of this sub sector increased by 7.8% from 2007 to 2008. Moreover in 2008 liquid and gaseous fuel sales increased by 10% (liquid) and 7% (gas) – presumably due to the (compared to 2007) colder weather in 2008 and lower energy prices for gasoil at the end of the year 2008.

2.3.2 Industrial processes

The overall trend in greenhouse gas emissions from industrial processes shows increasing emissions with a plus of 17% from 1990 to 2008. Within this period emissions fluctuated showing a minimum in 1993. Main drivers for the trend 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 55% higher CO_2-emissions in 2008 compared to 1990 and (iv) a strong increase of HFC emissions in the period 1992 to 2008 from 32 to 1 058 Gg CO_2 equivalents.

From 2007 to 2008, emissions from this sector increased by 3.5%.

In 2008, greenhouse gas emissions from industrial processes amounted to 11 870 Gg CO_2 equivalents, which corresponds to 14% of the total national emissions.

The most important greenhouse gas of this sector was carbon dioxide with 84% of emissions from this category, followed by HFCs with 8.9%, SF_6 with 3.2%, N_2O with 2.7%, PFCs with 1.5% and finally CH_4 with 0.2%.

The most important sub-sectors of the industrial processes sector are metal production and mineral products, which caused 49% and 30% of the emissions from this sector in 2008.

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 24% from 1990 to 2008. The main driver is a decreasing use of solvents as a result of legal measures and decreasing N_2O use.

From 2007 to 2008 emissions decreased slightly by 0.3%.

In 2008, greenhouse gas emissions from solvent and other product use amounted to 388 Gg CO_2 equivalents, which corresponds to 0.4% of the total national emissions.

60% of these greenhouse gas emissions were indirect CO_2 emissions, 40% were contributed by N_2O emissions.

2.3.4 Agriculture

The overall trend in greenhouse gas emissions from agriculture shows decreasing emissions with a decrease of 10.8% from 1990 to 2008. The main drivers for this trend are 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 volatility in prices; this data is used for calculating N_2O emissions from an important sub-source: agricultural soils.

From 2007 to 2008 emissions increased by 1.8% mainly due to increased fertilizer sales. Furthermore, a higher amount of N input from crop residues contributed to the increasing trend.

In 2008, emissions from agriculture amounted to 7 631 Gg CO_2 equivalent, which corresponds to 8.8% of the total national emissions.

In the Austrian greenhouse gas inventory the sector agriculture is the largest source for both N_2O and CH_4 emissions: in 2008 72% (13.2 Gg) of total N_2O emissions and 62% (169 Gg) of total CH_4 emissions in Austria originated from this sector. For N_2O this corresponds to 53% of the GHG emissions from agriculture and for methane to 47%.

In 2008 the most important sub-sectors of agriculture were enteric fermentation and agricultural soils with both contributed 42% to the total greenhouse gas emissions from the agricultural sector.

2.3.5 LULUCF

Land use, land-use change and forestry is a net sink in Austria. The overall trend in net removals from LULUCF is plus 32% over the observed period. The main driver for this trend is the increase of the carbon stock in forest land. 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.

In 2008, net removals from this category amounted to 17 337 Gg CO_2 equivalents, which corresponds to 20% of national total GHG emissions (without LULUCF) compared to 17% in the base year.[24]

The most important sub-sector is forest land with net removals of 19 512 Gg CO_2 in 2008. Small CO_2, CH_4 and N_2O emissions arise from the other sub-sectors except grassland - the total net emissions of all subsectors except forest land amounted to 1 857 Gg CO_2 equivalents in 2008.

2.3.6 Waste

The overall trend in greenhouse gas emissions from waste shows decreasing emissions, with a decrease of 44% from 1990 to 2008. The main driver for this trend are implemented waste management policies: Waste separation, reuse and recycling activities have increased from 1990 on and the amount of deposited waste has decreased especially since 2004 when pre-treatment of waste became obligatory. Furthermore, methane recovery has been improved. The slight increase from 2002 to 2003 was followed by a decrease from 2004 on, which is due to the implementation of the Landfill Ordinance, which lead to a reduction in waste volume and carbon content of deposited waste.

From 2007 to 2008 GHG emissions decreased by 5.6% due to the effects of the implementation of the Landfill Ordinance described above.

In 2008, greenhouse gas emissions from the waste sector amounted to 2 024 Gg CO_2 equivalents, which corresponds to 2.3% of the total national emissions.

The most important greenhouse gas of the waste sector is CH_4 with a share of 81.1% of the total GHG emissions from this sector in 2008, followed by N_2O with 18.3%, and CO_2 with 0.6%.

The most important sub-sector of the waste sector is solid waste disposal on land, which caused 77% of the emissions from this sector in 2008; the second largest source was waste water handling with 14%.

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) 2010, Submission under the UNECE/CLRTAP Convention*, which will be published in spring 2010.

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[24] 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).

The National total emissions and trends (1990–2008) as well as emission targets[25] for air pollutants covered by the UNECE/LTRTAP 1999 Gothenburg Protocol to Abate Acidification, Eutrophication and Ground-level Ozone, also known as Multi-Effect Protocol are shown in Table 15. These reduction targets should be met by 2010 by parties to the UNECE/LRTAP convention who signed this protocol.

Table 15: Total emissions and trends 1990–2008 of indirect GHGs and SO_2 as well as emission targets for air pollutants covered by the Multi-Effect Protocol and CO.

		NO_x	**CO**	**NMVOC**	**SO_2**
1990	Gg	195.22	1 435.27	273.84	74.37
1991		204.40	1 505.50	265.34	71.47
1992		193.65	1 471.93	239.78	55.08
1993		187.85	1 438.95	239.91	53.44
1994		181.80	1 387.21	223.52	47.82
1995		181.88	1 276.40	223.50	47.40
1996		203.84	1 253.42	215.22	44.66
1997		191.75	1 159.36	200.84	40.20
1998		206.60	1 115.18	185.57	35.60
1999		198.87	1 040.08	172.06	33.86
2000		207.28	966.09	176.84	31.67
2001		217.86	930.09	177.43	33.05
2002		226.53	891.32	182.14	31.63
2003		237.59	885.14	181.55	32.39
2004		236.14	841.62	162.39	27.71
2005		241.64	831.99	167.81	27.54
2006		227.12	785.52	176.20	28.30
2007		220.67	741.97	164.56	24.71
2008		206.90	696.10	163.37	22.44
Trend 1990–2008		***6%***	***-52%***	***-40%***	***-70%***
NEC		***107***	***--***	***159***	***39***

UNECE/LTRTAP 1999 Gothenburg Protocol to Abate Acidification, Eutrophication and Ground-level Ozone: the reduction targets should be met by 2010

Except for NO_x, where the emissions slightly increased, emissions of indirect greenhouse gases decreased by more than 40 % in the period from 1990 to 2008.

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

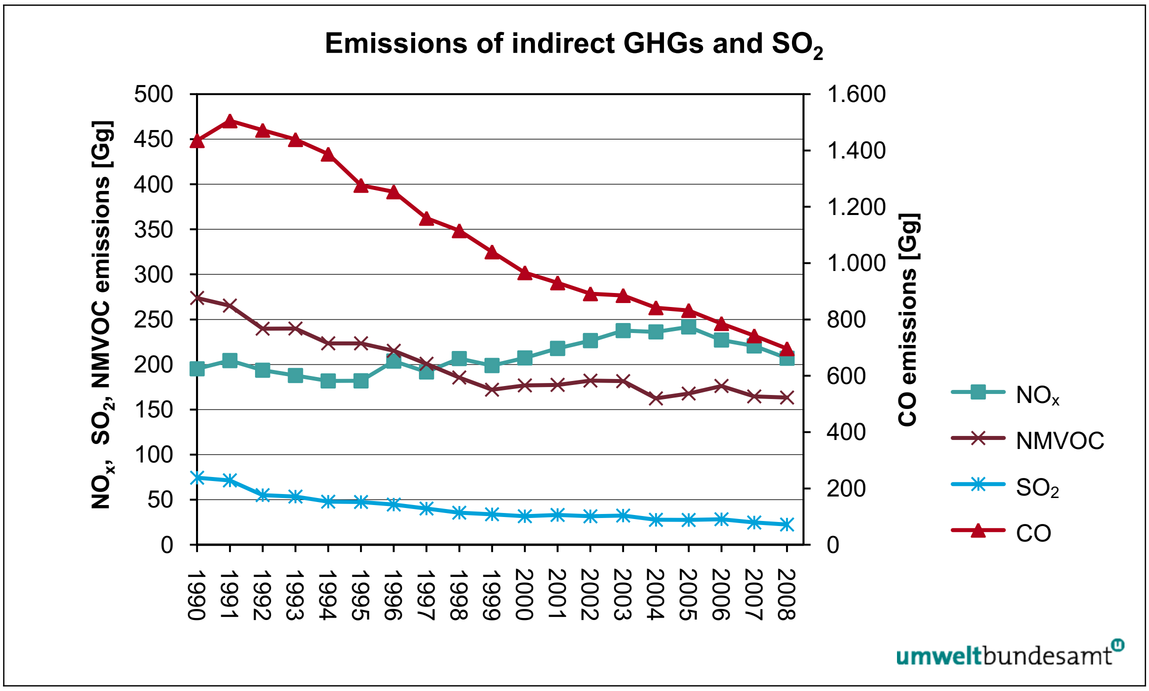

Figure 6: Emissions of indirect GHGs and SO_2 1990–2008.

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 195 to 207 Gg during the period from 1990 to 2008. In 2008 the NO_x emissions were 6.0% above the level of 1990.

In 2008 about 96% of NO_x emissions in Austria originated from fossil fuel combustion, with the major part originating from mobile combustion – road transport (59% in national total NO_x emission).

CO

CO emissions decreased from 1 435 to 696 Gg during the period from 1990 to 2008. In 2008 CO emissions were 52% below the level of 1990.

In the year 2008, 96% of total CO emissions in Austria originated from fuel combustion activities. The most important sub-source regarding CO emissions is the residential sector (39% in National Total CO emission) followed by mobile combustion – road transport (27% in national total CO emission).

NMVOC

NMVOC emissions decreased from 274 to 163 Gg during the period from 1990 to 2008. In 2008 NMVOC emissions were 40% below the level of 1990.

The most important emission sources for NMVOC emissions are solvent use and fossil fuel combustion, contributing 59% and 35% respectively of national total NMVOC emissions in 2008.

SO_2

SO_2 emissions decreased from 74 to 22 Gg during the period from 1990 to 2008. In 2008 SO_2 emissions were 70% below the level of 1990.

The decrease is mainly due to lower emissions from residential heating (-80%), combustion in the manufacturing Industries and construction (-40%) and energy industries (-77%), mainly caused by a switch from high sulfur fuels (like coal and heavy oil) to fuels with lower sulfur content, and the use of desulphurization units.

2.5 Emission trend for KP-LULUCF inventory in aggregate and by activity, and by gas

In 2008 CO_2 removals from AR in Austria amounted to 2 531 Gg CO_2. 517 Gg CO_2 resulted from cropland converted to forest land, 978 Gg CO_2 from grassland, 221 Gg CO_2 from wetland, 549 Gg CO_2 from settlement and 265 from other land. Emissions from Deforestation activities were 1 224 Gg CO_2 in 2008. Forest land converted to cropland amounted to 71 Gg CO_2, to grassland 350 Gg CO_2, to other land 432 Gg CO_2, to settlement 294 Gg CO_2 and to wetland 76 Gg CO_2.

Due to the nature and permanence of ARD areas, there is from 1990 on a steady increase in ARD areas (see chapter 10.2.1) and related to that a steady increase of removals and emissions, respectively, at these areas.

3 ENERGY (CRF SECTOR 1)

3.1 Overview of sector

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 2008 about 74.7% of national total GHGs emissions and 86.2% 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 16.8% from 55.4 Tg CO_2 equivalents in 1990 to 64.73 Tg CO_2 equivalents in 2008, which is mainly caused by increasing emissions from transport.

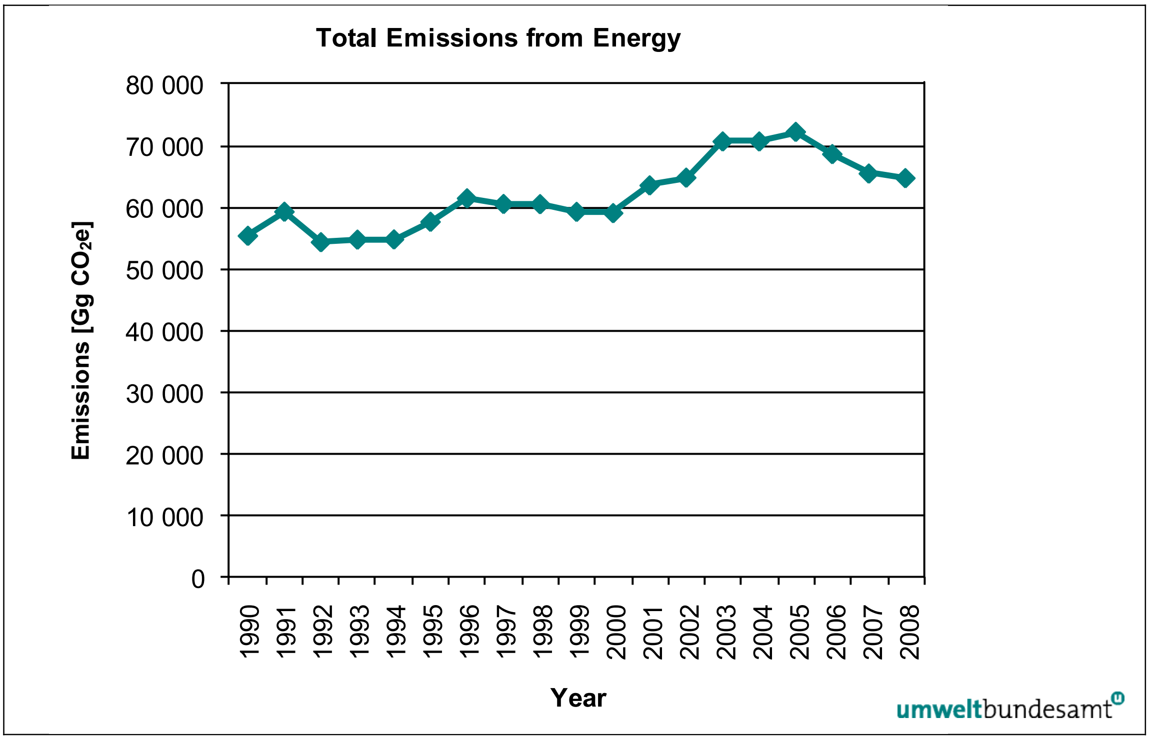

Figure 7: Trend of GHG emissions from 1990–2008 for energy.

Total emissions from energy mainly consist of CO_2; N_2O and CH_4 only make up about 1.2% and 0.8%, 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. Between 2005 and 2008 emissions from public electricity production, road transport and the residential/commercial sector decreased. The decrease of residential emissions is mainly due to warm weather conditions during the heating periods which reduced also emissions from district heating plants.

Emissions from public electricity production decreased due to less coal and oil combustion and the increase of electricity net imports. Emissions from road transport mainly decreased due to less fuel sales to vehicles which export the fuel in their tanks ("fuel tourism").

Table 16: Emissions of greenhouse gases and their trend from 1990–2008 from IPCC Category 1 Energy.

	CO_2 [Gg]	CH_4 [Gg]	N_2O [Gg]	Gg CO_2 equivalent
1990	54 178	31.94	1.79	55 404
1991	57 969	33.71	2.01	59 301
1992	53 072	32.71	1.97	54 370
1993	53 472	32.48	2.03	54 783
1994	53 545	30.37	2.04	54 816
1995	56 362	31.15	2.11	57 671
1996	60 122	31.85	2.21	61 475
1997	59 307	27.35	2.18	60 556
1998	59 256	26.54	2.31	60 529
1999	58 012	26.06	2.33	59 280
2000	57 820	25.21	2.34	59 076
2001	62 274	25.41	2.45	63 567
2002	63 534	24.30	2.48	64 814
2003	69 383	24.32	2.56	70 687
2004	69 343	24.20	2.52	70 634
2005	70 840	25.40	2.61	72 183
2006	67 310	24.20	2.54	68 605
2007	64 183	24.34	2.48	65 463
2008	63 474	24.14	2.41	64 727
Trend 1990–2008	*17.2%*	*-24.4%*	*34.4%*	*16.8%*

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 decreased since 1990 because of a change in the fuel mix and mild winters during the last three years. Emissions from the other categories except *1.A.1 Energy Industries* 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 the length of natural gas pipelines and the distribution network.

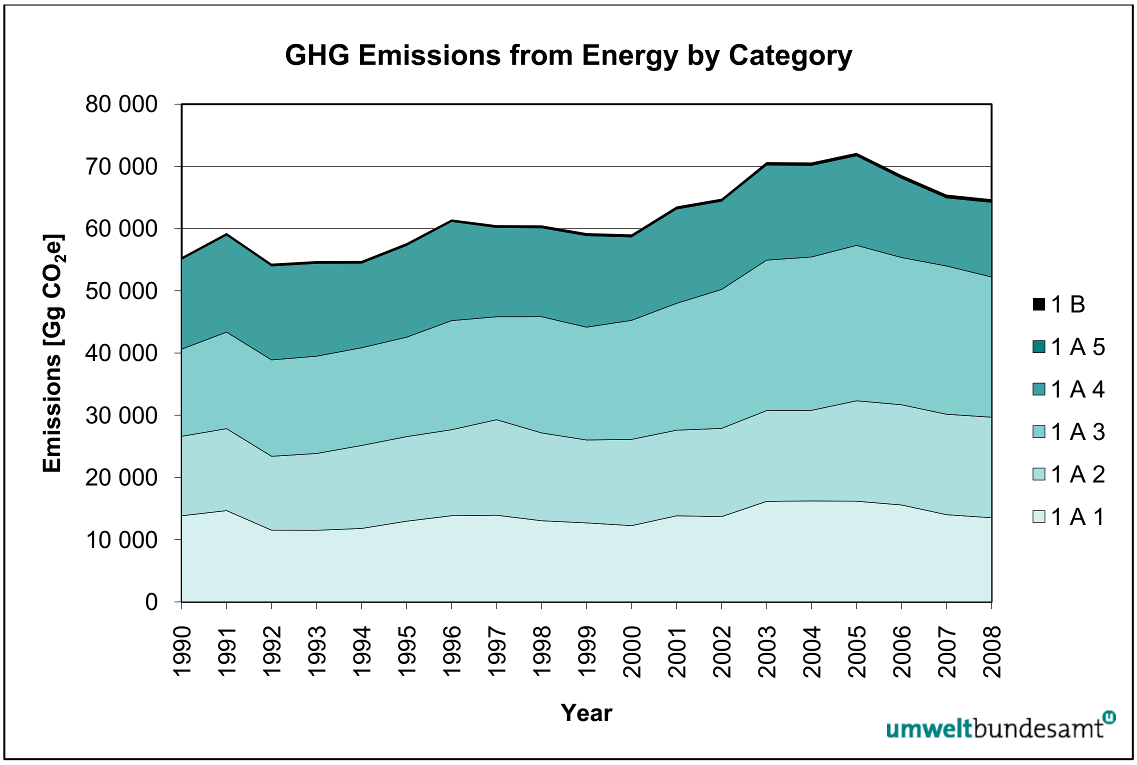

Figure 8: GHG emissions in [Gg CO_2 equivalent] from 1990–2008 from Energy by sub categories.

Table 17: Total GHG emissions in [Gg CO_2 equivalent] from 1990–2008 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	55 404	55 092	13 842	12 772	14 010	14 432	36	312	11	301
1991	59 301	58 982	14 679	13 169	15 517	15 579	38	319	9	309
1992	54 370	54 024	11 527	11 874	15 497	15 092	35	345	8	337
1993	54 783	54 443	11 513	12 346	15 639	14 906	40	339	8	332
1994	54 816	54 470	11 809	13 337	15 702	13 579	43	346	6	340
1995	57 671	57 319	12 971	13 593	15 985	14 737	33	353	6	347
1996	61 475	61 180	13 856	13 816	17 534	15 934	40	296	5	291
1997	60 556	60 210	13 936	15 349	16 547	14 340	38	346	5	341
1998	60 529	60 165	13 050	14 116	18 676	14 280	43	364	5	359
1999	59 280	58 899	12 702	13 322	18 132	14 701	43	381	5	376
2000	59 076	58 699	12 261	13 864	19 131	13 401	42	377	6	371
2001	63 567	63 174	13 840	13 761	20 385	15 146	42	393	5	388
2002	64 814	64 438	13 709	14 182	22 330	14 175	43	376	6	370
2003	70 687	70 243	16 161	14 590	24 184	15 265	44	444	5	439
2004	70 634	70 194	16 231	14 561	24 645	14 712	44	439	1	438
2005	72 183	71 743	16 184	16 143	24 981	14 391	45	440	0	439
2006	68 605	68 129	15 579	16 107	23 668	12 729	45	476	0	476
2007	65 463	64 974	14 019	16 138	23 833	10 938	46	489	0	489
2008	64 727	64 260	13 527	16 161	22 535	11 991	46	467	0	467
Trend 1990-2008	16.8%	16.6%	-2.3%	26.5%	60.8%	-16.9%	28.6%	49.8%	-100.0%	55.3%

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). Furthermore, information on sectoral/reference approach and feedstocks/non-energy use of fuels is given in this sector.

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 Comparison of the Sectoral Approach with the Reference Approach

3.2.1.1 Comparison of CO_2 emissions

In the following, CO_2 emissions from the sectoral and reference approach are compared and explanations for the differences are provided.

Table 18 presents CO_2 emissions of sectoral and reference approach.

Table 18: CO_2 emissions of sectoral and reference approach.

Year	**Reference Approach**				**Sectoral Approach *1 A Fuel Combustion***				
	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	28 188	15 917	12 238	**56 343**	28 119	13 924	11 301	732	**54 076**
1991	30 721	16 771	12 939	**60 431**	30 595	14 518	11 940	805	**57 858**
1992	29 799	12 957	12 705	**55 460**	29 329	10 666	12 000	956	**52 951**
1993	30 869	11 650	13 399	**55 918**	30 738	9 495	12 453	675	**53 360**
1994	30 126	11 810	13 782	**55 718**	30 107	9 379	13 111	820	**53 417**
1995	30 731	13 499	15 048	**59 278**	30 316	10 741	14 339	839	**56 235**
1996	33 149	13 511	16 017	**62 677**	32 931	10 760	15 287	1 073	**60 051**
1997	32 614	14 318	15 437	**62 369**	32 131	11 318	14 720	1 017	**59 186**
1998	34 905	12 550	15 848	**63 304**	34 256	8 905	15 136	818	**59 114**
1999	32 889	12 481	16 125	**61 494**	32 406	9 210	15 406	819	**57 841**
2000	32 017	14 152	15 388	**61 557**	31 697	10 443	14 684	832	**57 656**
2001	34 530	14 581	16 309	**65 420**	34 235	11 249	15 629	978	**62 091**
2002	35 317	14 880	16 494	**66 691**	35 277	11 134	15 792	1 163	**63 367**
2003	37 745	15 983	17 833	**71 561**	38 068	12 624	17 070	1 389	**69 150**
2004	38 552	15 813	17 621	**71 985**	38 389	12 310	16 916	1 518	**69 133**
2005	39 042	15 722	19 307	**74 070**	38 776	11 945	18 508	1 405	**70 634**
2006	37 804	15 872	17 605	**71 281**	37 030	11 740	16 792	1 515	**67 077**
2007	36 956	14 851	16 476	**68 283**	35 710	10 947	15 810	1 480	**63 946**
2008	35 642	13 968	17 639	**67 249**	34 643	10 294	16 833	1 492	**63 261**

Table 19 presents the difference of CO_2 emissions in percent between reference and sectoral approach.

Table 19: Difference of CO_2 emissions by type of fuel in percent.

Year	Liquid	Solid	Gaseous	Total
1990	0.24%	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	1.49%	35.51%	4.67%	6.32%
2000	1.01%	35.51%	4.80%	6.77%
2001	0.86%	29.62%	4.35%	5.36%
2002	0.11%	33.65%	4.44%	5.24%
2003	-0.85%	26.61%	4.47%	3.49%
2004	0.42%	28.46%	4.17%	4.13%
2005	0.69%	31.62%	4.31%	4.86%
2006	2.09%	35.19%	4.84%	6.27%
2007	3.49%	35.67%	4.21%	6.78%
2008	2.88%	35.69%	4.79%	6.30%

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 -1.2 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 20 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 20: 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	0.9%
2000	193	582	3 489	-832	0	3 432	0.8%
2001	204	551	3 449	-978	0	3 226	0.2%
2002	205	573	3 879	-1 163	0	3 493	-0.3%
2003	220	625	3 721	-1 389	0	3 177	-1.1%
2004	218	568	3 650	-1 518	0	2 917	-0.1%
2005	239	598	4 128	-1 405	125	3 684	-0.3%
2006	217	638	4 206	-1 515	879	4 426	-0.3%
2007	205	560	4 214	-1 480	1 010	4 509	-0.3%
2008	218	623	4 147	-1 492	993	4 489	-0.7%

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.*

3.2.1.2 Comparison of energy consumption

Table 21 compares the energy consumption of the two approaches.

Table 21: 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	432 123	168 749	219 239	820 111	379 090	139 889	203 981	8 990	731 951
1991	466 134	177 293	231 794	875 221	411 650	146 161	215 528	10 079	783 418
1992	456 762	137 588	227 610	821 960	395 222	108 336	216 608	12 009	732 174
1993	465 099	123 589	240 044	828 732	413 705	96 290	224 788	9 775	744 559
1994	456 704	125 316	246 908	828 928	405 845	95 062	236 666	10 527	748 100
1995	461 761	142 854	269 583	874 198	408 410	108 495	258 830	10 916	786 651
1996	500 585	143 595	286 941	931 121	444 557	109 225	275 944	14 015	843 741
1997	499 970	152 325	276 551	928 846	433 219	114 973	265 706	13 122	827 020
1998	529 340	133 791	283 920	947 051	461 733	90 343	273 204	12 285	837 565
1999	501 314	132 648	288 876	922 837	435 929	92 380	278 086	11 500	817 895
2000	489 832	150 050	275 681	915 563	428 701	105 499	265 047	12 180	811 426
2001	527 260	154 743	292 169	974 172	462 524	113 823	282 109	14 489	872 946
2002	537 396	157 556	295 485	990 438	473 451	112 577	285 061	16 776	887 865
2003	571 536	169 515	319 481	1 060 532	508 370	128 003	308 120	19 401	963 894
2004	586 281	167 929	315 671	1 069 881	512 668	125 543	305 339	24 720	968 269
2005	587 043	166 548	345 876	1 099 468	521 123	123 100	334 173	22 573	1 000 969
2006	578 880	168 303	315 391	1 062 574	501 506	121 347	303 198	25 551	951 603
2007	562 961	157 774	295 161	1 015 896	485 026	113 242	285 457	24 399	908 124
2008	541 780	148 499	315 995	1 006 275	469 006	106 425	303 924	25 210	904 566

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.

3.2.2 International bunker fuels

3.2.2.1 International navigation

Greenhouse gas emissions and activity data from navigation assigned to international bunkers are presented in the following table.

Table 22: Greenhouse gas emissions and activity from 1.C1.B International bunkers-marine 1990-2008.

	CO_2 [Gg]	N_2O [Gg]	CH_4 [Gg]	Activity [TJ]
1990	19	0.006	0.001	251
1991	20	0.007	0.001	266
1992	20	0.007	0.001	272
1993	21	0.007	0.001	279
1994	20	0.007	0.001	273
1995	20	0.007	0.001	268
1996	19	0.007	0.001	263
1997	19	0.007	0.001	258
1998	19	0.007	0.001	253
1999	18	0.007	0.001	251
2000	20	0.007	0.001	275
2001	20	0.007	0.001	275
2002	24	0.009	0.001	325
2003	17	0.006	0.001	234
2004	60	0.022	0.003	814
2005	65	0.023	0.003	876
2006	42	0.016	0.002	576
2007	36	0.013	0.002	491
2008	31	0.011	0.001	427

Methodological Issues

The applied methodology for estimating the total fuel consumption and greenhouse gas emissions is described in the subchapter on mobile sources of *1 A 2 f* (see 3.2.7.9).

In 2010, greenhouse gas emissions from water-borne navigation (inland navigation on the river Danube) are reported separately for national and international navigation for the first time between 1990 and 2008. For this purpose navigation diesel consumption was obtained from the energy balance. Data origins from the Federal Ministry of Economy, Family and Youth (BMWFJ 2010). which – according to the national oil statistics directive – collects data from all Austrian companies who export or import oil products .

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

Recalculations

The splitting of activity data of diesel oil between national and international navigation shows that in 2008 domestic navigation accounts for approximately 40% of the total diesel oil consumption in Austria. Following, there is a decrease of CO_2 emissions within the Category 1 A 3 d Navigation by around 31.5 Gg.

3.2.2.2 International aviation

Emissions from aviation assigned to international bunkers include the transport modes international airport traffic (LTO-cycles) and international cruise traffic for IFR-flights (International Flight Rules).

Table 23: Greenhouse gas emissions and activity from 1.C1.A International bunkers-aviation 1990–2008.

	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	796	0.006	0.025	0.015	11 014
1991	103	891	0.006	0.028	0.016	12 330
1992	116	962	0.007	0.031	0.017	13 310
1993	129	1 011	0.008	0.032	0.018	13 998
1994	141	1 044	0.009	0.033	0.019	14 453
1995	154	1 173	0.010	0.037	0.020	16 127
1996	165	1 302	0.010	0.041	0.023	17 933
1997	175	1 350	0.011	0.043	0.027	18 603
1998	186	1 392	0.011	0.044	0.030	19 182
1999	190	1 352	0.011	0.043	0.029	18 583
2000	210	1 485	0.010	0.047	0.031	20 398
2001	200	1 452	0.010	0.046	0.030	19 935
2002	233	1 307	0.010	0.041	0.035	17 955
2003	243	1 210	0.010	0.038	0.036	16 612
2004	290	1 435	0.011	0.046	0.043	19 702
2005	270	1 689	0.012	0.054	0.040	23 203
2006	268	1 781	0.012	0.056	0.040	24 460
2007	290	1 886	0.013	0.060	0.043	25 903
2008	294	1 888	0.013	0.060	0.044	25 924

Methodological Issues

Emissions have been calculated using the methodology and emission factors as described in Chapter 3.2.7.10 (*1 A 3 a Civil Aviation)*.

3.2.3 Feedstocks and non-energy use of fuels

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*.

disposal: 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*.

3.2.4 CO_2 capture from flue gases and subsequent CO_2 storage, if applicable

CO_2 capture from flue gases and CO_2 storage is not occurring in Austria.

3.2.5 Country-specific issues

With regard to country-specific issues it can be referred to Chapter 3.2.7, where point source emissions as well as the CO_2 emission trading system (ETS) are considered.

3.2.6 Source Category Description

Transport

In 2008 the most important source of GHGs was transport, with a share of 26% in national total GHG emissions. 13.9% of national GHG emissions were released by passenger cars, 2.1% by light duty vehicles, 8.9% by heavy-duty vehicles and 0.2% 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 0.04% in total GHG emissions. Because Austria is a landlocked country, there is no occurrence of maritime activities. However, emissions from international transport at inland waterways are excluded from the national total and reported as marine bunkers. About 0.1% of national GHG arise from domestic aviation.

Manufacturing Industries

Combustion in manufacturing industries and construction was the second largest sub-category with a share of 18.7% in 2008 total GHG emissions. This category also includes mobile machinery mainly used in the construction sector. Emissions from non energy fuel use such as reducing agents are reported under industrial processes (CRF Category 2).

Energy Industries

The third largest GHG source of the energy sector in 2008 with a share of 15.6% total GHG emissions of was energy industries, were fossil fuels are used for electrical power and district heating production. In the year 2008 overall gross public electricity production was 56 021 GWh[26]

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[26] Source: IEA Questionnaire Dec/2009 by STATISTIK AUSTRIA.

of which 38 040 GWh (67.9%) were generated by hydro plants, 15 919 GWh (28.4%) by thermal power plants and 2 062 GWh (3.7%) by solar, geothermal and wind power plants. Industrial auto producers generated 8 748 GWh of electricity in the year 2008. 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*).

Other Sectors

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 13.8% in 2008 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.

Other (Military)

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 2008.

3.2.6.1 Key Sources

The methodology and results of the key category analysis is presented in Chapter 1.5. Table 24 presents the key source categories of *1 A Fuel Combustion Activities*.

Table 24: 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 2008; 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 2008)

TA = Trend Assessment 2008

3.2.6.2 Completeness

Table 25 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 25: 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** **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)** **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)** **030311 Cement** **030317 Glass** **030312 Lime** **030319 Bricks and Tiles** **030323 Magnesia production (dolomite treatment)** **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)** **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** **0702 Light duty vehicles < 3.5 t** **0703 Heavy duty vehicles > 3.5 t and buses** **0704 Mopeds and Motorcycles < 50 cm³** **0705 Motorcycles > 50 cm³** **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** **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** **0806 Other Mobile Sources and Machinery-Agriculture** **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	**080404 International sea traffic (international bunkers)**			
Gasoline		NO	NO	NO
Gas/Diesel oil		✓	✓	✓
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)** **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.

3.2.7 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 2005–2008 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:
  $\text{Activity}_{\text{category, fuel}} = (\text{Energy\_Balance\_Activity}_{\text{category, fuel}} - \Sigma i(\text{ETS\_Activity}_{\text{plant i, fuel}})) \times \text{Energy\_Balance\_NCV}_{\text{fuel}} + \Sigma i(\text{ETS\_Activity}_{\text{plant i, fuel}} \times \text{ETS\_NCV}_{\text{plant i, fuel}})$
- ETS CO_2 emissions are considered by fuel. The remaining CO_2 emissions are calculated by remaining activity data and "national default" emission factors:
  $\text{CO2}_{\text{category, fuel}} = (\text{Energy\_Balance\_Activity}_{\text{category, fuel}} - \Sigma i(\text{ETS\_Activity}_{\text{plant i, fuel}})) \times \text{Energy\_Balance\_NCV}_{\text{fuel}} \times \text{Default\_EF}_{\text{fuel}} + \Sigma i(\text{ETS\_CO2}_{\text{plant i, fuel}})$

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.

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[27] 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 3.2.7.9.

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[27] 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.

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.

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 26 shows certificated CO_2 emissions from the ETS (UMWELTBUNDESAMT, C 2006-2009) 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 26: 2005–2008 CO_2 emissions [Gg] as reported by the ETS.

	Category	**2005**	**2006**	**2007**	**2008**
Total ETS[1]		33 373	32 381	31 745	32 004
1.A	FUEL COMBUSTION ACTIVITIES	25 299	23 998	22 821	22 841
1.A.1.a	Public Electricity and Heat Production	11 482	10 374	9 037	8 973
1.A.1.b	Petroleum refining	2 827	2 830	2 868	2 806
1.A.1.c	Manufacture of Solid fuels and Other Energy Industries	43	50	52	47
1.A.2.a	Iron and Steel	5 688	5 527	5 582	5 805
1.A.2.b	Non-ferrous Metals	0	0	0	0
1.A.2.c	Chemicals	665	623	592	611
1.A.2.d	Pulp, Paper and Print	2 245	2 153	2 150	2 128
1.A.2.e	Food Processing, Beverages and Tobacco	316	278	283	295
1.A.2.f	Other	2 010	2 139	2 239	2 157
1.A.4.a	Commercial/Institutional	22	23	19	19
2.	INDUSTRIAL PROCESSES	8 091	8 449	8 976	9 279
2.A.1	Cement Production	1 797	1 954	2 131	2 133
2.A.2	Lime Production	579	570	596	621
2.A.3	Limestone and Dolomite Use	247	253	268	269
2.A.7.a	Bricks and Tiles (decarbonizing)	128	130	130	110
2.A.7.b	Sinter Production	310	312	329	332
2.A.7.c	Glass Production	35	37	40	44
2.C.1.a	Steel	763	778	826	820
2.C.1.b	Pig Iron	4 186	4 366	4 598	4893
2.C.1.e.1	Electric furnace steel plant	45	49	58	57

1) *Source: UMWELTBUNDESAMT, ECRA (2006/2007/2008/2009).*

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

CO_2 emission factors reported within the ETS

Table 27 and Table 28 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 27: 2008 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	**92.65**	**96.93**	**103.80**	**108.79**	**54.06**	**55.08**
010101 Public Power plants >= 300 MW_{th}	92.71	-	-	-	-	55.40
010102 Public Power plants >= 50 MW_{th} < 300 MW_{th}	93.78	-	-	-	-	55.40
010103 Public Power plants <= 50 MW_{th}	-	-	-	-	-	-
010201 Public District Heating plants >= 300 MW_{th}	-	-	-	-	-	55.40
010202 Public District Heating plants >= 50 MW_{th} < 300 MW_{th}	-	-	-	-	-	55.40
010203 Public District Heating plants < 50 MW_{th}	-	-	-	-	-	55.40
010301 Refinery	-	-	-	117.03	-	53.19
010504 Other Energy Industries – Gas Turbines	-	-	-	-	-	55.40
020103 Commercial plants < 50 MW_{th}	-	-	-	-	-	55.39
0301 Industry – Steel	115.43	-	103.43	-	-	55.40
0301 Industry – Non ferrous metals	-	-	-	-	-	-
0301 Industry – Chemicals	93.97	-	-	-	77.11	55.40
0301 Industry – Pulp and Paper	89.72	-	-	-	68.42	55.40
0301 Industry – Food and Beverages	98.30	-	103.99	98.32	-	55.40
03010 Industry – Other	128.56	-	-	-	13.38	55.40
030311 Cement kilns	92.99	96.59	-	90.74	63.36	55.40
030312 Lime kilns	-	-	104.01	97.18	-	55.40
030317 Glass	-	-	-	-	-	55.40
030319 Bricks and Tiles	94.10	103.71	103.99	101.00	2.42	55.40
030323 Dolomite Treatment	-	-	-	94.67	99.92	55.40
030326 Integrated Iron & Steel works	91.66	-	103.80	-	80.17	55.06

Table 28: 2008 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	**77.63**	**78.00**	**79.41**	**74.99**	**72.57**	**78.60**	**64.02**
010101 Public Power plants >= 300 MW_{th}	77.46	-	79.33	75.14	76.11	-	-
010102 Public Power plants >= 50 MW_{th} < 300 MW_{th}	75.79	-	75.00	-	-	-	-
010103 Public Power plants <= 50 MW_{th}	-	-	-	-	-	-	-
010201 Public District Heating plants >= 300 MW_{th}	-	-	80.00	75.00	68.92	-	-
010202 Public District Heating plants >= 50 MW_{th} < 300 MW_{th}	77,00	78,00	80.00	74.99	57.45	-	-
010203 Public District Heating plants < 50 MW_{th}	76.21	-	80.00	74.98	-	-	63.98
010301 Refinery	-	-	-	-	-	78.92	-
010504 Other Energy Industries – Gas Turbines	-	-	-	-	-	-	-
020103 Commercial plants < 50 MW_{th}	-	-	-	73.96	55.63	-	-
0301 Industry – Steel	-	-	-	-	-	-	-
0301 Industry – Non ferrous metals	-	-	-	-	-	-	-
0301 Industry – Chemicals	-	-	80.22	78.06	72.78	68.48	-
0301 Industry – Pulp and Paper	77.93	-	78.26	74.98	73.01	-	-
0301 Industry – Food and Beverages	68.58	-	-	76.27	82.86	-	-
03010 Industry – Other	77.99	-	79.87	74.84	70.92	-	-
030311 Cement kilns	77.96	-	78.00	74.99	-	-	-
030312 Lime kilns	-	-	78.00	75.17	-	-	-
030317 Glass	78.01	-	-	77.42	67.56	-	-
030319 Bricks and Tiles	78.00	-	78.00	75.01	53.32	84.99	64.00
030323 Dolomite Treatment	64.21	-	-	-	80.99	-	68.83
030326 Integrated Iron & Steel works	-	-	79.75	-	-	-	-

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 3.2.3

3.2.7.1 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 15.8% for the year 2008. The increased CH_4 emissions are due to increased natural gas and biomass combustion in plants smaller 50 MW_{th} (see tables in Annex 2).

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 2005–2008 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 3.2.7.

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 2008 as well as the national default emission factors are listed in the following table. The CO_2 emission factor for municipal solid waste is taken from (ABFALLWIRTSCHAFT 2003).

Table 29: Emission factors of Category 1.A.1 a for the year 2008.

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
Diesel oil	75.00	0.20	0.60

Fuel	Default CO_2 [t/TJ]	CH_4 [kg/TJ]	N_2O [kg/TJ]
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 2009) 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 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 30: 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	**53 766**	39 681	13 908	0	5	172	44 205
2002	**54 432**	40 581	13 636	3	9	203	45 361
2003	**52 497**	34 230	17 883	3	15	366	49 503
2004	**56 039**	37 700	17 395	2	18	924	53 383
2005	**58 404**	37 786	19 267	2	21	1 328	54 087
2006	**55 008**	36 071	17 160	3	22	1 752	58 118
2007	**56 021**	38 040	15 919	2	24	2 036	56 969
2008	**58 278**	39 499	16 735	2	28	2 014	59 972

[1] *including pumped storage; Source: Statistik Austria 2009*

As shown in Table 31 electricity supply inceased by 7 960 GWh since 2000 of which approx. 80% has been supplied by additional imports.

Table 31: 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	56 399	61 517	13 824	15 192	-1 368
2001	58 624	62 420	14 467	14 252	215
2002	57 853	62 546	15 375	14 676	699
2003	59 342	60 166	19 002	13 389	5 613
2004	60 499	64 136	16 629	13 548	3 081
2005	62 603	66 660	20 397	17 732	2 665
2006	62 974	63 540	21 257	14 407	6 850
2007	64 230	64 769	22 130	15 511	6 619
2008	64 359	67 101	19 796	14 933	4 863

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 20 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.

3.2.7.2 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 2008. Crude oil input which was 8 Mio t in 1990 and 8.7 Mio t in 2008.

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 32: 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 32. 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, 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 33. The IEF fluctuations reflect changes in refinery gas composition.

Table 33: 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	56.8
2000	51.9
2001	52.2
2002	70.5
2003	84.8
2004	82.9
2005	72.5
2006	63.2
2007	60.7
2008	66.4

N_2O emissions are calculated by multiplying fuel consumption by the emission factors presented in Table 34 (they are selected according to chapter 3.2.7).

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 34: 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

Fuel	CO_2 [t/TJ]	N_2O [kg/TJ]
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 2009) 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. The last line shows the difference between input and output. Natural gas consumption is not considered in this approach.

Table 35: Refinery input/output mass balance.

Material flow [kt]	1990	1995	2000	2005	2006	2007	2008
Total Input	**9 062**	**9 244**	**8 887**	**9 284**	**9 086**	**9 146**	**9 436**
Crude oil	7 952	8 619	8 240	8 743	8 472	8 496	8 710
NGL	41	43	107	43	47	141	80
Feedstocks	1 069	582	541	471	468	348	404
Biofuel (blending)				27	99	161	242
Total Output	**8 824**	**8 959**	**8 610**	**9 098**	**8 866**	**8 890**	**9 034**
Fuel oil	1 913	1 502	979	1 045	915	879	769
Gas oil	1 239	1 454	1 062	997	1 004	612	991
Diesel	1 531	1 920	2 662	2 931	2 780	2 976	3 108
Other Kerosene	31	8	1	1	8	1	3
Aviation kerosene	291	420	544	592	526	604	472
Aviation gasoline	0	0	0	0	0	0	0
Motör gasoline	2 631	2 271	1 815	1 798	1 615	1 704	1 684
White spirit	0	5	0	0	0	0	0
Bitumen	269	254	343	466	392	411	444
Other petroluem products	499	761	859	851	1 186	1 217	1 082
LPG	47	60	34	107	50	70	98
Refinery gas	373	305	312	309	390	417	383
Input-Output	**237**	**285**	**277**	**186**	**220**	**256**	**402**

Recalculations

Liquid fuel consumption 1999–2001 has been revised following the energy balance. In the previous submission liquid fuel consumption was calculated from other data sources.

Natural gas consumption 2001 (-0.5 PJ) to 2007 (+3.6 PJ) has been also revised following the energy balance. This implies e.g. a lower natural gas consumption in 2007 for other *1.A Fuel Combustion Activities*.

Planned improvements

A large fluctuation of Refinery gas CO_2-IEF has been identified. Activity data should be reconsidered. From 2005 to 2008 refinery gas activity data (IEA JQ 2009) increased by 33% while CO_2 emissions increased by only 1.4%.

3.2.7.3 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 0.8% for the year 2008.

Methodology

CORINAIR simple methodology is applied.

For 2005 to 2008 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 36: 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 2009) 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 2009) 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 2009).

Recalculations

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

3.2.7.4 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 9.7% for the year 2008.

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 2008 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 362/267; the plant reported 267 t NMVOC and by applying the ratio obtained from the CORINAIR simple methodology, total CH_4 emissions were estimated to be 80 t. In a last step CH_4 emissions were allocated to the different fuel types.

Point source CO_2 emissions 2003 and 2004

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 37: 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	0.028	0.052
2002	397	0.011	0.001	5 118	0.027	0.052
2003	367	0.010	0.001	5 263	0.068	0.053
2004	167	0.004	0.001	5 557	0.081	0.054
2005	443	0.012	0.002	6 003	0.089	0.057
2006	486	0.013	0.002	5 851	0.095	0.060
2007	382	0.011	0.002	5 927	0.090	0.062
2008	404	0.011	0.002	5 837	0.080	0.060

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 2008 are presented in Table 38 and Table 39.

Table 38: Emission factors of Category 1.A.2.a for 2008, 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 39: Emission factors of Category 1.A.2.a for 2008, 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 2009) as presented in Annex 4.

Point source activity data are reported by plant operators which are widely consistent with (IEA JQ 2009).

Recalculations

Update of activity data according to the revised energy balance as described in Annex 2. Update of point source CO_2 emissions 2007 (+88 Gg) based on verified information provided by plant operators.

3.2.7.5 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 0.5% for the year 2008.

Methodology

CORINAIR simple methodology is applied. Fuel consumption is taken from (IEA JQ 2009) 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 2008 are presented in the following table.

Table 40: Emission factors of Category 1.A.2.b for 2008.

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 2009) 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 revisions for the years 2006 and 2007 (-21 Gg CO_2 from natural gas).

3.2.7.6 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 2.1% for the year 2008. 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 2008 CO_2 ETS data are considered.

CO_2 emissions from industrial waste: Table 41 shows the composition of the implied emissions factor 2000-2009 for industrial waste. One plant with a capacity of 150 kt solid waste/year is considered with a NCV of 10 TJ/kt waste and a CO_2 emission factor of 104.17 t/TJ. From 2005 on ETS data is considered with plant specific emissions and energy consumption. The remaining energy use (other waste) is considered with a CO_2 emission factor of 52.09 t/TJ. 'Other waste' is considered as 50% waste gas (with a high share of hydrogen) and chemical reaction heat (which is not relevant for GHG emissions). Therefore an emission factor of 50% of the default emission factor is selected.

Table 41: Composition of 1.A.2.c Chemical industries – industrial waste – CO_2 IEF for the years 2000 to 2008.

Year	Total energy use	Solid waste (150 kt/year)		ETS		Other waste		CO_2 IEF
	[TJ]	[TJ]	CO_2 EF	[TJ]	CO_2 IEF	[TJ]	CO_2 EF	[t/TJ]
2000	2 258	1 500	104.17	378[1]	70.62	380	52.09	89.79
2001	2 815	1 500	104.17	378[1]	70.62	937	52.09	82.33
2002	4 129	1 500	104.17	378[1]	70.62	2 251	52.09	72.70
2003	5 821	1 500	104.17	378[1]	70.62	3 943	52.09	66.71
2004	7 257	1 500	104.17	378[1]	70.62	5 378	52.09	52.48
2005	5 532	1 500	104.17	378	70.62	3 654	52.09	67.48
2006	4 686	1 500	104.17	560	74.59	2 626	52.09	71.45
2007	3 465	1 500	104.17	528	75.01	1 438	52.09	78.12
2008	2 495	1 500	104.17	329	77.11	666	52.09	86.70

[1] *For 2000 to 2004 the value of 2005 has been selected.*

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 2008 are presented in Table 42.

Table 42: Emission factors of Category 1 A 2 c for 2008.

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	86.70[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 2009) 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 2001 to 2007 (+27 Gg CO_2). In the energy balance activity data of industrial waste has been revised significantly for the years 2006 (-3 PJ) and 2007 (- 5.5 PJ).

3.2.7.7 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 2008.

Methodology

The CORINAIR simple methodology is applied. For the years 2005 to 2008 CO_2 ETS data are considered.

CO_2 emissions from industrial waste: The following Table 43 shows the composition of the implied emissions factor 2000-2008 for industrial waste. From 2005 on ETS data is considered with plant specific emissions and energy consumption. From 1990 to 2004 energy consumption of the energy balance is taken and considered with a CO_2 emission factor of 104.17 t/TJ. In general ETS data shows slightly higher energy consumption (in terms of TJ) than current energy statistics, therefore ETS data is used from 2005 on.

Table 43: Composition of 1.A.2.d Pulp, Paper and Print – industrial waste – CO_2 IEF for the years 2000 to 2008.

Year	Total energy use (energy balance)	ETS		CO_2 IEF	CO_2
	[TJ]	**[TJ]**	**CO_2 IEF**	**[t/TJ]**	**[Gg]**
2000	NO			NO	0.00
2001	113			104.17	11.82
2002	121			104.17	12.65
2003	202			104.17	21.03
2004	246			104.17	25.65
2005	98	111	64.29	64.29	7.15
2006	88	149	43.85	43.85	6.53
2007	115	170	65.52	65.52	11.14
2008	110	130	68.42	68.42	8.92

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 2008 are presented in the following table.

Table 44: Emission factors of Category 1.A.2.d for 2008.

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 2009) as presented in Annex 4.

Recalculations

Changes of activity data are based on a recalculation of the energy balance as described in Annex 2. Only minor recalculations have been carried out: -3 Gg CO_2 from industrial waste in 2007.

3.2.7.8 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 2008.

Methodology

CORINAIR simple methodology is applied. For the years 2005 to 2008 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 2008 are presented in the following table.

Table 45: Emission factors of Category 1.A.2.e for 2008.

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 2009) as presented in Annex 4.

Recalculations

Changes of activity data are based on a recalculation of the energy balance as described in Annex 2. Changes of activity data imply minor changes in emissions: -3 Gg CO_2 from liquid fuels and -4 Gg CO_2 from gaseous fuels in 2007.

3.2.7.9 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 8.1% for the year 2008. N_2O emissions mainly arise from mobile machinery (1990: 68%; 2008: 66%).

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 6.2% for the year 2008.

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 80% to 90% 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 2008 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 3.72 GJ/t clinker in 2008.

Hard Coal, Brown Coal, Petrol Coke and Industrial Waste

In (IEA JQ 2009) 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. The following Table 46 shows the amount, NVCs and CO_2 IEFs of industrial waste which is used as a fuel in cement kilns. After 2005 the share of waste which contains 100% biomass has been taken from ETS data. The overall IEF is between 79.25 an 82.37 t CO_2/TJ which is reasonable because most of the waste origins from oil products. From 1990 to 2004 the mass of fractions with 100% biomass is not excplicitly known. The biogenic C-content of the diverse waste fractions is e.g.: 0% for waste oil and solvents, 3-24% for plastics, 27-30% for scrap tyres, 36-42% for high heat value fraction of MSW and 56% for paper reject. Examples for waste which is considered as 100% biomass is: glycerin, carcass meal, animal fat, sewage sludge, paper fibre residue and sawdust.

Table 46: Industrial waste used as fuel in cement kilns 1990-2008.

Year	**solid waste [kt]**		**NCV [1] [MJ/kg]**	**fossile [1] CO_2 IEF [t/TJ]**	**biomass [1] CO_2 IEF [t/TJ]**	**Fossile + [1] biomass CO_2 IEF [t/TJ]**
	100% biomass	**Fractions with fossile C-content**				
1990	-	59	22.07	49.83	-	-
1991	-	67	25.02	53.37	-	-
1992	-	79	23.80	49.81	-	-
1993	-	79	23.16	29.57	-	-
1994	-	83	23.41	70.44	-	-
1995	-	87	22.71	62.59	-	-
1996	-	100	21.64	47.44	-	-
1997	-	101	20.78	66.30	-	-
1998	-	122	21.97	30.21	-	-
1999	-	135	21.43	63.36	-	-
2000	-	170	20.94	60.56	-	-
2001	-	218	20.85	53.03	-	-
2002	-	239	20.78	65.54	-	-
2003	-	254	21.91	82.71	-	-
2004	-	257	22.07	63.36	-	-
2005	58	204	23.28	68.92	10.32	**79.25**

Year	solid waste [kt]		NCV [1] [MJ/kg]	fossile [1] CO_2 IEF [t/TJ]	biomass [1] CO_2 IEF [t/TJ]	Fossile + [1] biomass CO_2 IEF [t/TJ]
	100% biomass	Fractions with fossile C-content				
2006	40	261	22.25	63.02	16.60	**79.61**
2007	34	301	20.21	64.41	17.73	**82.14**
2008	76	297	22.14	63.36	19.01	**82.37**

[1] *Of solid waste with fossile C-content.*

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 2009).

Activity data 2005–2008

For the years 2005–2008 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 2008 ETS data is considered for glass, bricks & tiles and lime manufacturing plants.

Activity data

Fuel consumption is taken from (IEA JQ 2009) 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 2009) 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 2009).

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 2008 are presented in the following table.

Table 47: Emission factors of Category 1.A.2.f stationary sources for 2008.

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
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	63.36$^{3)}$	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.*

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 2006 (-30 Gg CO_2) and 2007 (+66 Gg CO_2) and solid fuels 2005 (+55 Gg CO_2) and 2006 (+22 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 1.9% for the year 2008. All GHGs emissions originate from liquid fossil fuel combustion.

Table 48: Greenhouse gas emissions from Category 1 A 2 f mobile sources 1990-2008.

	CO_2 [Gg]	CH_4 [Gg]	N_2O [Gg]	Gg CO_2 equivalent
1990	256	0.01	0.09	284
1991	289	0.02	0.10	321
1992	306	0.02	0.11	340
1993	322	0.02	0.11	358
1994	336	0.02	0.12	374
1995	356	0.02	0.13	397
1996	442	0.02	0.17	496
1997	419	0.02	0.16	470
1998	493	0.02	0.20	554
1999	471	0.02	0.19	530
2000	550	0.02	0.22	619
2001	518	0.02	0.21	583
2002	503	0.02	0.20	566
2003	535	0.02	0.19	595
2004	592	0.02	0.18	650
2005	811	0.02	0.21	876
2006	977	0.03	0.23	1 047
2007	1 052	0.03	0.22	1 120
2008	1 152	0.03	0.22	1 221
Trend 1990-2008	*351%*	*101%*	*143%*	*330%*

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

Methodological Issues

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.

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 49: Implied emission factors and activities for industrial off-road traffic 1990–2008.

	Activity	**Implied Emission Factors**		
	TJ	**CO_2 t/TJ**	**CH_4 kg/TJ**	**N_2O kg/TJ**
1990	3 455	74.02	3.91	26.07
1991	3 904	74.02	3.90	26.10
1992	4 136	74.02	3.89	26.12
1993	4 349	74.02	3.88	26.13
1994	4 536	74.02	3.71	26.97
1995	4 817	73.85	3.61	27.43
1996	5 991	73.85	3.43	28.49
1997	5 675	73.85	3.41	28.73
1998	6 673	73.85	3.31	29.26
1999	6 393	73.68	3.28	29.39
2000	7 467	73.68	3.22	29.73
2001	7 028	73.68	3.22	29.79
2002	6 830	73.68	3.11	29.21
2003	7 259	73.68	2.69	26.78

	Activity	Implied Emission Factors		
	TJ	CO_2 t/TJ	CH_4 kg/TJ	N_2O kg/TJ
2004	8 041	73.68	2.48	22.80
2005	11 011	73.69	2.08	18.77
2006	13 262	73.66	1.93	17.01
2007	14 278	73.66	1.81	15.35
2008	15 642	73.66	1.73	13.97

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 50 to Table 53. These implied emission factors represent emissions according to the engine power output and also fuel consumption.

Table 50: Implied emission factors for diesel engines > 80 kW.

Year	CO_2	CH_4	N_2O
	[t/TJ]	[kg/TJ]	
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 51: Implied emission factors for diesel engines < 80 kW.

Year	CO_2	CH_4	N_2O
	[t/TJ]	[kg/TJ]	
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 52: Implied emission factors for 4-stroke-petrol engines.

Year	CO_2	CH_4	N_2O
	[t/TJ]	[kg/TJ]	
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 53: Implied emission factors for 2-stroke-petrol engines.

Year	CO_2 [t/TJ]	CH_4 [kg/TJ]	N_2O
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

Recalculations

Activity data for mobile machineries (especially for mobile machineries in the off-road industry sector) was up-dated for the whole time series following the revised national energy balance. The recalculation resulted in a higher activity of mobile machineries in industry compared to the previous estimate.

Planned improvements

As soon as new studies about non-road fuel consumption and pollutant emissions are available, input data for the off-road traffic is updated and recalculated with the model GEORG.

3.2.7.10 1.A.3.a Civil Aviation

Key Source: Yes (CO_2)

Greenhouse gas emissions from aviation are low in comparison to total emissions from the transport sector, but show a strong increase of 118% from 1990 to 2008. 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 54: CO_2 and N_2O emissions from 1 A 3 a Civil Aviation by subcategories 1990–2008.

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	223	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

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]
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
2008	22.2	8.3	39.3	0.0021	0.0012	305	114	540

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

For the years 2000-2008 the CORINAIR Tier 3a 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.

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

For the years 2000-2008 fuel consumption for the different transport modes IFR national LTO, IFR international LTO, IFR national cruise and IFR international cruise was calculated according to the CORINAIR Tier 3a method, with average consumption data per aircraft typs and flight distances. The fuel consumption of IFR international cruise was adjusted as explained above. The number of flight movements per aircraft type was 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.

Table 55: Number of national IFR LTO cycles and fuel consumptions as obtained from the MEET model 1990–2008.

	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
2008	7 039	2 630	12 475	20 741
Trend 1990-2008	*122%*	*6%*	*177%*	*233%*

Emission factors

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 the 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 refer 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).

Quality Assurance and Quality Control (QA/QC)

In order to give explanations on how the consistency of the time-series from 1990 to 2008 is ensured when performing recalculations the year 2000 is taken as an example. The following table provides an overview of fuel consumption in the aviation sector in the year 2000, once calculated with the CORINAIR Tier 3b methodology (old methodology used up to 2008) and once calculated with the CORINAIR Tier 3a methodology which is the new method applied in 2008.

It is evident that numbers are not strongly deviating from each other and that differences are within the expected range. However, the independent estimate based on a different methodology makes the results overall more robust.

Table 56: Methodology dependent calculation of fuel consumption in 2000 from 1 A 3 a Civil Aviation.

Year 2000	**Fuel**				
	dom. LTO	**dom. LTO**	**dom. cruise**	**dom. LTO**	**dom. cruise**
	Gasoline [Mg]	**Kerosene [Mg]**	**Kerosene [Mg]**	**Kerosene [Mg]**	**Kerosene [Mg]**
CORINAIR Tier 3b methodology	2 039	13 613	6 868	17 161	61 641
CORINAIR Tier 3a methodology	2 039	12 310	6 109	13 178	66 708
Deviation	0.0%	-9.6%	-11.0%	-23.2%	8.2%

Recalculations

Update of national/international fuel consumption data resulting in a recalculation of CO_2, CH_4 and N_2O emissions from 2000 to 2008 according to the bottom up CORINAIR Tier 3a method.

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

Planned improvements

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

3.2.7.11 1.A.3.b Road Transport

Key Source: Yes (CO_2: diesel/gasoline)

Emissions from road transportation are covered in this category.

Table 57: Greenhouse gas emissions from Category 1 A3 b Road Transport 1990-2008.

	CO_2 [Gg]	**CH_4 [Gg]**	**N_2O [Gg]**	**Gg CO_2 equivalent**
1990	13 283	3.04	0.56	13 519
1991	14 760	3.33	0.69	15 043
1992	14 735	3.34	0.71	15 025
1993	14 873	3.34	0.74	15 172
1994	14 912	3.29	0.78	15 223
1995	15 178	3.08	0.79	15 489
1996	16 728	2.79	0.81	17 039
1997	15 748	2.50	0.80	16 048
1998	17 717	2.42	0.90	18 048
1999	17 098	2.12	0.87	17 413
2000	17 998	1.92	0.90	18 319
2001	19 335	1.78	0.93	19 661
2002	21 421	1.71	1.01	21 771
2003	23 181	1.58	1.05	23 539
2004	23 691	1.41	1.02	24 038
2005	24 021	1.26	0.99	24 355

	CO_2 [Gg]	CH_4 [Gg]	N_2O [Gg]	Gg CO_2 equivalent
2006	22 614	1.10	0.92	22 921
2007	22 807	0.98	0.87	23 097
2008	21 411	0.84	0.77	21 667
Trend 1990-2008	*61%*	*-72%*	*39%*	*60%*

Table 58: GHG emissions from Road Transport, differentiated by means of transportation 1990-2008.

	Passenger cars		**light duty vehicles**	**heavy duty vehicles**	**moped**	**motorcycle**
	petrol	**diesel**				
	[Gg CO_2e]	**[Gg CO_2e]**	**[Gg CO_2e]**	**[Gg CO_2e]**	**[Gg CO_2e]**	**[Gg CO_2e]**
1990	7 442	1 397	1 309	3 306	31	34
1991	8 277	1 652	1 353	3 696	29	37
1992	7 932	1 742	1 395	3 889	27	41
1993	7 629	1 866	1 417	4 188	26	45
1994	7 374	2 076	1 472	4 225	25	50
1995	7 141	2320	1 493	4 454	24	57
1996	6 596	2 537	1 511	6 308	23	64
1997	6 251	2 834	1 546	5 326	22	70
1998	6 592	3 314	1 589	6 453	22	78
1999	6 116	3 529	1 640	6 021	21	86
2000	5 920	3 849	1 688	6 749	20	91
2001	5 987	4 341	1 701	7 517	20	96
2002	6 495	5 150	1 697	8 310	19	100
2003	6 663	5 862	1 716	9 175	18	104
2004	6 482	6 361	1 741	9 329	18	107
2005	6 276	6 696	1 788	9 467	18	110
2006	6 013	6 698	1 809	8 274	17	111
2007	5 863	6 971	1 866	8 265	17	115
2008	5 258	6 769	1 822	7 685	16	117
Trend 1990-2008	*-29%*	*385%*	*39%*	*132%*	*-47%*	*239%*

In 2008, half of the greenhouse gas emissions are caused by passenger cars (petrol and diesel) and approximately one third by heavy duty vehicles. In comparison with the emissions of 1990 the emissions of diesel cars have nearly quadrupled.

Methodological Issues

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

- Total gasoline and diesel consumption of the area under consideration
- 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 9 shows a schematic picture of the methodology of GLOBEMI.

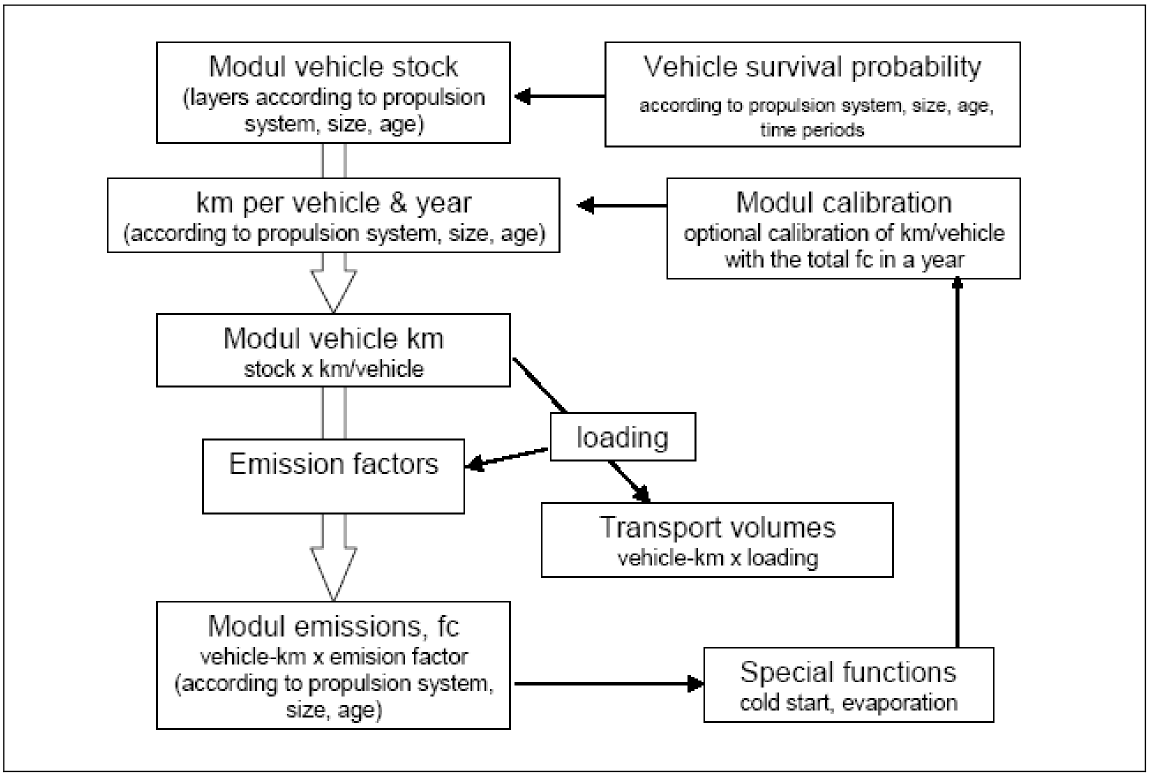

Figure 9: Schematic picture of the GLOBEMI model.

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.

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

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)

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

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

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

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

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

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

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

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).

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.

Since 2005 biogenic fuel (biodiesel, bioethanol, plant oil) has been used in the Austrian road transport sector. Biodiesel and bioethanol are mainly used for blending fossil fuels, whereas plant oil is distributed in pure form. For the year 2008 a consumption of 406 000 tons of biodiesel and 85 000 tons of bioethanol (for blending with gasoline) is used as input data for the calculation model based on the results of investigations on biodiesel in the transport sector in Austria (UMWELTBUNDESAMT 2009).

In 2008 there was an energetic substitution of 5.5% by biofuels in the road transport sector. Compared to 2005, the first year of blending biofuels, the substitution amounted to only 0.8% (UMWELTBUNDESAMT 2006, UMWELTBUNDESAMT 2009)

The following table gives an overview of the use of biofuels and the corresponding amount of substituted CO_2 emissions in the road transport sector between 2008 and 2005, the first year of blending biofuels in Austria.

Table 59: Substitution of CO_2 emissions in 1.A.3.b Road Transport through the use of biofuels in absolute figures 2005–2008.

	passenger cars	**light duty vehicles**	**heavy duty vehicles**
	[Gg CO_2]	**[Gg CO_2]**	**[Gg CO_2]**
2005	84	20	119
2006	326	81	406
2007	430	96	452
2008	631	111	479
Trend 2005-2008	*654%*	*445%*	*303%*

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 60: Implied emission factors of passenger cars 1990–2008.

	Activity	**Implied Emission Factors**		
		CO_2	**CH_4**	**N_2O**
	TJ	**T/TJ**	**kg/TJ**	**kg/TJ**
1990	116 425	74.31	18.87	3.91
1991	130 513	74.30	19.40	4.42
1992	126 998	74.30	20.27	4.68
1993	124 522	74.28	21.03	4.95
1994	123 774	74.26	21.09	5.31
1995	123 987	74.22	19.64	5.40
1996	119 746	74.20	18.01	5.47
1997	119 233	74.14	16.19	5.53
1998	129 998	74.12	14.32	5.73
1999	126 776	74.04	12.70	5.72
2000	128 475	74.02	11.16	5.77
2001	136 029	73.99	9.64	5.60
2002	153 512	74.00	8.19	5.44
2003	165 372	73.98	6.95	5.21
2004	169 838	73.97	5.90	4.93
2005	171 833	73.94	5.03	4.69
2006	169 935	73.34	4.31	4.41
2007	171 760	73.37	3.67	4.12
2008	161 076	73.40	3.23	3.87

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 61: Implied emission factors of light duty vehicles 1990–2008.

	Activity	**Implied Emission Factors**		
		CO_2	**CH_4**	**N_2O**
	TJ	**T/TJ**	**kg/TJ**	**kg/TJ**
1990	17 456	74.16	13.91	1.78
1991	18 040	74.14	12.90	1.83
1992	18 606	74.13	11.95	1.89
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	21 306	73.92	5.80	1.80

	Activity	Implied Emission Factors		
		CO_2	CH_4	N_2O
	TJ	T/TJ	kg/TJ	kg/TJ
1999	22 043	73.77	4.94	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	3.16	1.63
2003	23 094	73.73	2.69	1.60
2004	23 444	73.73	2.25	1.56
2005	24 072	73.73	2.04	1.56
2006	24 405	73.61	1.75	1.55
2007	25 179	73.62	1.46	1.51
2008	24 585	73.63	1.13	1.46

Table 62: Implied emission factors of heavy duty vehicles 1990–2008.

	Activity	CO_2	CH_4	N_2O
	TJ	T/TJ	kg/TJ	kg/TJ
1990	44 344	74.02	2.19	1.57
1991	49 575	74.02	2.07	1.55
1992	52 170	74.02	1.96	1.53
1993	56 194	74.02	1.87	1.52
1994	56 699	74.02	1.83	1.47
1995	59 920	73.85	1.77	1.43
1996	84 886	73.85	1.58	1.41
1997	71 672	73.85	1.52	1.39
1998	86 855	73.84	1.38	1.37
1999	81 232	73.67	1.30	1.35
2000	91 067	73.67	1.22	1.34
2001	101 450	73.67	1.15	1.30
2002	112 177	73.67	1.10	1.25
2003	123 878	73.67	1.05	1.20
2004	125 971	73.67	1.04	1.17
2005	127 825	73.68	1.03	1.16
2006	111 745	73.67	1.05	1.14
2007	111 644	73.67	1.04	1.10
2008	103 830	73.67	1.04	1.06

Table 63: Implied emission factors of mopeds 1990–2008.

	Activity	CO_2	CH_4	N_2O
	TJ	T/TJ	kg/TJ	kg/TJ
1990	277	74.37	1 753	0.68
1991	259	74.36	1 736	0.67
1992	248	74.36	1 681	0.65
1993	237	74.35	1 635	0.63
1994	230	74.34	1 574	0.61
1995	224	74.35	1 510	0.59
1996	219	74.35	1 444	0.56
1997	215	74.27	1 381	0.54
1998	213	74.27	1 308	0.51
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	183	73.01	857	-
2008	181	73.06	812	-

Table 64: Implied emission factors of motorcycles 1990–2008.

	Activity	CO_2	CH_4	N_2O
	TJ	T/TJ	kg/TJ	kg/TJ
1990	456	74.,37	35.3	0.877
1991	487	74.36	34.9	0.822
1992	541	74.36	34.4	0.739
1993	599	74.35	33.7	0.835
1994	670	74.34	33.1	0.896
1995	760	74.35	32.5	0.790
1996	844	74.35	31.9	0.830
1997	927	74.27	31.4	0.863
1998	1 036	74.27	30.9	0.869
1999	1 148	74.26	30.4	0.871
2000	1 213	74.26	29.8	0.824
2001	1 274	74.22	29.1	0.864
2002	1 337	74.27	28.6	0.898
2003	1 387	74.27	27.8	0.865
2004	1 426	74.27	27.2	0.842
2005	1 466	74.21	26.6	0.887
2006	1 508	72.97	25.7	0.862
2007	1 555	73.01	25.0	0.836
2008	1 578	73.06	24.7	0.824

Quality Assurance and Quality Control (QA/QC)

Quality management for input data of 1.A.3.b Road Transport is implemented by carrying out the following checklist after receipt of input data:

- ✓ 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 calculation units!
- ✓ Check of plausibility of results (time-series order of magnitude)!
- ✓ Are all references clearly made?
- ✓ Are all assumptions documented?

Uncertainty Assessment

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.

Recalculations

An update of statistical energy data, particularly the energy consumption for mobile machineries in 1.A.2.f c shows that more fuel is used by off-road vehicles. As the overall fuel consumption is a fixed value, this increase in fuel consumption had to be counterbalanced by a decrease of fuel export ("fuel tourism) on the road.

Adaptation of the specific CO_2 emissions factors of passenger cars according to the national CO_2-monitoring data.

The following improvements were accomplished:

Transport biofuels: Consumption and CO_2 emissions from pure and blended biofuels are now reported under biomass in categories 1.A.2.f, 1.A.3.b, 1.A.4.b, 1.A.5. Therefore the implied CO_2-emission factors of "diesel oil" and "liquid fuels" reflect pure fossil fuels.

Petrol IEF: For 1990 to 1991 the net calorific value (NCV) and fuel consumption of petrol has been revised (increased) by means of the 1992 value. This does not imply changes in emissions but improves time series consistency of the CO_2 implied emission factor which has been flagged as an outlier by the ERT.

3.2.7.12 1.A.3.c Railways

Key Source: No

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

Table 65: Greenhouse gas emissions from Category 1 A 3 c Railways 1990-2008.

	CO_2 [Gg]	CH_4 [Gg]	N_2O [Gg}
1990	178	0.01	0.06
1991	163	0.01	0.06
1992	162	0.01	0.05
1993	158	0.01	0.05
1994	159	0.01	0.05
1995	149	0.01	0.05
1996	134	0.01	0.05
1997	133	0.01	0.05
1998	131	0.01	0.05
1999	135	0.01	0.05
2000	135	0.01	0.05
2001	130	0.01	0.05
2002	141	0.01	0.05
2003	141	0.01	0.05
2004	140	0.01	0.05
2005	162	0.01	0.06
2006	164	0.01	0.06
2007	157	0.01	0.06
2008	165	0.01	0.06
Trend 1990-2008	*-7.5%*	*-21.2%*	*-1.7%*

The applied methodology is described in the subchapter on mobile sources of *1 A 2 f* (see 3.2.7.9. Activities used for estimating the emissions and the implied emission factors are presented in the following table.

Table 66: Emission factors and activity data for railway 1990–2008.

	Activity	Implied Emission Factors		
		CO_2	CH_4	N_2O
	TJ	T/TJ	kg/TJ	kg/TJ
1990	2 385	74.63	3.77	25.24
1991	2 187	74.62	3.75	25.27
1992	2 169	74.65	3.75	25.27
1993	2 115	74.61	3.73	25.34
1994	2 134	74.59	3.71	25.46
1995	1 995	74.49	3.69	25.46
1996	1 804	74.55	3.68	25.51
1997	1 795	74.25	3.61	25.91
1998	1 769	74.21	3.58	26.06

	Activity	Implied Emission Factors		
		CO_2	CH_4	N_2O
	TJ	T/TJ	kg/TJ	kg/TJ
1999	1 830	74.03	3.55	26.15
2000	1 826	73.97	3.51	26.32
2001	1 758	73.89	3.47	26.55
2002	1 902	73.91	3.38	26.56
2003	1 908	73.86	3.30	26.48
2004	1 899	73.73	3.22	26.45
2005	2 194	73.73	3.20	26.46
2006	2 222	73.72	3.25	27.05
2007	2 125	73.72	3.21	26.76
2008	2 234	73.72	3.17	26.50

Recalculations

Activity data was updated and updated emission factors have been used.

3.2.7.13 1.A.3.d Navigation

Key Source: No

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

Table 67: Greenhouse gas emissions from Category 1 A 3 d Navigation 1990-2008

	CO_2 [Gg]	CH_4 [Gg]	N_2O [Gg]
1990	34	0.008	0.009
1991	28	0.008	0.007
1992	27	0.008	0.006
1993	27	0.008	0.006
1994	36	0.008	0.010
1995	42	0.008	0.012
1996	43	0.008	0.012
1997	43	0.008	0.012
1998	48	0.008	0.014
1999	47	0.008	0.014
2000	50	0.008	0.015
2001	53	0.008	0.016
2002	56	0.008	0.017
2003	49	0.008	0.015
2004	19	0.006	0.004
2005	12	0.005	0.001
2006	24	0.006	0.006
2007	33	0.006	0.009
2008	35	0.006	0.010
Trend 1990-2008	*2%*	*-27%*	*11%*

The applied methodology is described in the subchapter on mobile sources of *1 A 2 f* (see 3.2.7.9). Activities used for estimating the emissions and the implied emission factors are presented in the following table.

Table 68: Emission factors and activity data for the sector Navigation 1990–2008.

	Activity	Implied Emission Factors		
		CO_2	CH_4	N_2O
	TJ	T/TJ	kg/TJ	kg/TJ
1990	463	74.09	17.94	19.09
1991	382	74.10	20.85	17.72
1992	362	74.11	21.72	17.30
1993	360	74.11	21.75	17.29
1994	486	74.09	16.87	19.63
1995	566	73.95	14.76	20.60
1996	587	73.94	14.11	20.92
1997	586	73.93	13.90	21.03
1998	653	73.92	12.63	21.69
1999	639	73.78	12.60	21.69
2000	684	73.78	11.82	22.14
2001	719	73.76	11.20	22.51
2002	761	73.77	10.54	22.78
2003	662	73.78	11.39	22.10
2004	255	73.94	23.61	14.91
2005	161	74.09	33.89	8.49
2006	322	73.40	17.93	17.76
2007	454	73.49	13.15	20.33
2008	475	73.51	12.70	20.59

Recalculations

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

Planned Improvements

As the split between national and international fuel sold in the navigation sector on the river Danube in Austria has been examined in Chapter International Bunkers (3.2.2.1), no further improvements are planned at the moment.

3.2.7.14 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 0.9% for the year 2008. 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 2009) 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 69.

Table 69: 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

Recalculations

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

3.2.7.15 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 18.6% for the year 2008.

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 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 17% for the year 2008.

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 2009) 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, 1999/2000, 2004, 2006 and 2008 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. Because the newest census data is always reconsidered to improve previous years census data evaluation this implies a periodic recalculation in time series.

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. 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 70: 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 2008 are presented in Table 71.

Table 71: Emission factors of Category 1.A.4 conventional boilers for the year 2008.

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)	141.23	184.81	3–5	7.00
Wood Waste	110.00 1)	16.77	184.81	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 72) are derived from conventional boiler emission factors with the ratio of conventional boiler and new biomass heatings NMVOC emission factors:

$$EF(CH_4)_{\text{new biomass}} = EF(CH_4)_{\text{conventional}} * EF(NMVOC)_{\text{new biomass}}/EF(NMVOC)_{\text{conventional}}$$

Table 72: 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 2009) as presented in Annex 4.

Since (IEA JQ 2009) 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 2009).

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 73 shows the selected share of each heating type for category *1.A.4.b.*

Table 73: Share of 1.A.4.b heating type on fuel category for the year 2008.

	Central Heating	**Appartement Heating**	**Stove**
Hard Coal	77%	6%	17%
Brown Coal			
Brown Coal Briquettes			
Coke			
Gas oil	94%	3%	3%
Residual Fuel Oil, Gas Works Gas, LPG, Petroleum	100%	–	–
Natural Gas	56%	41%	4%
Fuel Wood	76%	5%	19%
Wood Chips, Pellets, other solid biomass	89%	3%	8%

The following table shows biomass boiler sales from 2000 which are considered with lower CO, NMVOC and CH_4 emissions than equipment installed before 2000. The accumulated consumption in 2008 is 32.5 PJ which is 48% of total biomass consumption of *1.A.4.b residential*. The average yearly consumption is calculated by average consumption per household. In case of boilers it is assumed that a building contains 2.12 households which are heated by a single boiler. The selected factors are derived from the 2008 household census.

Table 74: Number of biomass boiler sales 2000-2008 and fuel consumption estimate.

Year	Pellet boilers	Pellet stoves	Wood chip boilers	Log wood boilers
2000	3 466	-	-	-
2001	4 932	-	2 645	5 364
2002	4 492	997	2 615	4 276
2003	5 193	1 827	2 890	4 144
2004	6 077	3 245	3 224	4 555
2005	8 874	3 780	4 509	6 078
2006	10 467	5 640	4 726	6 937
2007	3 915	1 750	3 578	4 835
2008	11 101	3 045	4 096	7 405
Accumulated total	**58 517**	**20 284**	**28 283**	**43 594**
Avg. yearly consumption per boiler or stove [GJ]	203	48	331	236
Total Consumption of new boilers 2008 [TJ]	11 885	974	9 354	10 268

Figure 10 shows activity data of *1.A.4.b Residential (without mobile machinery)* by type of fuel together with the correlating heating degree days of the heating period January to April and November to December for the years 1990 to 2008.

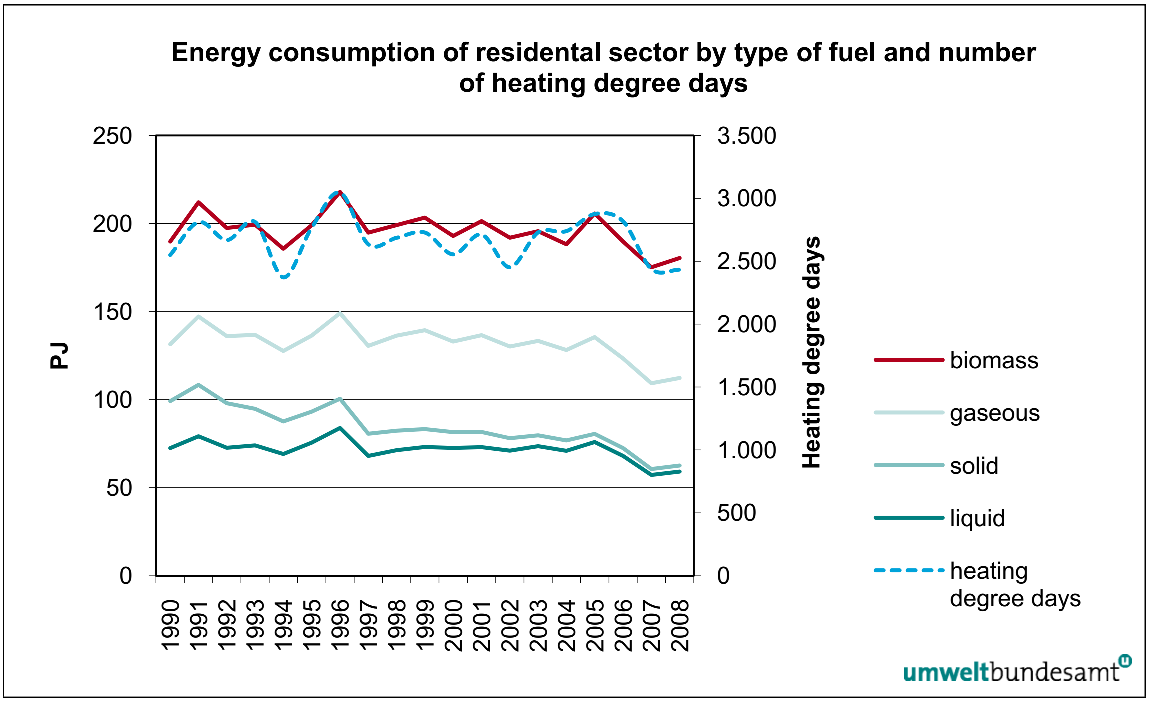

Figure 10: Energy consumption [PJ] of residential sector by type of fuel and number of heating degree days 1990–2008.

Recalculations

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

Recalculations affect activity data 1999 to 2007 which mainly implies changes in CO_2 emissions for natural gas 1999 (-129 Gg CO_2) to 2007 (-296 Gg CO_2), solid fuels 2007 (-111 Gg CO_2). Gasoil has been shifted between years 2003 and 2005 to 2007 to consider end consumer stock changes.

Biomass consumption has been revised from 2001 to 2007 (-4.6 PJ which is -6%)

Update of heating type split from 2001 according to the 2008 household census evaluation. This affects calculation of CH_4, CO, NMVOC, NO_X and other non-GHG emissions from residential heating. New census data evaluation carried out by STATISTIK AUSTRIA indicate less fuel use in biomass stoves which implies lower CH_4 emissions.

Implication of change in reporting the share of biodiesel in blended diesel: Activity data and CO_2 emissions of biodiesel is now reported as biomass and implies lower IEFs for biomass and higher IEFs for liquid fuels for CH_4 and N_2O.

1.A.4 Other sectors – mobile sources

1.A.4.b Household and Gardening

Key Source: No

The applied methodology is described in the subchapter on mobile sources of 1 A 2 f (see 3.2.7.9). Activities used for estimating the emissions and the implied emission factors are presented in Table 76.

Table 75: Greenhouse gas emissions from mobile sources of household and gardening 1990–2008.

	CO_2 [Gg]	CH_4 [Gg]	N_2O [Gg]
1990	144	0.06	0.02
1991	145	0.06	0.02
1992	146	0.07	0.02
1993	147	0.07	0.02
1994	145	0.06	0.03
1995	146	0.06	0.03
1996	144	0.06	0.03
1997	143	0.06	0.03
1998	142	0.06	0.03
1999	142	0.05	0.03
2000	142	0.05	0.03
2001	142	0.05	0.03
2002	142	0.05	0.02
2003	141	0.05	0.02
2004	141	0.05	0.02
2005	139	0.05	0.02
2006	136	0.04	0.02
2007	133	0.04	0.02
2008	130	0.04	0.02
Trend 1990-2008	*144*	*0.06*	*0.02*

Table 76: Emission factors and activity data for mobile sources of household and gardening 1990–2008.

	Activity	**Implied Emission Factors**		
		CO_2	**CH_4**	**N_2O**
	TJ	**T/TJ**	**kg/TJ**	**kg/TJ**
1990	1 945	74.21	33.26	12.22
1991	1 950	74.21	33.28	12.21
1992	1 967	74.21	33.16	12.28
1993	1 978	74.20	33.07	12.34
1994	1 957	74.20	33.02	12.81
1995	1 963	74.13	31.83	13.21
1996	1 948	74.12	31.01	13.15
1997	1 930	74.08	30.16	13.24
1998	1 914	74.08	29.27	13.34
1999	1 912	74.00	28.38	13.41
2000	1 913	74.00	27.57	13.53
2001	1 917	73.98	26.94	13.61
2002	1 912	74.01	26.31	12.13
2003	1 907	74.01	26.13	11.99
2004	1 909	74.01	25.57	10.45
2005	1 880	73.98	24.31	10.21
2006	1 850	73.27	23.04	9.96
2007	1 819	73.30	21.68	9.20
2008	1 768	73.32	20.45	8.92

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

Table 77: Greenhouse gas emissions for mobile sources of Agriculture and Forestry 1990-2008.

	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	730	0.04	0.25	91	0.02	0.03
2007	724	0.04	0.24	100	0.03	0.03
2008	734	0.04	0.24	101	0.03	0.03
Trend 1990-2008	*7%*	*-23%*	*3%*	*20%*	*2%*	*15%*

Table 78: Emission factors and activity data for mobile sources of Agriculture and Forestry 1990–2008.

	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	9 272	74.0	5.1	24.8	1 135	74.1	22.7	20.6
1991	9 303	74.0	5.1	24.8	1 063	74.1	18.6	21.7
1992	9 375	74.0	5.0	24.9	1 085	74.1	19.3	21.6
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	10 196	73.7	3.9	25.8	1 216	73.8	17.7	21.9
2006	9 908	73.7	3.9	25.7	1 232	73.5	19.5	21.1
2007	9 836	73.7	3.8	24.8	1 361	73.5	19.2	20.4
2008	9 962	73.7	3.6	23.8	1 377	73.5	19.1	19.7

Recalculations

Activity data for mobile machineries for the whole time series was updated following the revised national energy balance.

3.2.7.16 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 79: Greenhouse gas emissions from military aviation 1990-2008.

	CO_2 [Gg]	CH_4 [Gg]	N_2O [Gg]
	military Kerosene	**military Kerosene**	**military Kerosene**
1990	33	0.0011	0.0021
1991	35	0.0011	0.0022
1992	32	0.0010	0.0020
1993	37	0.0012	0.0024
1994	39	0.0013	0.0025
1995	30	0.0010	0.0019
1996	37	0.0012	0.0023
1997	35	0.0011	0.0021
1998	40	0.0013	0.0024
1999	40	0.0013	0.0023
2000	39	0.0013	0.0024
2001	39	0.0013	0.0025
2002	40	0.0013	0.0025
2003	40	0.0013	0.0025
2004	41	0.0013	0.0026
2005	42	0.0014	0.0026
2006	42	0.0014	0.0026
2007	43	0.0014	0.0027
2008	43	0.0014	0.0027

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).

CH_4 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 2008 are an extrapolation of the trend between 1990 and 1999.

Planned 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 3.2.7.9).

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 (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 80: Greenhouse gas emissions from Military (Off-Road without Aviation) 1990-2008.

	CO_2 [Gg]	CH_4 [Gg]	N_2O [Gg]	Activity [TJ]
1990	2.12	0.00010	0.0008	28.7
1991	2.12	0.00010	0.0008	28.6
1992	2.12	0.00010	0.0008	28.6
1993	2.12	0.00010	0.0008	28.5
1994	2.12	0.00009	0.0008	28.5
1995	2.12	0.00009	0.0008	28.3
1996	2.12	0.00009	0.0008	28.1
1997	2.12	0.00008	0.0008	27.9
1998	2.12	0.00008	0.0008	27.7
1999	2.12	0.00008	0.0008	27.6
2000	2.12	0.00008	0.0008	27.5
2001	2.12	0.00008	0.0008	27.4
2002	2.12	0.00007	0.0008	27.3
2003	2.11	0.00007	0.0008	27.2
2004	2.11	0.00006	0.0008	27.2
2005	2.09	0.00006	0.0007	26.8
2006	2.08	0.00005	0.0006	25.9
2007	2.06	0.00004	0.0006	25.8
2008	2.05	0.00004	0.0005	25.7
Trend 1990-2008	*-4%*	*-60%*	*-37%*	*-10%*

3.2.8 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), implied emissions factors 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

3.2.9 Uncertainties and time series consistency

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 81. For transport, the respective factors are new and have been taken from an assessment of the overall transport GHG emissions (HAUSBERGER 2005).

Table 81: 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).

3.2.10 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 construction machinery fuel consumption. This leads to shifts from 1.A.3.b diesel to 1.A.2.f liquid fuels for the years 2005-2007 (+336 Gg CO_2).
- Improvements of reporting liquid bio fuels such as pure and blended biodiesel and ethanol fuel. From 2005 onwards activity data and CO_2 emissions from liquid bio fuels is now reported as biomass. This affects categories 1.A.2.f, 1.A.3.b, 1.A.4.b, 1.A.4.c and 1.A. 5. Therefore the implied CO_2-emission factors of "diesel oil" and "liquid fuels" reflect pure fossil fuels.
- Revised energy balance: From 1999 onwards revised domestic model. Shifts of gasoil oil gross inland consumption (revision of stock changes at end consumers) between the years 2003 and 2005 to 2007. Increase of low sulphur fuel oil gross inland consumption (revision of stock changes at end consumers) for the year 2001. Shift of natural gas consumption between almost all categories for the years 1999 to 2007. The shift of natural gas from final energy consumption to oil refinery use implies a shift of CO_2 emissions from 1.A.1.b - liquid fuels to 1.A.1.b - gaseous fuels for the years 2006 to 2007 and vice versa for the year 2005. From 1990 to 1998 minor shifts of biomass from public heat to autoproducers CHP plants.
- Improvement of time series consistency for gasoline IEFs: For 1990 to 1991 the net calorific value (NCV) and fuel consumption of gasoline has been revised (increased) by means of the 1992 value. This does not imply changes in emissions but improves time series consistency of the CO_2 implied emission factor which has been flagged as an outlier by the ERT.

More detailed figures are presented in Annex 2. The reasons for recalculations are explained in the relevant subchapters.

3.2.10.1 CO_2 emissions

Table 82 shows the recalculations of CO_2 emissions for the subcategories of sector *1.A Fuel Combustion.*

Table 82: 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	-18.60	0.00	-1.54	-17.07	0.00	0.00
1991	-19.64	0.00	-1.73	-17.91	0.00	0.00
1992	-20.22	0.00	-1.83	-18.39	0.00	0.00
1993	-20.63	0.00	-1.92	-18.71	0.00	0.00
1994	-20.29	0.00	-2.04	-18.25	0.00	0.00
1995	-19.86	0.00	-2.16	-17.70	0.00	0.00
1996	-19.40	0.00	-2.60	-16.80	0.00	0.00
1997	-19.05	0.00	-2.32	-16.73	0.00	0.00
1998	-18.65	0.00	3.15	-21.80	0.00	0.00
1999	-207.82	-193.07	121.54	-12.39	-123.90	0.00
2000	-159.96	-145.93	-19.47	-4.13	9.58	0.00
2001	128.08	-350.93	81.18	11.13	386.71	0.00
2002	11.90	-25.80	-32.97	24.72	45.95	0.00
2003	-228.21	-29.10	25.34	58.91	-283.36	0.00
2004	111.58	-201.26	-4.95	-75.06	392.85	0.00
2005	759.81	2.25	304.03	-368.70	822.22	0.00
2006	-911.79	-63.11	-22.56	-314.23	-511.88	0.00
2007	-197.51	-10.23	303.39	-402.63	-88.04	0.00

3.2.10.2 CH_4 emissions

Table 83 shows the recalculations of CH_4 emissions for the subcategories of sector *1.A Fuel Combustion.*

Table 83: 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	-0.03	0.00	0.00	-0.03	0.00	0.00
1991	-0.03	0.00	0.00	-0.03	0.00	0.00
1992	-0.03	0.00	0.00	-0.03	0.00	0.00
1993	-0.02	0.00	0.00	-0.02	0.00	0.00
1994	0.10	0.00	0.00	0.10	0.00	0.00
1995	0.10	0.00	0.00	0.10	0.00	0.00
1996	0.09	0.00	0.00	0.09	0.00	0.00

	1 A	1 A 1	1 A 2	1 A 3	1 A 4	1 A 5
1997	0.08	0.00	0.00	0.08	0.00	0.00
1998	0.08	0.00	0.00	0.08	0.00	0.00
1999	0.08	0.00	0.00	0.07	0.00	0.00
2000	0.06	0.00	0.00	0.06	0.01	0.00
2001	-1.19	-0.01	0.01	0.05	-1.25	0.00
2002	-2.17	0.00	0.00	0.05	-2.21	0.00
2003	-3.41	0.00	0.01	0.04	-3.46	0.00
2004	-3.70	0.00	0.03	0.03	-3.75	0.00
2005	-2.63	0.02	0.02	0.02	-2.70	0.00
2006	-3.83	0.00	-0.04	0.02	-3.82	0.00
2007	-2.43	0.01	-0.06	0.02	-2.40	0.00

3.2.10.3 N_2O emissions

Table 84 shows the recalculations of N_2O emissions for the subcategories of sector *1.A Fuel Combustion.*

Table 84: 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	0.01	-0.01	0.00	0.02	0.00	0.00
1991	0.01	-0.01	0.00	0.01	0.00	0.00
1992	0.01	-0.01	0.00	0.01	0.00	0.00
1993	0.01	-0.01	0.00	0.01	0.00	0.00
1994	0.02	-0.01	0.00	0.02	0.00	0.00
1995	0.02	-0.01	0.00	0.02	0.00	0.00
1996	0.01	0.00	0.00	0.02	0.00	0.00
1997	0.02	0.00	0.00	0.02	0.00	0.00
1998	0.02	0.00	0.00	0.02	0.00	0.00
1999	0.01	-0.01	0.00	0.02	0.00	0.00
2000	0.02	-0.01	-0.01	0.03	0.00	0.00
2001	-0.01	-0.01	0.00	0.03	-0.03	0.00
2002	-0.06	-0.01	-0.02	0.03	-0.06	0.00
2003	-0.09	-0.01	-0.02	0.03	-0.09	0.00
2004	-0.11	-0.01	-0.01	0.01	-0.09	0.00
2005	0.03	0.04	0.02	0.03	-0.07	0.00
2006	0.00	0.05	0.03	0.04	-0.11	0.00
2007	0.06	0.05	0.04	0.03	-0.06	0.00

3.2.10.4 Emissions in Gg CO_2 equivalent

Table 85 shows the recalculations in [Gg CO_2 equivalent] for the subcategories of sector *1.A Fuel Combustion.*

Table 85: 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	-16.06	-1.86	-1.17	-13.03	0.00	0.00
1991	-17.45	-1.87	-1.35	-14.23	0.00	0.00
1992	-18.51	-1.73	-1.52	-15.27	0.00	0.00
1993	-18.44	-1.74	-1.62	-15.07	0.00	0.00
1994	-12.39	-1.75	-1.84	-8.81	0.00	0.00
1995	-11.73	-1.77	-1.94	-8.02	0.00	0.00
1996	-13.83	-1.51	-3.09	-9.23	0.00	0.00
1997	-12.09	-1.04	-2.08	-8.97	0.00	0.00
1998	-11.25	-1.24	3.52	-13.53	0.00	0.00
1999	-204.38	-195.58	121.05	-5.30	-124.56	0.00
2000	-152.88	-148.18	-21.65	7.20	9.76	0.00
2001	100.31	-353.05	80.39	21.19	351.79	0.00
2002	-51.26	-28.45	-39.98	35.33	-18.17	0.00
2003	-327.41	-31.13	19.12	69.93	-385.34	0.00
2004	1.21	-204.81	-8.91	-70.02	284.94	0.00
2005	713.65	16.53	311.48	-359.46	745.10	0.00
2006	-991.26	-47.22	-15.26	-302.24	-626.54	0.00
2007	-230.75	5.08	313.68	-391.67	-157.85	0.00

3.2.11 Planned Improvements

At current no relevant improvements are planned.

3.3 Fugitive Emissions (CRF Category 1.B)

3.3.1 Source Category Description

In the year 2008 0.5% 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.

3.3.1.1 Emission Trends

Table 86 presents GHG emissions arising from this category, their share and trend from 1990 to 2008.

Table 86: Greenhouse gas emissions from Category 1 B Fugitive Emissions.

	GHG emissions [Gg CO_2 equivalent]		
	Total	**CO_2**	**CH_4**
1990	311.75	102.09	209.66
1991	318.77	111.09	207.68
1992	345.16	120.13	225.03
1993	339.23	112.13	227.11
1994	346.29	127.64	218.65
1995	352.72	127.15	225.57
1996	295.60	71.14	224.46
1997	346.40	120.63	225.77
1998	363.78	141.94	221.83
1999	380.76	170.65	210.11
2000	376.99	164.65	212.35
2001	392.94	182.85	210.08
2002	376.13	167.15	208.97
2003	444.09	233.15	210.93
2004	439.45	210.15	229.30
2005	439.52	205.15	234.37
2006	475.97	232.16	243.82
2007	489.26	237.16	252.10
2008	466.94	212.16	254.78
Share 2008	100%	45%	55%
Trend 1990-2008	50%	108%	22%

3.3.1.2 Completeness

Table 87 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 87: *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		IE1)	IE1)
1 B 2 a Oil			
i Exploration	0502 Extraction, 1st treatment and loading of liquid fossil fuels	IE2)	IE2)
ii Production		✓	✓
iii Transport	050502 Transports and Depots	IE2)	IE2)
iv Refining/Storage	0401 Processes in Petroleum Industries	NA3)	✓
v Distribution of oil products	0504 Liquid fuel distribution 0505 Petrol distribution	NA	NA4)
1 B 2 b Natural Gas			
i Exploration	0503 Extraction, 1st treatment and loading of gaseous fossil fuels	NA	IE2)
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		IE5)	IE6)

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*

3.3.2 Methodological issues

3.3.2.1 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 88). Coal mining was stopped in 2007, thus the overall trend from the base year to 2008 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[29]). 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 88: Activity data (brown coal produced) and CH_4 emissions for Fugitive Emissions from Fuels – Coal Mining 1990–2008.

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
2008	NO	NO

3.3.2.2 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.

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[29] http://www.ipcc-nggip.iges.or.jp/EFDB/main.php

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..

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 89).

Methane emissions for the years 1992 to 2008 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 89: Activity data (Crude Oil Refined and Gas Produced, respectively) and emissions for Fugitive Emissions from Fuels – Oil Refining and Production 1990–2008.

	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
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	4.10	2.10	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	2.60	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	8 496	0.27	1 848	5.62	3.04	142	77
2008	8 710	0.28	1 532	5.51	3.59	135	88

3.3.2.3 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 category because of the qualitative criteria applied (see chapter 1.5.1). In 2008 fugitive CH_4 emissions from natural gas contributed 0.2% 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.

CH_4 emissions increased between 1990 and 2008 by 37%, due to extension of the pipeline network and storage sites. Although the natural gas distribution network has been equally extended, CH_4 emissions from this source have been decreasing due to replacement of old pipelines made of cast iron by pipelines made of plastics.

Sour Gas Processing

CO_2 emissions from natural gas production (sour gas processing) are reported by the *Association of the Austrian Petroleum Industry* and were calculated from sour gas composition. Activity data for natural gas production are reported by the *Association of the Austrian Petroleum Industry*.

Distribution, Transmission (pipelines) and Storage

Detailed information on fugitive CH_4 emissions from natural gas distribution and storage has been collected in a national study for the year 1999 (Life Cycle Inventory Austria 2000 – Review). In this study emissions are calculated for each transport system, for each storage site and for each distribution system. The study accounts for the different emission sources, with the respective emission factors.

Fugitive CH_4 emissions from storage mainly result from storage sensors, compressors, separators and venting. As the information on these emissions is limited to the year 1999 and no detailed information could be collected for the other years, a country-specific emission factor was developed based on the bottom-up emission calculation. These emissions were then divided by the mean value of the annual amount of gas injection and withdrawal. This activity was given as reference in the national study and was considered to be appropriate as emissions are directly related to the amount of gas handled. The developed EF equals to 541.5 kg CH_4 per Mm^3 natural gas. This emission factor was then applied to the respective mean value of the annual amount of gas injection and withdrawal for all years, thus the method applied equals to Tier 2 methodology. The activity data was obtained 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).

Fugitive CH_4 emissions from transmission (pipelines) mainly result from connections, venting and accidental releases. Fugitive emissions due to diffusion through pipeline material are small, because in Austria the material used is nearly 100% insulated steel. Detailed information on the main emission sources could be obtained for 1999, thus the same approach as for storage emissions was chosen, applying a Tier 2 approach for emission calculation. The country-specific emission factor was developed using the emissions calculated in the detailed bottom-up approach and relating them to the total length of the pipeline system. The developed EF equals to 475 kg CH_4 per km pipeline and year. The annual pipeline length was provided by the Austrian Natural Gas and District Heat Association and equals to pipelines working under high and medium pressure.

The natural gas distribution system consists of pipelines working under low pressure. Fugitive emissions from natural gas distribution mainly result from diffusion and emission factors largely depend on the pipeline material, see Table 90. Small emission sources are also connections to dwellings, pressure regulating valves and accidental releases.

Emissions were calculated applying a Tier 3 approach. Specific distribution pipeline lengths separated by material were provided by the Austrian Natural Gas and District Heat Association for all years and the bottom-up emission factors were developed with this information for each year.

Table 90 gives an overview of the development of the structure of the gas-distribution network since 1990. Specific annual information on the smaller emission sources, except connections to dwellings, mentioned above were not available, thus these emissions were kept constant. Nevertheless, the uncertainty introduced by this approach is small, because these small emission sources contribute by 5% or less to the total emissions from natural gas distribution in Austria.

Table 90: Structure of the gas distribution network

Gas distribution network	**Length of distribution network [km]**			**Change [%]**	**Emission factors [kg CH_4/km and year]**
Material	**1990**	**2000**	**2008**	**1990–2008**	
Insulated steel	2 881	3 760	3 613	+25%	25
Plastics (HDPE,PVC)	6 368	18 501	23 159	+264%	13
Ductile cast iron	2 213	1 720	1 547	-30%	701
Grey cast iron	210	118	29	-86%	1 402
Total	**11 672**	**24 099**	**28 348**	**+143%**	

Table 91: Activity data and emissions for Fugitive Emissions from Fuels – Natural Gas Distribution and Sour Gas Processing 1990–2008.

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	11 672	2.11	248 090	59
1991	12 700	2.05	285 901	68
1992	13 893	2.12	357 135	80
1993	15 178	2.07	321 653	75
1994	16 589	1.99	363 582	80
1995	17 778	1.96	405 638	89
1996	18 995	1.93	136 737	30
1997	20 219	1.86	406 177	89
1998	21 339	1.85	367 195	81
1999	22 701	1.83	352 318	81

Year	Natural Gas Distribution		Sour Gas Processing	
	Gas network [km]	CH_4 Emissions [Gg]	Sour Gas Prod. [1 000 m³]	CO_2 Emissions [Gg]
2000	24 099	1.81	358 357	93
2001	25 042	1.81	393 492	95
2002	24 216	1.76	347 513	83
2003	25 699	1.78	408 198	100
2004	26 158	1.69	373 099	88
2005	26 958	1.69	338 349	83
2006	27 413	1.67	402 990	92
2007	27 945	1.66	444 029	95
2008	28 348	1.64	372 406	77

Table 92: Activity data and emissions for Fugitive Emissions from Fuels – Natural Gas Transmission and Storage 1990–2008.

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	3 628	1.72	0.09	1 500	0.81
1991	3 696	1.76	0.09	1 500	0.81
1992	5 278	2.51	0.13	1 625	0.88
1993	5 265	2.50	0.13	1 980	1.07
1994	5 546	2.64	0.14	1 329	0.72
1995	5 972	2.84	0.15	1 820	0.99
1996	5 876	2.79	0.14	1 820	0.99
1997	5 924	2.81	0.15	1 820	0.99
1998	5 918	2.81	0.14	1 820	0.99
1999	6 052	2.88	0.15	1 172	0.63
2000	5 966	2.83	0.15	1 665	0.90
2001	6 213	2.95	0.15	1 132	0.61
2002	6 232	2.96	0.15	861	0.47
2003	6 243	2.97	0.15	1 574	0.85
2004	6 288	2.99	0.15	1 507	0.82
2005	6 290	2.99	0.15	1 828	0.99
2006	6 354	3.02	0.16	2 112	1.14
2007	6 495	3.09	0.16	2 530	1.37
2008	6 545	3.11	0.16	2 949	1.60

3.3.3 QA/QC

To validate the developed country-specific emission factors, they were compared with IPCC default factors (IPCC GPG, Table 2.16) and gas losses described in the 2006 IPCC Guidelines (Table 4.2.8).

For storage the developed emission factor lies within the range given in the IPCC GPG and results in slightly higher figures than the EF applied previously (low value of the range provided in Table 2.16). Emissions equal to 0.06% of the working gas capacity, which is classified as low (0.05%) in the 2006 IPCC GL.

For transmission the developed EF is lower than the range given in the IPCC GPG. Nevertheless, the gas losses of 675 m^3/km/a are classified between low (200) and medium (2000) in the 2006 IPCC GL.

For distribution the IEFs range between 5.8E-05 and 1.8E-04 Gg/km, this is lower than the range given in the IPCC GPG. The mean gas losses of 133 m^3/km/a are classified as low in the 2006 IPCC GL (100). Material specific emission factors of pipelines are neither provided in the IPPC GPG nor in the 2006 IPPC GL for comparison.

Based on the above described validation it was concluded that the developed country-specific EFs are reasonable.

3.3.4 Uncertainty

For the key category 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: Pipeline length (medium and high pressure) is provided by the Austrian Natural Gas and District Heat Association that collects these numbers directly from the operators. The associated uncertainty is assumed to be low (5%). The uncertainty of the country-specific EF is estimated to be very accurate for the year that was under investigation, but the uncertainty for other years is assumed to be higher (10%).

Storage: The amount of natural gas injected and withdrawn from the storage sites is well known (uncertainty 5%). For the uncertainty of the country-specific EF same assumption as for transmission was applied (uncertainty 10%).

Distribution: The length of distribution pipelines is directly obtained from the operators. Kilometres by material are provided, thus the uncertainty is considered to be low (4%). Emission factors are material specific and from international literature, thus the associated uncertainty is assumed to be low (7%).

This leads to the combined uncertainty (using the Tier 1 approach, with weights for the contribution to total source emissions) of 3% for AD, 5.8% for EF, resulting in a total uncertainty of emissions of 6.5%.

3.3.5 Recalculations

Methodological change

Methane emissions from natural gas distribution, transmission and storage were previously calculated applying a Tier 1 method using IPCC default EFs. Following a recommendation from the in-country review 2007 the method for calculating CH_4 emissions has been improved to Tier 2 and Tier 3. For the implementation of the higher tier methods country specific emission factors have been developed from national studies for the sub-categories storage and transmission. For the sub-category *gas distribution* that contributed more than 70 % to CH_4 emissions from 1.B.2.b in the last submission, a Tier 3 approach based on the annual composition of the distribution network materials has been developed.

There was also a shift in AD between transmission and distribution due to classification of pipelines (low, medium and high pressure).

The most significant change in emissions occurred for the sub-category *gas distribution*, because the previous method did not take into account different EFs for different pipeline material. Thus, the strong increase of emissions, reported previously was directly dependent on the strong increase of the total length of the distribution network and emissions have been highly overestimated. The national data that are now available show that for the extension of the distribution network insulated steel and plastics have been used and that a replacement of pipelines made of iron took place. These replacements lead to even lower emissions in 2008 compared to 1990, although the network length more than doubled in the same time.

Table 93: Recalculations of CH_4 emissions of 1.B.2.b by sub-category.

Year	**Difference between 2009 and 2010 submission [Gg CH_4]**			
	Storage	**Distribution**	**Transmission**	**Total**
1990	0.2	-7.2	-1.3	-8.3
1991	0.2	-8.0	-1.2	-9.1
1992	0.2	-8.8	-0.5	-9.1
1993	0.2	-9.6	-0.5	-9.9
1994	0.1	-10.8	-0.4	-11.0
1995	0.2	-11.8	-0.2	-11.7
1996	0.2	-12.5	-0.8	-13.1
1997	0.2	-13.3	-0.8	-13.9
1998	0.2	-14.0	-0.8	-14.6
1999	-0.1	-15.0	-1.1	-16.2
2000	0.2	-15.9	-1.1	-16.8
2001	0.1	-16.5	-1.0	-17.3
2002	0.1	-17.6	-1.0	-18.5
2003	0.1	-17.9	-1.2	-18.9
2004	0.1	-19.1	-1.2	-20.2
2005	0.0	-19.7	-1.2	-20.8
2006	-0.1	-20.1	-1.5	-21.7
2007	0.1	-20.3	-1.4	-21.6

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 2008.

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 101.

CO_2 emissions from glass production – previously reported in limestone, dolomite and soda ash use – are now reported in an aggregated manner under 2.A.7 – glass production. Furthermore, following a recommendation from the in-country review 2007, CO_2 emissions from uses of soda ash other than in glass industry have been reviewed, identified and included in the inventory for the whole time-series.

Also a new survey was conducted covering consumption and emissions in all sub-categories of *2.F. Consumption of Halocarbons and* SF_6. Following a recommendation from the in-country review 2007 special focus was given to emissions from manufacturing/installation and disposal. The results of this study were incorporated in the inventory and emissions of all gases and in all sectors have been revised for the whole time-series accordingly.

4.1.1 Emission Trends

In the year 2008, 13.7% of national total greenhouse gas emissions (without LULUCF) originated from industrial processes, compared to 12.9% 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 2008, greenhouse gas emissions from Category *2 Industrial Processes* amount to 11 870 Gg CO_2 equivalent compared to 10 111 Gg in the base year.

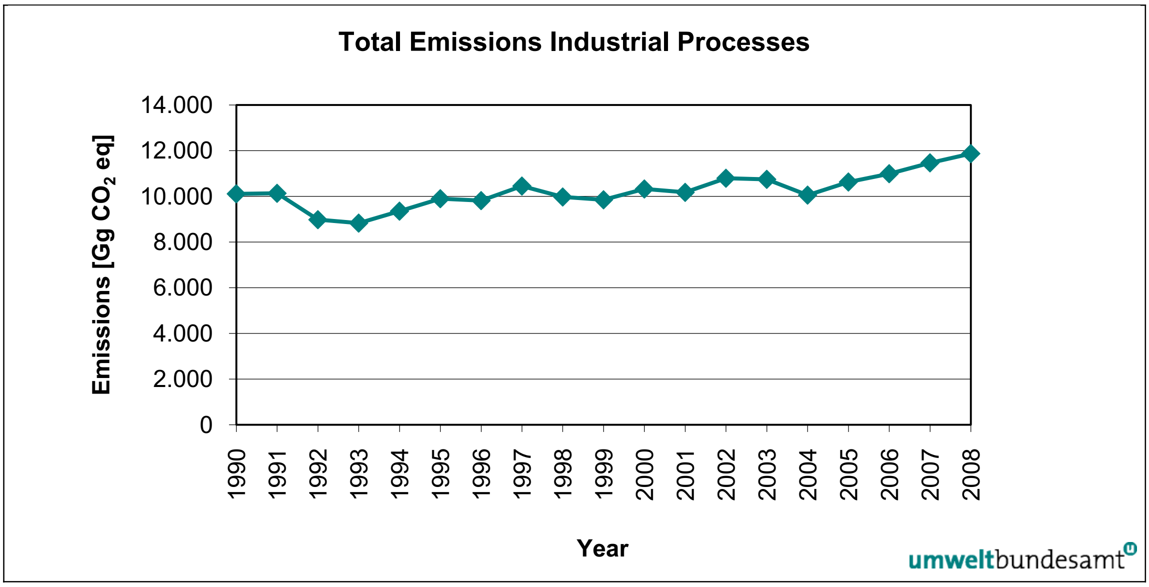

Figure 11: GHG emissions from IPCC Sector 2 Industrial Processes 1990–2008.

Emission trends by gas

The following table 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 2008.

Table 94: Greenhouse gas emissions from 2 Industrial Processes by gas in the base year and in 2008.

GHG	Base year*	2008	Base year*	2008
	CO_2 equivalent [Gg CO_2e]		[%]	
Total	10 110.94	11 870.01	*100%*	*100%*
CO_2	7 584.25	9 912.49	*75.0%*	*83.5%*
CH_4	14.83	18.63	*0.1%*	*0.2%*
N_2O	912.02	325.81	*9.0%*	*2.7%*
HFCs	26.32	1 058.10	*0.3%*	*8.9%*
PFCs	1 079.24	173.53	*10.7%*	*1.5%*
SF_6	494.28	381.44	*4.9%*	*3.2%*

* *1990 for all gases*

The most important GHG of the industrial processes sector is carbon dioxide with 83.5% of emissions from this category in 2008, followed by HFCs with 8.9%, SF_6 with 3.2%, N_2O with 2.7%, PFCs with 1.5% and finally CH_4 with 0.2%.

Table 95: Emissions from IPCC Category 2 Industrial Processes by gas from 1990–2008 and their trend.

	GHG emissions [Gg CO_2e]						
	Total	**CO_2**	**CH_4**	**N_2O**	**HFCs**	**PFCs**	**SF_6**
1990	10 111	7 584	15	912	26	1 079	494
1991	10 133	7 430	15	927	30	1 087	645
1992	8 979	6 944	14	837	32	462	689
1993	8 829	6 859	15	879	244	53	781
1994	9 352	7 189	15	825	293	58	972
1995	9 897	7 388	14	857	412	71	1 154
1996	9 814	7 087	15	874	532	72	1 234
1997	10 451	7 677	15	863	652	105	1 139
1998	9 972	7 321	15	897	769	56	913
1999	9 849	7 169	15	923	877	79	787
2000	10 322	7 774	15	952	902	85	596
2001	10 174	7 700	14	786	925	96	652
2002	10 792	8 268	15	807	969	98	635
2003	10 744	8 214	15	883	950	116	567
2004	10 054	8 169	15	281	955	137	497
2005	10 628	8 710	16	274	986	134	507
2006	10 990	9 118	19	280	963	146	465
2007	11 466	9 550	19	270	1 062	190	375
2008	11 870	9 912	19	326	1 058	174	381
Trend 1990-2008	17%	31%	26%	-64%	3920%	-84%	-23%

CO_2 emissions

As can be seen in Figure 12 CO_2 emissions from the industrial processes sector fluctuated during the period from 1990 to 2000; since 2001 the emissions tend upwards mainly due to increasing emissions from metal production. In 2008 CO_2 emissions from *Industrial Processes* amount to 9 912 Gg CO_2 equivalent, which corresponds to an increase of 31% compared to base year emissions.

About 58% of CO_2 emissions originate from *Metal Production* (mainly *Iron and Steel Production*) and about 36% from *Mineral Products*. The rest originates from *Chemical Industry* (mainly *Ammonia Production*).

CH_4 emissions

As can be seen in Figure 12 CH_4 emissions from Industrial Processes fluctuated over the period from 1990 to 2004, since then they show an increasing trend, mainly due to augmented capacity in ethylene production. In 2008 emissions are 26% 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 bee seen in Figure 12 N_2O emissions from the industrial processes sector fluctuated until 2000. From 2000 to 2001 emissions dropped by 17%; this is due to the introduction of a new catalyst in the nitric acid plant. After an increase until 2003, emissions decreased 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 2008, N_2O emissions from *Industrial Processes* are 64% below the level of the base year.

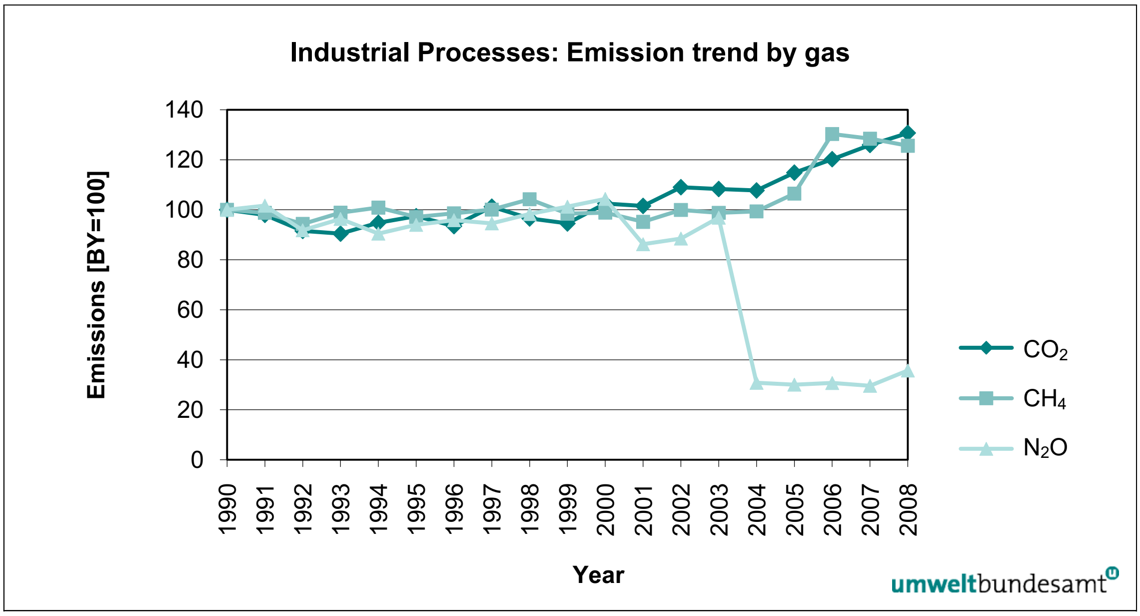

Figure 12: CO_2, CH_4 and N_2O emissions from Industrial Processes 1990–2008 in index form (base year = 100).

HFC emissions

As can be seen in Figure 13 HFC emissions increased remarkably during the period from 1990 to 2008. This increase is due to the use of these gases as substitutes for ozone depleting substances that are being phased out. HFC emissions mainly arise from *Refrigeration and Air Conditioning Equipment* and *Foam Blowing*. Although emissions from foam blowing decreased significantly since 2002 due to national policies (approx. 90%), the overall trend is increasing due to increased use in refrigeration and air conditioning.

PFC emissions

As can be seen in Figure 13 PFC emissions decreased remarkably during the period from 1990 to 2008. In 1990 PFC emissions amounted to 1 079 Gg CO_2 equivalent, they decreased 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 2008 they amounted to 174 Gg CO_2 equivalents, which is 84% below the level of the base year (1990). In 2008 PFC emissions mainly arise from semiconductor manufacture.

SF_6 emissions

As can be seen in Figure 13 SF_6 emissions increased at the beginning of the period and reached a maximum in 1996, since then SF_6 emissions are decreasing again. The minimum in 2000 is explained by decreasing emissions from semiconductor manufacture and noise insulating windows, the subsequent increased by emissions from shoes. In 2008 SF_6 emissions amounted to 381 Gg CO_2 equivalent, 23% below the level of the base year (1990). In 2008 SF_6 emissions resulted mainly from semiconductor manufacture, electric equipment and noise insulating windows.

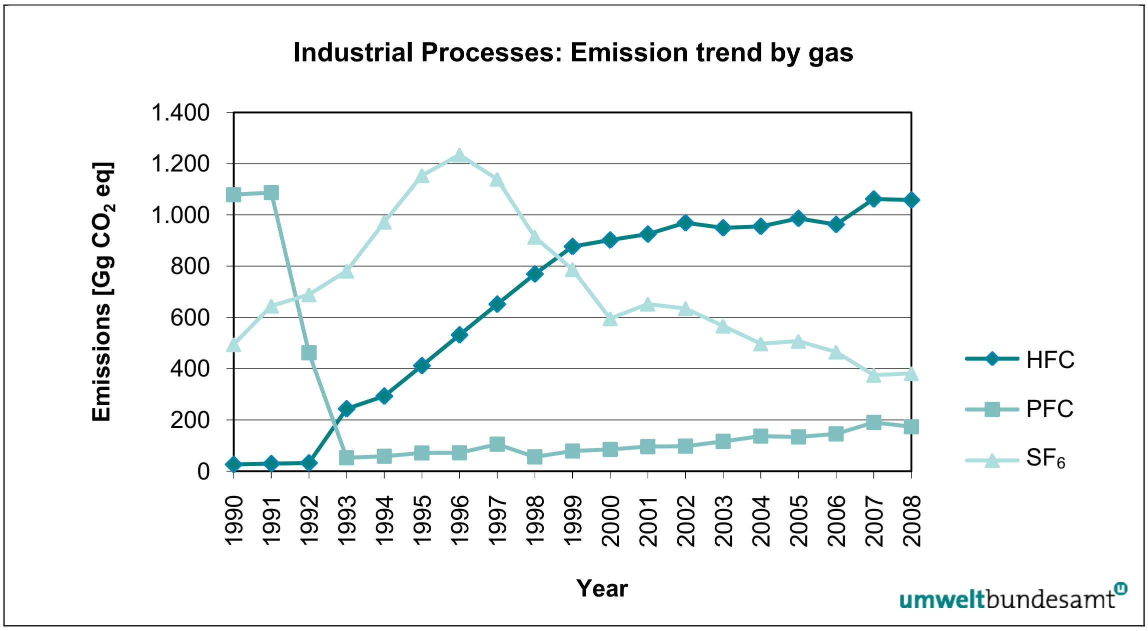

Figure 13: HFC, PFC and SF_6 emissions from Industrial Processes 1990–2008.

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 30%, respectively, of the emissions from this sector in 2008 (see Table 96).

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 96: Greenhouse gas emissions from IPCC Category 2 Industrial Processes by sector, their share and trend for the base year and 2008.

	Emissions [Gg CO_2e]		Share [%]		Trend BY–2008
	BY*	**2008**	**BY***	**2008**	
2 Industrial Processes	10 111	11 870	100%	100%	17%
A Mineral Products	3 274	3 531	32%	30%	8%
B Chemical Industry	1 512	938	15%	8%	-38%
C Metal Production	5 029	5 789	50%	49%	15%
F Consumption of Halocarbons and SF_6	296	1 613	3%	14%	444%

* *1990 for all gases*

Figure 14 and Table 97 present greenhouse gas emissions from IPCC Category 2 *Industrial Processes* by sub category for the years 1990 to 2008.

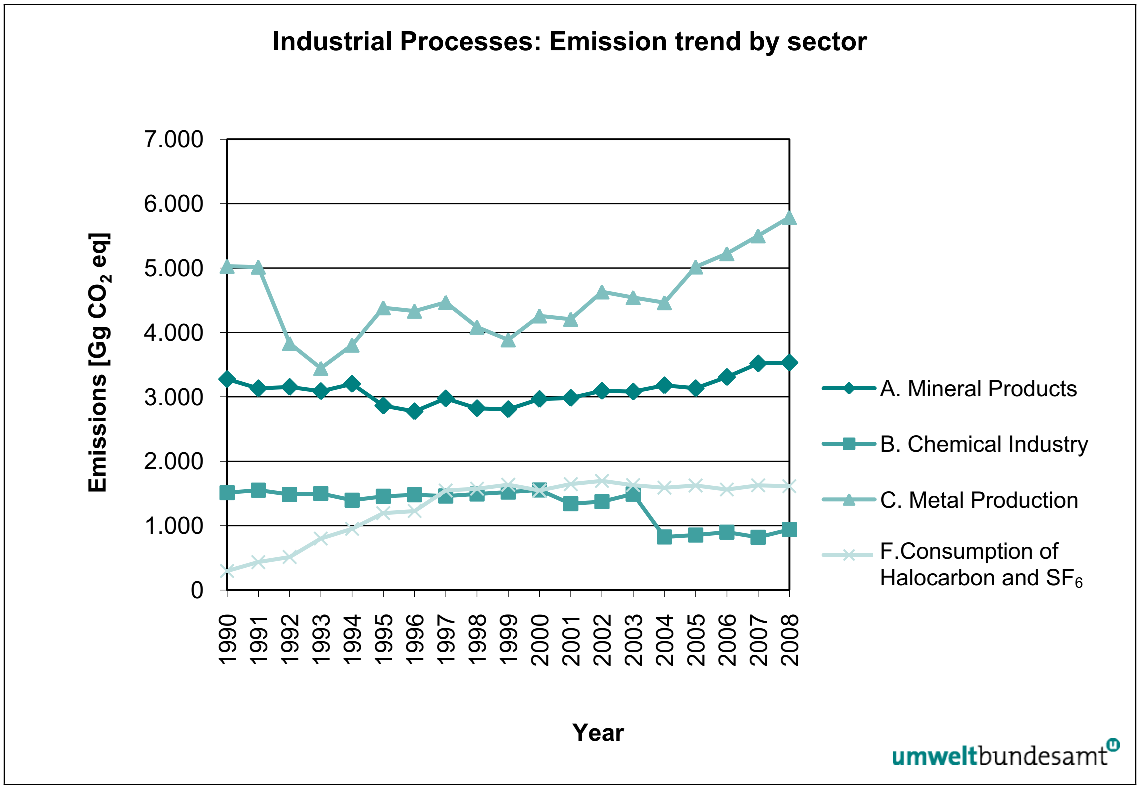

Figure 14: Emissions from IPCC Category 2 Industrial Processes per subcategory 1990–2008.

Table 97: Total greenhouse gas emissions from 1990–2008 by subcategories of Sector 2 Industrial Processes.

	GHG emissions [Gg CO_2 equivalent]				
	2 Total	**2.A**	**2.B**	**2.C**	**2.F**
1990	10 111	3 274	1 512	5 029	296
1991	10 133	3 132	1 551	5 016	434
1992	8 979	3 153	1 484	3 830	513
1993	8 829	3 087	1 499	3 443	800
1994	9 352	3 202	1 395	3 805	950
1995	9 897	2 863	1 455	4 385	1 194
1996	9 814	2 775	1 479	4 332	1 227
1997	10 451	2 975	1 460	4 468	1 547
1998	9 972	2 822	1 492	4 084	1 574
1999	9 849	2 807	1 521	3 886	1 635
2000	10 322	2 966	1 553	4 258	1 545
2001	10 174	2 983	1 340	4 206	1 644
2002	10 792	3 093	1 373	4 631	1 695
2003	10 744	3 081	1 490	4 543	1 629
2004	10 054	3 178	824	4 463	1 589
2005	10 628	3 133	853	5 019	1 623
2006	10 990	3 307	899	5 224	1 561
2007	11 466	3 518	820	5 502	1 626
2008	11 870	3 531	938	5 789	1 613

2.A Mineral Products

Greenhouse gas emissions increased by 8% from 1990 to 2008 in this sub-category. In this sub-category emissions from *Magnesia Sinter Production* and *Bricks* decreased between 1990 and 2008. Emissions from *Lime Production, Limestone, Dolomite and Soda Ash Use and Glass Production* increased and emissions from *Cement Production* exceed base year level since 2007, after a minimum in 1995–1999. 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 2008 emissions are 38% 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* (+63%). The overall trend is an increase by 15% 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 2008 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 results of the key category analysis is presented in Chapter 1.5.1. The following table summarizes the key sources in the IPCC Sector *2 Industrial Processes*.

Table 98: Key categories of Sector 2 Industrial Processes.

IPCC Category	Source Categories	Key Sources	
		GHG	KS-Assessment
2.A.1	Cement Production	CO_2	All
2.A.2	Lime Production	CO_2	All
2.A.3	Limestone and Dolomite Use	CO_2	LA08
2.A.7.b	Magnesia Sinter Plants	CO_2	All
2.B.1	Ammonia Production	CO_2	LA90,08
2.B.2	Nitric Acid Production	N_2O	All
2.C.1	Iron and Steel Production	CO_2	All
2.C.3	Aluminium production	PFC	LA90, TA
2.C.3	Aluminium production	CO_2	TA
2.C.4	SF_6 used in Al and Mg Foundries	SF_6	LA90, TA
2.F.1/2/3/4/5	ODS Substitutes	HFC, PFC	LA08, TA
2.F.7	Semiconductor Manufacture	FC	LA08, TA
2.F.9	Other Sources of SF6	SF_6	Q

LA90 = Level Assessment 1990

LA08 = Level Assessment 2008

TA = Trend Assessment BY–2008

Q = Qualitative Assessment

In the base year (1990), 12.6% of total greenhouse gas emissions in Austria originate from the 13 key categories of the industrial processes sector and 13.4% in 2008. These key categories cover 97.6% of total emissions from IPCC Sector *2 Industrial Processes.* The most important key category is *Iron and Steel Production* which has a share of 6.7% in total emissions in 2008.

Emissions from *Cement Production* contribute 2.5% to total emissions 2008 and 1.2% 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 2008.

Table 99: Level Assessment for the base year and 2008 for the key categories of Category 2 Industrial Processes.

IPCC Category	Source Categories	GHG	Level Assessment	
			BY	2008
2.A.1	Cement Production	CO_2	2.6%	2.5%
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%	0.6%
2.B.2	Nitric Acid Production	N_2O	1.2%	0.4%
2.C.1	Iron and Steel Production	CO_2	4.5%	6.7%
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%	1.2%
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.

Emission data reported under the European Emission Trading Scheme

Verified CO_2 emissions reported under the EU ETS were available for the years 2005-2008. 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.7a Bricks production, 2.A.7b Magnesia Sinter Plants, 2.A.7c Glass production 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 100, explanations see respective subchapters).

Table 100: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	20.0	2.0	20.1
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	2.0	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[30] and the Ordinance regarding Monitoring and Reporting of Greenhouse Gas Emissions[31].

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

[31] „*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

A summary of the changes made compared to the inventory for the year 2007 is presented below:

Update of activity data

2.C.2. Ferroalloys: Activity data for 2007 was updated.

2.C.4. SF_6 Used in Aluminium and Magnesium Foundries: In the course of industry inquires applications of SF_6 in secondary aluminium smelting works have been identified in recent years. The resulting emissions have been included in the inventory.

Improvements of methodologies and emission factors

2.A.4. Soda Ash Use: Following the recommendation from the in-country review 2007 CO_2 emissions from uses of soda ash other than in glass industry have been reviewed, identified and included in the inventory for the whole time-series.

2.F. Consumption of Halocarbons and SF_6: A new survey was conducted covering consumption and emissions in all sub-categories. Following a recommendation from the in-country review 2007 special focus was given to emissions from manufacturing/installation and disposal. The results of this study were incorporated in the inventory and emissions of all gases and in all sectors have been revised for the whole time-series accordingly.

For further information see the recalculation sections of the respective subchapters of this chapter and the tables presented in Chapter 9.

Allocation

2.A.7. Glass Production: CO_2 emissions from limestone, dolomite and soda ash use in the glass production are reported under this category in contrast to previous reports, where these emissions were reported under the categories 2.A.3 Limestone and Dolomite Use and 2.A.4 Soda Ash Use.

4.1.7 Completeness

Table 101 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 101: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	IE1)	NA	NA
2.A.6	Road Paving with Asphalt	040611	Road paving with asphalt	IE1)	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.A.7.c Glass Production	040613	Glass (decarbonizing)	✓	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	NO2)
2.B.4	Carbide Production	040412	Calcium carbide production	✓	NA3)	NA
2.B.5	Other	040407 040408	NPK fertilisers Urea	✓	✓	NA
2.B.5	Other	040501	Ethylene production	NA	✓	NA
2.C	**METAL PRODUCTION**					
2.C.1	Iron and Steel Production	040202 040206 040207 040208	Blast furnace charging Basic oxygen furnace steel plant Electric furnace steel plant 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 040304	Aluminium Production – SF_6 only Magnesium Production – SF_6 only	SF_6 ✓		
2.C.5	*Other*			NA	NA	NA
2.D	**OTHER PRODUCTION**					
2.D.1	*Pulp and Paper*			NA	NA	NA
2.D.1	*Food and Drink*			NA5)	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).

All planned improvements have been implemented in this sector. At the moment there are no further improvements planned.

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 category because of its contribution to the level of the greenhouse gas inventory of base year and 2008. In 2008 CO_2 emissions from cement production contributed 2.5% to total greenhouse gas emissions in Austria (see Table 99).

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 102 presents the process-related CO_2 emissions from the production of cement for the period from 1990 to 2008.

Table 102: CO_2 *emissions from decarbonising from cement production 1990–2008.*

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
2008	2 133	3 996 243	534

CO_2 emissions 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 clinker following cement demand are slowly increasing again with only minor fluctuations. The overall trend from 1990 to 2008 is plus 4.9%.

Concerning the fluctuating implied emission factors, emissions are the sum of several cement production plants that operate under different conditions like different raw materials, additives and technical equipment. Fluctuations in IEF can occur due to opening or closing of single production plants and due to shifting production figures of single plants between years. The stronger decrease of the IEF between 2005 and 2006 (-4.1%) has two reasons: first the raw meal factor (raw meal/clinker) decreased between 2005 and 2006 and second the carbonate content of raw meal decreased in most companies, mainly due to the increase of secondary raw materials such as clay substitute, brick chips, and recycled gyps.

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 2005-2008. For 2005-2008 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:

$$M_{(CO2\ calc)} = \sum_k (m_{(raw\ meal)})_k \bullet (x_{(MeCO3)k} \bullet M)$$

Whereas:

m ..... mass stream [kg/a]

x ...... mass portion

k ...... for the k^{th} cement plant

M ..... molecular weight CO_2 / molecular weight Me-carbonate

Me ... Ca, Mg

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.

During various reviews the Austrian IEF has been considered high compared to other Parties and the IPCC default value. A possible explanation can be found in (HACKL & MAUSCHITZ 2003), where the authors apply both methods, based on clinker and on raw meal, to calculate CO_2 emissions and find that if CO_2 emissions are calculated from clinker instead of the raw meal, this leads to 4% lower emissions.

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 2008 and to the trend of emissions of the total greenhouse gas inventory. In the year 2008 emissions from this category contributed 0.7% to the total amount of greenhouse gas emissions in Austria (see Table 99).

CO_2 is emitted during the calcination step of lime production. Calcium carbonate ($CaCO_3$) in limestone and calcium/ magnesium carbonates in dolomite rock ($CaCO_3 \bullet MgCO_3$) are decomposed to form CO_2 and quicklime (CaO) or dolomite quicklime ($CaO \bullet MgO$) respectively.

Table 103 presents activity data for this category (lime produced) as well as CO_2 emissions from lime production for the period from 1990 to 2008.

Table 103:Activity data and CO_2 emissions for Lime production 1990–2008.

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
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
2008	621	847 847	733

The overall trend for CO_2 emissions from this category is increasing emissions, in the year 2008 emissions were more than 50% higher than 1990 (see Table 103).

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 2005-2008 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 2008. In the year 2008 emissions from this category contributed 0.3% to the total amount of greenhouse gas emissions in Austria (see Table 99).

In this category CO_2 emissions from decarbonising of limestone in the iron and steel industry, limestone use for desulphurization and in chemical industry are considered. CO_2 emissions from decarbonising of limestone and dolomite in glass industry were moved to 2.A.7.c Glass Production.

Emissions from this category increased by 38% between 1990 and 2008, mainly due to increased limestone use in iron and steel industries.

Table 104:Activity data and CO_2 emissions for Limestone and Dolomite Use 1990–2008.

Year	CO_2 emissions [Gg]	Limestone Used [t/a]
1990	182	413 280
1991	182	413 040
1992	162	368 880
1993	162	368 400
1994	175	398 400
1995	205	466 560
1996	181	411 840
1997	210	476 640
1998	220	499 191
1999	201	456 959
2000	233	528 643
2001	225	511 150
2002	247	560 799
2003	247	561 209
2004	257	583 276
2005	244	561 797
2006	237	551 117
2007	252	582 971
2008	255	590 632

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 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 2005-2008 verified CO_2 emissions and activity data, reported under the ETS, were used for the inventory. These data cover limestone use in the iron and steel and chemical industry. The use of limestone in chemical industry is included in the inventory since 2005.

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 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

The country-specific EFs for limestone have been compared with the IPCC default value. They deviate from the IPCC default in the range of 1%-2%, which is within the uncertainty range.

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. This results in a combined uncertainty of emissions of 20.1% (calculating with the plus 20% of activity data).

4.2.3.5 Recalculations

Compared to last years' inventory CO_2 emissions from decarbonising of limestone and dolomite in glass industry were allocated to 2.A.7.c Glass Production.

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 soda ash use in metallurgy and other industry is considered. CO_2 emissions from soda ash used in glass production are included in 2.A.7.c Glass Production.

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 2008 emissions from soda ash use contributed 0.01% to total emissions in Austria. The following table presents CO_2 emissions from this category.

Table 105:Activity data and CO_2 emissions for Soda Use 1990–2008.

Year	CO_2 emissions [Gg]	Soda Used [t/a]
1990	5	12 374
1991	4	10 837
1992	5	13 081
1993	6	13 545
1994	5	13 062
1995	6	13 531
1996	6	14 007
1997	6	15 465
1998	7	15 941

Year	CO_2 emissions [Gg]	Soda Used [t/a]
1999	6	15 102
2000	8	18 247
2001	7	16 195
2002	8	18 533
2003	8	19 876
2004	16	37 552
2005	13	30 208
2006	12	29 241
2007	11	27 489
2008	10	24 814

4.2.4.2 Methodological Issues

Emissions were estimated using the methodology and the default emission factor of the IPCC guidelines (415 kg CO_2/t soda).

The amount of total marketed soda ash is not available from national statistics. This data has been provided by Solvay Österreich GmbH (personal communication) for 2008 and 1990. The activity for the other years was calculated by interpolation. From this total amount, the amount used in glass production was subtracted (reported in 2.A.7.c). The remaining amount was classified emissive and non-emissive according to its use. The total amount of emissive use (metallurgy and other non-identified use) is included as activity data for the CO_2 calculation.

4.2.4.3 Recalculations

Following the recommendation from the in-country review 2007 CO_2 emissions from uses of soda ash other than in glass industry have been reviewed, identified and included in the inventory for the whole time-series in this submission.

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 and glass (decarbonising) 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 106 presents CO_2 emissions from bricks production for the period from 1990 to 2008. CO_2 emissions from bricks production had a maximum in 1995/1996, following brick production. In the year 2008 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 2005-2008 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 between 2001 and 2004.

Table 106 presents activity data for production of bricks and CO_2 emissions for this category for the period from 1990 to 2008.

Table 106:Activity data and CO_2 emissions for Bricks Production 1990–2008.

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
2008	110	2 029 947	54.04

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 2008 and also with regard to the trend assessment. In 2008 it contributed 0.4% to the total amount of greenhouse gas emissions in Austria (see Table 99).

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 107 presents CO_2 emissions from production of magnesia sinter for the period from 1990 to 2008. CO_2 emissions from magnesia sinter plants vary over the period from 1990 to 2008 with an overall decreasing trend. In 2008 emissions are 31% 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 2005-2008 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 107 presents activity data and CO_2 emissions from this category for the period from 1990 to 2008.

Table 107:CO_2 emissions from Magnesia Sinter Production 1990–2008.

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
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
2008	332	648 704	512

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.

4.2.6.4 Glass Production

Emissions: CO_2

Key Source: *no*

In this category CO_2 emissions from decarbonising of soda, limestone, dolomite and other minor carbonates used in glass industry is considered.

Methodological Issues

The IPCC methodology based on carbonates used was applied (2006 IPCC GL, Tier 3).

For calculation of CO_2 emissions from 1990 to 2004 the IPCC default emission factors of 415 kg CO_2/t soda, 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 carbonates used. Therefore, the IEFs since 2005 are slightly different compared to the IPCC default values.

Activity data for limestone, dolomite and soda 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 the carbonates 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.

For 2005-2008 verified CO_2 emissions and activity data, reported under the ETS, were considered for the inventory. These data cover small amounts of other carbonates used in glass industry that have been included from 2005 onwards.

Table 108 presents activity data and CO_2 emissions from this category for the period from 1990 to 2008.

Table 108:CO_2 emissions and carbonate use in Glass Production 1990–2008.

Year	Limestone [t]	Dolomite [t]	Soda ash [t]	Other Carbonates [t]	CO_2 Emissions [Gg]
1990	17 449	24 020	46 690		39
1991	20 082	27 646	53 737		44
1992	17 770	24 463	47 551		39
1993	17 786	24 485	47 593		39
1994	19 040	26 212	50 950		42
1995	19 050	26 225	50 975		42
1996	19 050	26 225	50 975		42
1997	17 766	24 457	47 539		39
1998	17 766	24 457	47 539		39
1999	19 487	26 826	52 144		43
2000	16 434	22 624	43 976		36
2001	19 303	26 573	51 652		43
2002	17 054	23 477	45 633		38
2003	20 892	30 368	45 263		42
2004	15 178	19 208	28 559		28
2005	21 163	21 241	36 876	2 467	35
2006	21 103	23 405	38 814	2 673	37
2007	23 632	24 914	41 539	2 577	40
2008	25 852	28 411	45 186	1 741	44

Source specific QA/QC

Limestone and dolomite use in glass industry is checked with glass production figures.

The country-specific EFs for limestone, dolomite and soda ash have been compared with the IPCC default values. They deviate from the IPCC default values less than 1%.

Recalculations

CO_2 emissions have been reallocated from 2.A.3 and 2.A.4 to this category.

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 2008. In 2008 it contributed 0.6% to the total amount of greenhouse gas emissions in Austria (see Table 99).

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 109 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 2008.

Emissions vary during the period and follow closely the trend in ammonia production. CO_2 emissions reach a first minimum in 1994, a second in 2001, and a third in 2007, all due to low production figures. In 2007 low production figures are due to a lower demand as raw material for the production of fertilizers. In 2008 CO_2 emissions are 3% higher 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 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 natural gas per tonne 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. 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 109 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. Figure 15 shows the trend of melamine production as an index of the base year.

Table 109: Activity data, emissions and implied emission factors for CO_2 and CH_4 emissions from ammonia production 1990–2008.

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

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]
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
2008	489 131	11 246	24.4	533	1 089	87.7

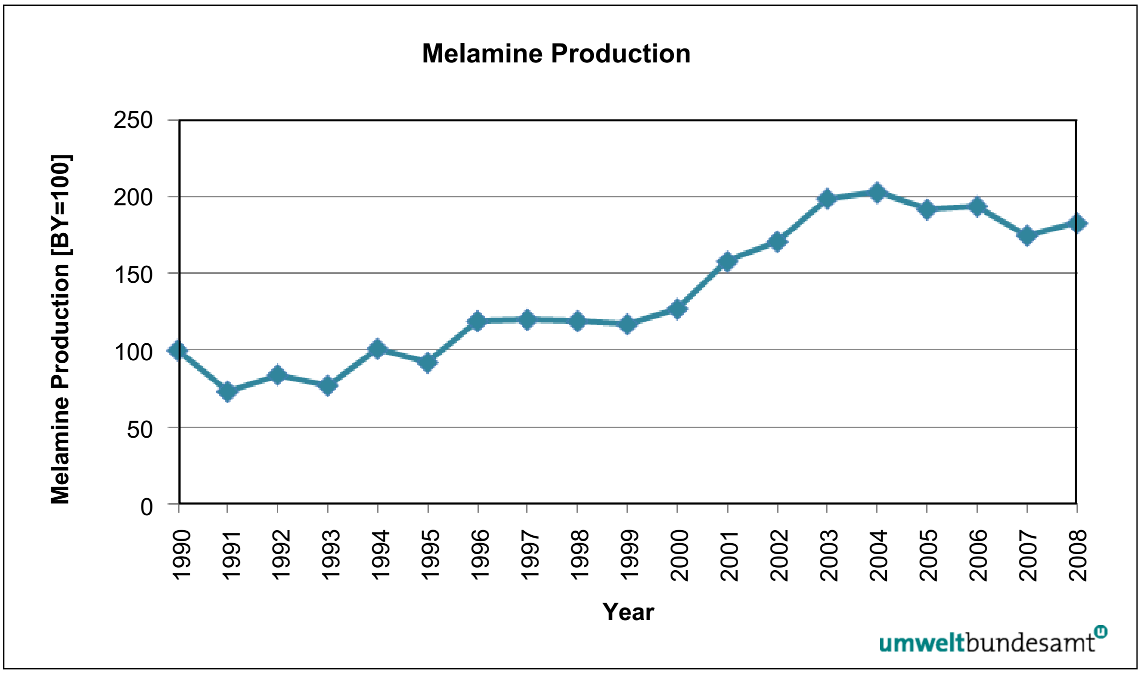

Figure 15: Melamine Production 1990–2008.

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 using the conversion factor 0.451 t natural gas per tonne NH_3.

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

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

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 2008 it contributed 0.4% to the total amount of greenhouse gas emissions in Austria.

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 110 presents N_2O and CO_2 emissions from production of nitric acid for the period from 1990 to 2008.

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. Since 2007 the IEF slightly increased again due to changes in the combustion system of one plant. In 2008 emissions are 64% below base year emissions.

CO_2 emissions also varied over the period from 1990–2008 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 110).

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 110:Activity data, emissions and implied emission factors for N_2O and CO_2 emissions from Nitric Acid Production 1990–2008.

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
2008	561 749	1 051	0.40	1.87	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 of N_2O emissions 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 discontinuous 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 2008, emissions from this source contribute 0.05% 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 111:Activity data and emissions for CO_2 emissions from Calcium Carbide Production 1990–2008.

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
2008	31 404	41

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 2008, total emissions from this source contribute 0.03% 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 2008 emissions from this category are 36% lower than in 1990 (see Table 112).

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 2002–2008. 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. 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 2002–2008; 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 112 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 2008.

Table 112:Activity data, emissions and implied emission factors for CO_2 and CH_4 emissions from NPK-fertilizer Production and Urea Production 1990–2008.

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
2008	419 711	0.34	157.2	1 042 098	19.41	18.63	137.9

4.3.4.3 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 2008 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 2008 and because of its contribution to the trend.

In the year 2008, CO_2 emissions from production of iron and steel contributed 6.7% 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 2008 was 0.0001%.

Table 113 presents total CO_2 and CH_4 emissions from the production of iron and steel for the period from 1990 to 2008. 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 2008 emissions were % above the level of 1990.

Table 113: Total CO_2 and CH_4 emissions from iron and steel 1990–2008.

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

Year	CO_2 [Gg]	CH_4 [Gg CO_2 eq]
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
2008	5 770	0.094

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[32] 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*).

For 2005-2008 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.

CO2 emissions from blast furnace pig iron production

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[32] 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

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[33].

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[34] (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 2005-2008 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 2002–2008 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.

For 2005–2008 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.

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[33] 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.

[34] Carbonatious ore is mined in Austria, thus it is reported in the statistical yearbook.

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 114. 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 accounting for reducing agents other than coke. The increase of IEF in 2008 can be explained by additional reducing agents accounted for in this sector, while at the same time keeping the split of non-energy / energy use of coke fixed.

Table 114: Activity data, emissions and implied emission factors for CO_2 emissions from pig iron production 1990–2008.

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
2008	1 338	2 032	5 846	4 893	837

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 2008 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 2005-2008 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 115 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 115:Activity data, emissions and implied emission factors for CO_2 and CH_4 emissions from Steel Production 1990–2008.

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
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

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]		
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
2008	6 873	820	119	0.69	757	57	3.79	4.48	877

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 2005-2008 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

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

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 2008, 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, 2005–2009) Austria produce ferro-molybdenum, ferro-vanadium and ferro-nickel. Activity data from 1995 to 2007 were directly taken from these publications. As no data were available for 1990–1994 the value from 1995 was taken for these years. For 2008 the trend 1996–2007 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 116:Activity data and emissions from ferroalloy production 1990–2008.

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	14.5	19.7
2008	13.3	18.0

4.4.2.3 Recalculations

Activity data for the year 2007 has been updated since the last submission. This recalculation resulted in an increase of emissions of 16%.

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 117 presents PFC and CO_2 emissions from primary aluminium production for the period from 1990 to 1992.

Table 117: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):

$$\text{kg } CF_4/t_{Al} = (1.7 \times AE/pot/day \times F \times AE_{min})/CE$$

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 technology applied was head to head HSS. 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. Furthermore, activity data were compared with international statistics (UNICS, USGS) and although they did not match completely deviations were within the uncertainty range and not unusual, especially for figures that are treated confidential in national statistics. Only the figure for aluminium production in 1990 from UNICS was nearly double as high as the national figure. Nevertheless, this figure is not credible, because it exceeds total capacity.

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 to that extent, 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 2008 very low emissions arose from this category (see Table 99).

Molten magnesium spontaneously burns in the presence of atmospheric oxygen. Therefore, in magnesium casting SF_6 is used in small amounts in blends with carrier gases as a protective cover gas to prevent oxidation and ignition resp. to quench fire of molten magnesium. It has been a common assumption that the SF_6 in magnesium cover gas will not be destroyed but more or less completely emitted. Recent studies showed that SF_6 undergoes to some degree destruction. The low intensity of this process depends on specific operation conditions. Industry introduced in the last years stepwise alternative cover gases.

In secondary aluminium smelting works normally inert gases without additives are used to remove, prior to casting, hydrogen as well as alkaline and alkaline earth metals and solids from smelt to prevent porosity in the cast pieces (aluminium cleaning). In some cases a purification system of inert gases is used to which SF_6 is added in concentrations of 1-2.5%.

Table 118 presents SF_6 emissions from magnesium and aluminium foundries for the period from 1990 to 2008.

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 2008 they decreased by nearly 100%. This decreasing trend is explained by technological advances and the replacement of SF_6 by other substances used for surface protection; since 2008 the use of SF_6 per foundry is limited to 850 kg /a in Europe (EC Regulation 842/2006).

Table 118:SF_6 emissions from magnesium and aluminium foundries 1990–2008.

Year	SF_6 emissions [Mg]
1990	10.60
1991	11.60
1992	10.60
1993	11.60
1994	15.60
1995	18.54
1996	25.55
1997	14.61
1998	6.87
1999	4.52
2000	1.55
2001	1.20
2002	0.30
2003	0.15
2004	0.00
2005	0.20
2006	0.53
2007	0.01
2008	0.01

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 for magnesium casting. During the last ten years, two magnesium casting companies existed in Austria which could use SF_6 from the technical process as fire-extinguishing cover gas. One company relied on a $N_2/CO_2/SO_2$-system. The other company changed over in former times to fluorinated ketone (Novec) as an alternative cover gas system but used SF_6 to quench fire of molten magnesium. SF_6 has been used until 2006.

For aluminium casting the same method was applied until 1999, when it was not further used by companies. From the six secondary aluminium smelters only one started the use of SF_6 as cleaning gas again from 2006 onwards. For these recent years an EF of 1.5% of SF_6 consumed was applied. This EF is based on measurements in a German aluminium plant that have shown significant destruction of SF_6 (decomposition into sulphur and fluorine) during the process (SCHWARZ & GSCHREY 2009).

4.4.4.3 Source specific QA/QC

The amount of SF_6 used is cross-checked with data from SF_6 suppliers. The IEF for magnesium casting (referred to magnesium cast) range between 0.1 and 7.4 kg SF_6 / t and are all 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

In the last submission no SF_6 emissions were assumed from 2003 onwards. During recent industry inquiries, updated data have been collected that showed SF_6 use in magnesium foundries until 2006 and that in Aluminium foundries SF_6 is still used in small amounts. This data has been incorporated into 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 five times higher in 2008 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 119, emissions by sub sector and gas are presented in Table 120 and Table 121.

In 2005 and 2006 actual SF_6 emissions exceed potential emissions. This is due to emissions from disposal of noise insulating windows.

Table 119:Potential and actual emissions of IPCC Category 2 F per substance group [Gg CO_2e*] 1990–2008.*

	HFCs [Gg CO_2e]		**PFCs [Gg CO_2e]**		**SF_6 [Gg CO_2e]**		**Total [Gg CO_2e]**	
Year	**Potential**	**Actual**	**Potential**	**Actual**	**Potential**	**Actual**	**Potential**	**Actual**
1990	31.83	26.32	32.28	29.05	582.51	240.94	646.62	296.3
1991	44.06	29.56	40.99	36.89	834.36	367.50	919.41	434.0
1992	46.16	32.31	49.70	44.73	927.62	435.58	1023.47	512.6
1993	296.64	243.56	58.41	52.57	993.99	503.65	1349.04	799.8
1994	334.72	293.06	64.77	58.30	1157.84	599.01	1557.33	950.4
1995	750.52	411.89	78.87	71.27	1249.48	710.96	2078.88	1194.1
1996	1 038.72	531.94	79.02	71.70	978.65	623.50	2096.39	1227.1
1997	1 211.45	651.70	115.87	105.15	1136.06	790.08	2463.38	1546.9
1998	1 284.08	769.33	122.26	55.95	1286.20	749.02	2692.55	1574.3
1999	1 448.22	876.64	205.58	78.63	1039.27	679.23	2693.07	1634.5
2000	1 725.30	901.88	253.90	84.79	895.14	558.40	2874.34	1545.1
2001	1 746.52	924.92	313.85	95.91	890.64	623.54	2951.01	1644.4
2002	1 782.43	969.22	316.20	97.70	919.16	627.63	3017.79	1694.6
2003	1 692.29	949.55	396.29	116.44	632.56	563.03	2721.13	1629.0
2004	1 685.84	955.14	353.30	136.65	652.97	497.35	2692.11	1589.1
2005	1 362.94	986.41	360.87	133.82	485.33	502.54	2209.15	1622.8
2006	1 244.26	962.62	389.77	145.72	397.54	452.46	2031.57	1560.8
2007	1 329.17	1 061.99	458.18	190.12	414.42	374.24	2201.76	1626.4
2008	1 161.70	1 058.10	428.30	173.53	425.71	381.12	2015.71	1612.8

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 (SF_6, PFC)

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 2008 and to the trend of emissions. In the year 2008 HFC emissions from ODS contributed 1.2% to the total amount of greenhouse gas emissions in Austria, in the base year (1990) 0.0% (see Table 99).

2.F.7 Semiconductor Manufacture (HFCs, PFCs and SF_6) because of its contribution to the total inventory's level in the year 2008 and to the trend of emissions. In the year 2008 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 (SF_6, PFC) 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 . In the year 2008 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 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.

For the years 2000-2008 a second study (LEISEWITZ & SCHWARZ 2010) was contracted in order to conduct a complete survey of all F-gas uses and emission sources. In this study a combined bottom-up/top-down approach was used.

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[35] 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

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

obligation. That's why not all enterprises reported their consumption. In the recent study the available data has been used either directly or for verification.

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, for some sources in the refrigeration sector emissions are equalled to refilled amounts. Additionally emissions can occur during production or disposal of Halocarbons or SF_6 containing products, and all these emissions have been accounted for. 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. Refilled as well as newly filled in amounts are included.

The following subchapters present emission factors and data sources used for the respective subcategories.

Table 120: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												
Stationary												
HFC-32	650	t	0.00	0.00	0.00	0.00	0.02	0.80	1.59	2.37	3.15	3.93
HFC-125	2 800	t	0.00	0.00	0.00	0.00	0.03	7.01	14.00	20.98	27.97	34.95
HFC-134a	1 300	t	1.35	2.12	2.83	4.14	30.94	57.75	84.55	111.36	138.16	164.96
HFC-152a	140	t	0.00	0.00	0.00	0.00	0.00	0.06	0.85	1.65	2.44	3.24
HFC-143a	3 800	t	0.00	0.00	0.00	0.00	0.00	0.39	8.91	17.43	25.95	34.48
HFC-23	11700	t	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
C3F8	7 000	t	0.00	0.00	0.00	0.00	0.00	0.41	0.83	1.24	1.65	2.06
Mobile												
HFC-134a	1 300	t	0.00	0.00	0.00	0.00	2.32	6.39	12.15	19.77	29.35	41.19
Gg CO_2e			**1.76**	**2.75**	**3.68**	**5.38**	**43.33**	**107.90**	**205.68**	**305.89**	**408.63**	**514.34**
2.F.2 Foam Blowing												
HFC-134a	1 300	t	0.00	0.00	0.00	151.89	158.79	200.88	217.90	234.08	251.08	253.43
HFC-152a	140	t	0.00	0.00	0.00	74.75	78.15	81.54	88.34	95.14	101.93	101.93
Gg CO_2e			**0.00**	**0.00**	**0.00**	**207.93**	**217.37**	**272.56**	**295.64**	**317.62**	**340.67**	**343.72**
2.F.3 Fire Extinguishers												
HFC-23	11 700	t	0.00	0.00	0.00	0.01	0.04	0.05	0.08	0.10	0.13	0.16
HFC-227ea	2 900	t	0.00	0.00	0.00	0.00	0.00	0.00	0.02	0.05	0.09	0.13
Gg CO_2e			**0.00**	**0.00**	**0.00**	**0.17**	**0.41**	**0.64**	**0.99**	**1.37**	**1.81**	**2.25**
2.F.4 Aerosols												
HFC-134a	1 300	t	17.05	17.53	17.86	17.90	18.28	18.56	18.95	19.23	19.78	20.31
Gg CO_2e			**22.17**	**22.79**	**23.21**	**23.28**	**23.77**	**24.13**	**24.63**	**24.99**	**25.71**	**26.40**
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_2e			**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_2e		1.93	3.07	4.44	5.81	7.18	8.53	9.74	9.43	2.96	3.23
PFC-unspecified	Gg CO_2e		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_2e			**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	0.51	0.55	0.58	0.61	0.65	0.66	0.64	0.65	0.77	0.72
Gg CO_2e			**12.28**	**13.07**	**13.86**	**14.65**	**15.44**	**15.87**	**15.40**	**15.58**	**18.30**	**17.11**
2.F.9 Other												
SF_6	23 900	t	5.30	7.50	7.66	7.82	9.13	11.14	11.71	11.99	12.56	11.53
C3F8	7 000	t	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Gg CO_2e			**126.56**	**179.20**	**183.10**	**187.00**	**218.19**	**266.32**	**279.81**	**286.65**	**300.28**	**275.61**

Table 121:Emissions of IPCC Category 2.F by source 2000–2008.

GHG	GWP	Unit	2000	2001	2002	2003	2004	2005	2006	2007	2008
2.F.1 Refrigeration and Air Conditioning Equipment											
Stationary											
HFC-32	650	t	4.71	7.25	7.32	7.43	10.09	10.88	11.33	12.59	12.72
HFC-125	2 800	t	41.94	46.33	46.59	47.35	53.50	64.98	67.38	79.09	79.40
HFC-134a	1 300	t	191.77	172.07	172.48	173.41	154.82	155.85	162.61	162.45	174.37
HFC-152a	140	t	4.04	3.10	3.10	3.10	2.17	1.61	1.61	1.05	1.05
HFC-143a	3 800	t	43.00	44.34	44.53	45.29	48.53	59.77	62.02	72.94	73.15
HFC-23	11700	t	0.18	0.14	0.14	0.14	0.11	1.27	1.27	2.44	2.44
C3F8	7 000	t	2.48	2.03	2.03	2.03	1.59	1.25	1.25	0.92	0.92
Mobile											
HFC-134a	1 300	t	54.56	67.74	81.52	94.80	111.27	126.53	149.10	159.96	176.24
		Gg CO_2e	**624.11**	**631.04**	**650.99**	**674.56**	**699.43**	**807.13**	**860.82**	**960.98**	**999.39**
2.F.2 Foam Blowing											
HFC-134a	1 300	t	140.25	142.12	123.88	125.92	128.08	84.65	9.73	9.60	9.52
HFC-152a	140	t	595.04	608.14	946.24	637.02	428.95	204.55	247.69	248.62	87.10
		Gg CO_2e	**265.64**	**269.89**	**293.52**	**252.88**	**226.56**	**138.68**	**47.32**	**47.29**	**24.57**
2.F.3 Fire Extinguishers											
HFC-23	11 700	t	0.00	0.28	0.00	0.00	0.18	0.43	0.34	0.41	0.86
HFC-227ea	2 900	t	0.17	0.00	0.73	0.13	0.54	0.31	0.63	0.11	0.00
		Gg CO_2e	**0.50**	**3.22**	**2.14**	**0.38**	**3.68**	**5.92**	**5.85**	**5.13**	**10.11**
2.F.4 Aerosols											
HFC-134a	1 300	t	18.42	22.83	24.05	23.29	24.36	30.37	40.29	36.87	17.73
		Gg CO_2e	**23.94**	**29.68**	**31.26**	**30.28**	**31.66**	**39.48**	**52.38**	**47.93**	**23.04**
2.F.5 Solvents											
HFC-43-10mee	1 300	t	0.90	0.92	1.16	1.39	0.70	0.00	0.00	0.00	0.00
		Gg CO_2e	**1.17**	**1.20**	**1.50**	**1.81**	**0.91**	**0.00**	**0.00**	**0.00**	**0.00**
2.F.7 Semiconductor Manufacture											
HFC-unspecified	Gg CO_2e		3.85	4.14	4.05	3.88	4.06	3.98	5.03	7.07	7.39
PFC-unspecified	Gg CO_2e		67.46	81.67	83.46	102.20	125.49	125.04	135.50	182.55	166.39
SF_6	23 900	t	13.92	15.02	15.00	15.82	15.91	7.08	7.04	4.12	4.42
		Gg CO_2e	**403.97**	**444.69**	**445.89**	**484.15**	**509.92**	**298.17**	**308.69**	**288.00**	**279.51**
2.F.8 Electrical Equipment											
SF_6	23 900	t	0.73	0.76	0.79	0.79	0.86	0.91	0.94	1.01	1.06
		Gg CO_2e	**17.34**	**18.09**	**18.92**	**18.93**	**20.49**	**21.86**	**22.40**	**24.10**	**25.41**
2.F.9 Other											
SF_6	23 900	t	8.72	10.32	10.47	6.95	4.04	13.03	10.96	10.53	10.46
C3F8	7 000	t	0.00	0.00	0.00	0.00	0.00	0.00	0.21	0.17	0.11
		Gg CO_2e	**208.40**	**246.57**	**250.33**	**166.04**	**96.49**	**311.53**	**263.34**	**252.91**	**250.71**

4.5.2.1 2.F.1 Refrigeration and Air Conditioning Equipment

Consumption data was obtained directly from the most important importers, retailers and service companies 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 chapters describe what kind of refrigeration and air-conditioning equipment has been considered in which sub-category, which refrigerants have been used in the respective applications and what method was used for the calculation of emissions in Austria.

Domestic refrigeration

To some degree HFC-134a is used as refrigerant in refrigerators (fridges and freezers) for domestic use. HFC-134a as refrigerant was introduced by industry at the end of 1993 as replacement of CFC-12. In the following years it was replaced itself by R600a (iso-butane) in some European countries. In central Europe only a small part of imported new domestic refrigeration equipment operates with HFC-134a (about 0.1 kg per system). This share is estimated for Austria with ~1% of newly imported fridges/freezers. In contrast the 1994 age group is estimated to be manufactured 100% with HFC-134a. Refrigerators for domestic use mainly are imported to Austria. Data on F-gas consumption for the manufacturing of such refrigerators in Austria are not available and are – if existing – included in the data on manufacturing of refrigerators for commercial use.

Lifetime of domestic refrigeration equipment is calculated with 15 years. In 2008 the year 1994 with 100% HFC-134a comes to disposal. The emissions from stocks are estimated with 0.3% per year, the emission from disposal with 30% based on expert judgement.

Commercial refrigeration

This sector includes emissions from manufacturing of small refrigeration equipment mostly for export ("stand-alone" commercial application including also some equipment for domestic refrigeration), emissions from refrigeration in Supermarkets and other Commercial Refrigeration.

Two Austrian companies manufacture smaller "stand-alone" equipment for commercial and domestic refrigeration (fridges, freezers) with HFC R-134a and R-404A as cooling agents. The equipment is mostly exported. Both companies communicated their data on F-gas consumption. Emissions from manufacturing are estimated to equal 0.1%.

The sector *Supermarkets* is well structured and easily surveyed. Although no detailed figure on the equipment installed is available the sector is definable. Data on consumption for new systems and refilling were provided by the main service companies; the stocks were calculated accordingly. Refrigerants used are R-134a, R-402A, R-404A, R-407C, R-410A and R-507. Emissions from manufacturing were estimated to equal 0.2%. Lifetime of Supermarket refrigeration equipment is calculated with 10 years and emissions from disposal to equal 30%. Emissions from stocks were set equal to the amounts refilled as reported by the companies. This leads to an implied product life factor that range between 12.5% and 15%.

The sector *other commercial refrigeration* is very heterogeneous and no detailed data on equipment installed is available. This sector can be considered the residual sector of 2.F.1 because it contains refrigeration in small and non-industrial commercial sectors, in the private and public service sector, and food trade other than supermarkets. Data on consumption for new systems and refilling were through import and retail figures, the stocks were calculated accordingly. Refrigerants used are R-134a, R-23, R-401A, R-402A, R-404A, R-407A, R-407C, R-410A, R-417A, R-422D and R-507. Emissions from manufacturing were estimated to equal 0.2%. Lifetime of other refrigeration equipment is calculated with 14 years and emissions from disposal to equal 30%. Emissions from stocks were set equal to the amounts refilled as reported by the companies. This leads to an implied product life factor that range between 13% and 20%.

Industrial refrigeration

In industrial refrigeration refrigerants are used for production process, e.g. in chemical industry to keep definite process temperatures or in food industry for cooling/freezing. The equipment is mostly not pre-manufactured but constructed on site. In contrast to commercial refrigeration, in the industrial sector non HFC/HCFC refrigerants play the major role, especially NH_3. The refrigeration systems normally are served by service companies. Refrigerants of importance today are R-404A, R-407C, R-507. HCFC R-22 is still in use, especially in older equipment. Emissions from manufacturing were estimated to equal 0.15%. Lifetime of industrial refrigeration equipment is calculated with 10 years and emissions from disposal to equal 30%. Emissions from stocks were set equal to the amounts refilled as reported by the companies. This leads to an implied product life factor that range between 7% and 7.5%.

Transport refrigeration

This group includes refrigerated road vehicles (vans, trucks, trailers). Today the most important refrigerants are R-404A, R-134a and R-410A. Refrigerants of less importance: R-407C, HCFC/HFC-blends R-401A and R-402A and HCFC R-22. Manufacturing of refrigeration units does not take place in Austria. Emissions occur from stock and from disposal. Statistical data on refrigerated road vehicles in Austria are not available. Hence experts from the main furnishers of refrigeration units provided the relevant activity data (stock data, refilling of the refrigeration units). The lifetime of the equipment is estimated with 10 years and emissions from disposal equal 30%. Product life factor is estimated to equal 29%.

Stationary Air Conditioning

This sector includes stationary air conditioning, room air conditioning and heat pumps.

Stationary air conditioning includes large equipments >20 kW. Data on consumption for new systems and refilling were provided by service companies the stocks were calculated accordingly. Refrigerants used are R-134a, R-401A, R-402A, R-404A, R-407C and R-410A. Emissions from manufacturing were estimated to equal 0.05%. Lifetime of air conditioning equipment is calculated with 12 years and emissions from disposal to equal 30%. Emissions from stocks were set equal to the amounts refilled as reported by the companies. This leads to an implied product life factor that range between 10% and 11%.

Room acclimatisation / air conditioning is in contrast to stationary acclimatisation a small sector in terms of HFC consumption for new and refilling. Room AC systems include small mobile and compact equipment to be installed at windows or walls, fixed split- and multisplit systems up to 20 kW and larger Variable Refrigerant Flow (VRF) or Multi Air Conditioning systems. Small equipment, split- and multisplit systems and VRF systems are imported already charged with refrigerant and they are not manufactured within the country. Refrigerants used are R-22, R-407C and R-410A. The product life factor of 2.5% is based on expert judgement.

Heat pumps use energy stored in the ground, ground water or air. The installation of heat pumps with HFC started in Austria in the 1990s. The stock of equipment in 1995 was estimated to be in total >50,000 units. About 65% of the newly installed equipment in 2006 was dedicated to space heating and about 28% for heating of water for domestic use as the main areas of application. Heat pumps are manufactured in Austria and – mostly – imported. F-gases used are R-134a, R-404A, R-407C and R-410A, propane is also of importance. In Austria the share of heat pumps for heating of water for domestic use is comparable high. Emissions from stock were calculated with a product life factor of 2%, the product manufacturing factor used is 0.1% and emissions from disposal have been calculated from 2007 onwards, based on a life time of 15 years (EF_{disp} 30%).

Mobile Air Conditioning

In Austria mobile air conditioning includes passenger cars, trucks, busses, agricultural machines, rail and manufacturing of vehicles for construction sites. In Austria the use of R-134a for mobile air conditioning started in 1994.

A detailed model was used to calculate emissions from passenger cars. This includes figures on new registered cars, MAC quota and the average charge. The stocks were calculated accordingly. Operating emissions were calculated as 10% from stocks, emissions from manufacturing as 0.7% and emissions from disposal with 30% assuming a life time of 12 years.

For trucks, buses and agricultural machines a similar model was used. Operating emissions were calculated as 10%, 15% and 25% from stocks, emissions from manufacturing as 0.5% and 0.3%, and emissions from disposal with 30% assuming a life time of 10-12 years.

Figures on vehicles for construction site were directly obtained from the producers. Emissions were calculated applying a product manufacturing factor of 0.3%.

Rail includes railways, tramways and metro. Also in this sector data on vehicle stock, and charge were collected and emissions were calculated by applying a product manufacturing factor of 0.04%, a product life factor of 5% and a disposal loss factor of 30% (applied on reported figures of decommissioning).

Recalculations

Due to the new study the whole refrigeration and air conditioning sector was re-evaluated. This has lead to updated AD, EF and to an update of the structure of this sector. The new study mainly evaluated the years 2000 to 2008. In order to ensure time-series consistency the years before 2000 have also been updated according to the surveyed structure for 2000. Special attention was paid to also evaluate emissions from manufacturing and disposal. Previously the sub-sector commercial refrigeration included only "stand-alone" commercial applications; other commercial applications were included in industrial refrigeration. This has been re-allocated for this submission.

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. The sector was further updated by the latest study on F-gas uses (LEISEWITZ & SCHWARZ 2010) including emissions from manufacturing.

Soft foam

No use of fluorinated gases in soft foams was identified for Austria.

Hard foam

Several types of HFC recently are used for manufacturing of XPS insulation foam (HFC-134a, HFC-152a), of PU rigid foam (HFC-134a, HFC-245fa, HFC-365mfc) and PU one component foam (HFC-134a, HFC-152a) in Austria. Emissions emerge from manufacturing of XPS and PU rigid foam as well as from stocks (and in-situ usage in case of one component foam). Emissions from disposal are not yet to be expected as the lifetime of the foam products is long (>20 years).

According to the Austrian FC-regulation the usage of HFC in the area of foam manufacturing and placing on the market is – with the exemption of XPS panels >80 mm thickness – not any longer allowed from 01.01.2005 onwards, in case of PU one component foams from 01.01.2006 onwards. Differing, special approval for such products may be given under specific conditions (for two years).

XPS hard foam

Since many years the main blowing agent for manufacturing of XPS hard foam is CO_2. But HFC-134a and HFC-152a may also be used for this purpose under specific conditions. In Austria, since 1995, products blown with HFC-134a and since 2000 with HFC-152a, have been put on the market in the order of in total 400-450 thousand m^2. Consequently these HFC can be found in the stock of XPS in buildings etc. During 2000-2008 one Austrian company used HFC-152a as blowing agent for a small portion of about 3% of its XPS outlet in case of short-dated lots for which CO_2 driven XPS foam is not suitable. XPS foam with CO_2 needs a longer storage with regard to shrinking behaviour. The export share of the companies foam products was until 2005 about 50%, later on raising to about 60%. Production data and information about the used blowing agent were obtained from Associations of Industry (construction industry) and from producers.

In case of HFC-152a a prompt out gassing after manufacturing was assumed. Hence annual HFC-152a emissions are estimated to be in the same size as the annual consumption for manufacturing.

HFC-134a was used for manufacturing of XPS-foam within the country and occurred in imports until 2004. This blowing agent remains longer in the foam, the half life time is calculated with >20 years and depends on the panels thickness. HFC-134a emissions from stocks are calculated with a product life factor of 1.15% until 2004 and 0.81% from 2005 onwards, based on information from producers. Emissions from manufacturing were assumed to equal 25% according to the default value for first year losses from the IPCC GPG.

PU hard foam

In the main application areas of PU hard foam (rigid foam insulating panels, flexibly coated; rigidly faced sandwich panels a.o.) hydrocarbons and CO_2 are usually used as blowing agent, but HFC-134a may also be used. In the area of PU insulating foam for pipes HFC-245fa and HFC-365mfc cover a small share of the market whilst CO_2 and pentane are dominating. Fluorinated gases are used in Austria since 2000.

The Austrian market of PU hard foam panels is very small compared to XPS. The share of HFC-134a blown panels of the Austrian PU rigid foam (panels) market was about 10% (import plus production within the country). In case of PU sandwich panels a market share of 25% HFC-134a blown panels (production within Austria and import; the remainder blown with CO_2 or mostly pentane) is assumed. Since 2005 panels blown with HFC-134a are not placed on the market anymore. About 10% of the market of PU insulating foam for pipes in Austria has been blown with HFC-245fa and 365mcf during 2000-2004. From 2005 onwards usage of HFC in this foam sector is prohibited as well as in the other areas.

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. Emissions from manufacturing were assumed to equal 10% according to the default value for first year losses from the IPCC GPG.

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.

PU one component foam

For PU one component foam (OCF) propellants used include HFC-free formulations (flammable gases, propane, butane a.o.), blends of flammable gases and HFC-134a or HFC-152a. HFC 134a and HFC 152a are used as blowing agents for OCF since 1993 in Austria. OCF without HFC has been used in Austria for the first time in 1999. The Austrian F-gas regulation prohibits the use of OCF with HFC from 2006 onwards. Exemptions acc. §7(4) IV are possible for fire protection products The European F-gas regulation (EC No 842/2006) provides a ban on HFC in OCF with a GWP >150 starting from July 2008; HFC-152a (GWP 140) is not affected by this ban. From 2004/2005 onwards the HFC-regulation provoked a rigorous decrease of HFC consumption in OCF to a niche of about 5% of the OCF market. For calculating emissions it is assumed that 100% of the blowing agent is emitted in the first year.

Recalculations

Emissions from one component foams, previously reported under *soft foam* were reallocated to *hard foam*. Emissions from manufacturing have been included. This slightly changed the stock calculation for XPS and PU hard foams as these amounts were previously considered to add to the stock.

4.5.2.3 2.F.3 Fire Extinguishers

Stationary fire protection systems for flooding indoor spaces today mainly use inert gases. Formerly used ozone layer depleting halones have been replaced in some cases by HFC. HFC-23 and HFC-227ea in fire extinguishers were first introduced to the Austrian market in 1993 and 1996, respectively. F-gases for fire fighting are imported in cylinders and filled in fixed installed systems. Fire protection companies re-export recovered F-gas for disposal to the foreign traders/manufacturers.

Detailed data on consumption for new equipment, the stock in existing fixed flooding systems, annual losses (refilling) and recovered F-gases for disposal were obtained directly from the fire protection companies.

HFC emissions occur from filling in fixed systems, from the bank (in case of false alarm, fire, leakage, accidents etc.) and from disposal. Test flooding, in former times an important source of emissions, did not take place since 2000. The emission factor for filling of fixed systems is calculated with 0.05%, the EF for disposal with 1%, both figures accord with literature and reports from fire protection companies. The emissions from bank are equalized with the company reports for refilling of losses. The implied EF from bank is with ~1.5% within the range estimated in IPCC 2006 (p. 7.63) for installed flooding systems (2 ± 1% per year). The mean value of 1.7% was applied to estimate emissions for the years before 2000, for which no detailed data on refilled amounts were available.

Recalculations

C_4F_{10} previously reported for being installed in the 1990s and used in some older Sulzer-equipment, was substituted before 2000 by HFC-227ea, without being released. Thus, these emissions were excluded from the inventory. The EF, previously based on expert judgement, is now based on amounts refilled reported by companies.

4.5.2.4 2.F.4 Aerosols/Metered Dose Inhalers

The group of Aerosols includes medical aerosols, i.e. Metered Dose Inhalers (MDI), technical (or "general") aerosols and the so called "Novelty Aerosols". In Austria only HFC-134a is used as propellant for such aerosols. As the consumption of the product follows in general the purchase immediately, annual stock and annual emissions are equal.

Information about HFC-134a use for medical and technical aerosols was collected by the authors of the recent study (LEISEWITZ & SCHWARZ 2010) directly from industry since 2000. The other years for HFC use in technical and medical sprays were estimated using the Austrian GDP as indicator. Emissions from manufacturing (1.5%) are included in the emissions from stock (product life factor = 100%).

Manufacturing of novelty aerosols does not occur within Austria. Import goods origin from other European Member States. As there is no information on the Austrian market available consumption has been estimated as 0.4% of the total European consumption (estimated by the European Organisation of Aerosol Manufacturers to range between 940 t/year in 2000 and 260 t in 2008). This share was verified by comparison with reported data from importers. Since 2004 marketing of novelty sprays is forbidden in Austria. Under the assumption that certain exceptions are allowed and remainders are sold a continuous decrease in consumption is assumed. Emissions were estimated assuming that 100% are emitted in the first year.

Recalculations

HFC consumption data have been updated according to new industry inquiries. The EF, previously 50% was updated to 100%.

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. Since 2004 the use of HFC in solvents is prohibited in Austria. Since then no further use occurred, which has been confirmed by industry during the latest inquiries.

Emissions were estimated assuming that 100% are emitted in the first 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.

Recalculations

Consumption and emissions of fluorinated gases from 2000 onwards were updated with additional data provided by manufacturers in the course of the latest study.

4.5.2.7 2.F.8 Electrical Equipment (SF_6)

SF_6 is used as an arc quenching and insulating gas in high-voltage (>36 kV [110-380 kV]) and medium-voltage (1-36 kV) switchgear and control gear. The equipment – mainly (Gas-Insulates Systems, GIS) – has not been manufactured during the report period in Austria, but has been completely imported. High-voltage GIS (HV GIS) operate with a high operating pressure (up to 7 bar) and large gas quantities. They are imported with a transport filling and are filled up on site. The systems are “closed for life” and have to be replenished in their lifetime. Emissions from operating HV systems are higher than emissions from medium-voltage GIS (MV GIS). These operate with lower overpressure and small gas quantities of only some kg/system. They are already charged with SF_6 when imported and are hermetically closed (“sealed for life”). Both categories of equipment have lifetimes of 30-40 years.

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.

The EF_{op} of HV- and MV-GIS correspond to the default emission factors of the IPCC GL 2006 with 0.7% (HV) and 0.1% (MV) per year, respectively. Manufacturing emissions from first filling were estimated to 1% according to reported data, the EF_{disp} is assumed to equal 2%.

Recalculations

Emissions from manufacturing and disposal have been included in the inventory. The product life factor, previously based on expert judgement, has been updated differentiating between medium and high voltage gears.

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.

Approximately one-third of the total amount of SF_6 used for filling of the double glass windows is released during assembly. For the stock of gas remaining inside the window (bank), an annual leakage rate of 1 percent is assumed. At the end of the lifetime, about 75% of the initial stock remains and is lost by disposal. As of 2003, the Austrian F-gas regulation stopped by legal prohibition the usage of SF_6 as filling gas for soundproof glazing. Emissions at disposal became relevant in 2005, 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

SF_6 shows a low permeability through rubber (cf. IPCC GL 2006, p. 8.31). The German tyre manufacturer Continental AG exploited this property and offered in the 1990s tyres with SF_6 as filling gas instead of air. In Austria the national tyre and automotive trade sold tyres with SF_6 as filling gas filled within the country. The gas used for this purpose was supplied by only one SF_6 importer, who reported on the amount of SF_6 sold to the Austrian tyre and automotive trade. As of 2003, the Austrian F-gas regulation stopped abruptly by legal prohibition the usage of SF_6 as filling gas for tyres.

According to IPCC GL 2006 it is assumed that SF_6 completely emits from car tyres with their disposal three years after filling. Filling emissions are regarded to be insignificant. Consumption of SF_6 and disposal emissions three years later are identical.

Shoes

Nike introduced sport shoes with gas cushions filled with SF_6 in the early 1990's. From 2003 to 2006 the company used as alternative PFC (C_3F_8) for the same purpose. Shoes with F-gas cushions are not manufactured in Austria but imported. SF_6 emissions from sport shoe soles occurred in Austria up to 2006, PFC-C_3F_8 from 2006 to 2008.

Data on the import of these products to Austria could not be provided by Nike. It was accepted as plausible that the German and the Austrian market could be regarded as comparable. Data on the German market are well documented. Austria has 10% of the population compared to Germany, hence the same percentage was assumed for annual consumption of such footwear in Austria. In case of perfluoropropane the European consumption in 2003-2005 is known and the Austrian market calculated with 2.5% (= 10% of the German market).

Operating emissions during the use of the footwear are not considered. The lifetime of sport shoes is estimated with 3 years. At the disposal of old shoes 100% of the initial filling is released to the atmosphere (i.e. EF_{disp} = 100%). Emissions of year 3 are treated to be equal to the amount of F-gas filled in sport shoes put on the market in the year n-3.

Research

SF_6 is used in particle accelerators (linear accelerators, linacs) as insulating gas to prevent electrical flash over. A small number of high voltage equipment (0.3->23 MV) is or has been used in Austria in academic research, in industry and medical therapy. The bigger HV-equipment for research and industrial purposes operates normally with an accelerator and HV-generator situated in a tank insulated with SF_6 that is mostly pressurized. Gas losses occur at servicing, repair or adjustment of the device. Linear accelerators for medical radiotherapy (cancer therapy) are industrially made and prefilled. Their waveguide is SF_6 insulated; the filling volume is in the order of ~3 litre – much smaller than the above mentioned equipment in research and industry. Electronic microscopes (>100 kV) have a high voltage tank filled with ~ 5 kg SF_6.

Manufacturers and operators provided the number of devices operating in Austria. Data on filling volume and refilling have been collected from the institutions and companies operating the equipment, from manufacturers and from service companies. The annual F-gas consumption (first filling of new products) normally is very small (order of kg) and reached only one year about 400 kg. The stock is for all years below 1 t. The implied EF is in the order of 6%, but there is a wide difference between the several types of equipment.

The emissions from bank are equalized with the company reports for refilling of losses.

Recalculations

Windows: First year of occurrence of emissions from disposal was changed from 2006 to 2005, based on the lifetime of windows. Consumption of SF_6 for the years 2000-2003 was updated with additional data provided by manufacturers and suppliers in the course of the latest study.

Tyres: EF was changed according to IPCC GL 2006, where it is assumed that SF_6 completely emits from car tyres with their disposal three years after filling. Previously emissions were calculated as one third per year for the three years following consumption.

Shoes: C3F8 emissions, previously not reported have been included in the inventory.

4.5.3 Source specific QA/QC

EF obtained by industry inquiries were compared with the IPCC default values. In the national study the total consumption of HFC, PFC and SF_6 was obtained by the main importers and this data was checked against information from retailers, service companies and producers of equipment. The complete model and all calculation sheets were provided to inventory compilers and quality control was performed by a detailed data audit. All documentation on correspondence during the study and any information obtained is stored and was provided to the inventory compiler.

4.5.4 Uncertainty estimate

For the key sources an uncertainty estimate was made:

2.F.1/2/3/4/5 ODS Substitute

Uncertainty of the activity data was estimated to be 20%, as on the one hand total consumption figures are adjusted with import/export figures, but on the other hand the disaggregation to sub sectors is in some cases ambiguous (which has an effect on emissions as the emission factors used for the different sub categories can differ significantly).

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 SF6

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 Planned Improvements

All planned improvements have been implemented in this inventory. For the time being no further improvements are planned.

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 2008, 0.4% of total GHG emissions in Austria (388 Gg CO_2 equivalents) originated from *Solvent and Other Product Use*. 60% of these emissions were indirect CO_2 emissions, 40% were accounted for by N_2O emissions.

Figure 16 and Table 122 present the trend in total greenhouse gas emissions by subcategories.

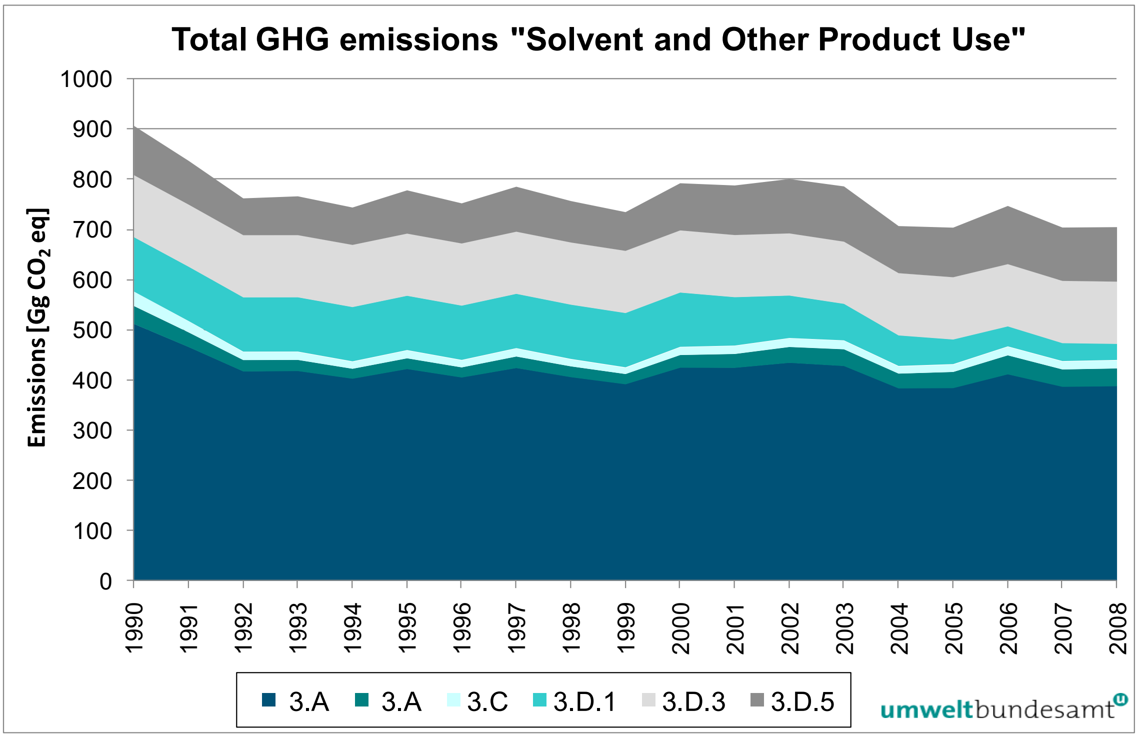

Figure 16: Total greenhouse gas emissions and trend from 1990–2008 by subcategories of Category 3 Solvent and Other Product Use.

Table 122: Total greenhouse gas emissions and trend from 1990–2008 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*	*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	425.12	58.52	25.17	15.03	326.40	108.50	124.00	93.90
2001	424.82	62.37	27.55	15.47	319.43	96.72	124.00	98.71
2002	434.79	69.41	31.45	16.63	317.30	84.94	124.00	108.36
2003	428.48	71.50	33.20	16.52	307.25	73.16	124.00	110.09
2004	384.10	61.78	29.38	13.76	279.19	61.38	124.00	93.81
2005	384.65	65.98	32.10	14.15	272.42	49.60	124.00	98.82
2006	411.97	77.43	37.67	16.60	280.26	40.30	124.00	115.96
2007	387.23	70.96	34.52	15.22	266.54	36.27	124.00	106.27
2008	388.41	72.49	35.27	15.54	265.11	32.55	124.00	108.56
Trend 2007–2008	0.3%	2.2%	2.2%	2.2%	-0.5%	-10.3%	0.0%	2.2%
Trend 1990-2008	-24.1%	-38.4%	-0.7%	-44.4%	-19.8%	-70.0%	0.0%	10.6%

Greenhouse gas emissions in this sector decreased by 24% between 1990 and 2008, due to decreasing solvent and N_2O use as well as due to the positive impact of the enforced laws and regulations in Austria:

- Solvent Ordinance: limitation of emission of volatile organic compounds due to the use of organic solvents in certain paints and varnishes and vehicle refinishing products in order to combat acidification and ground-level ozone

  Federal Law Gazette II No. 398/2005[36]*, amendment of Federal Law Gazette 872/1995*[37]*; amendment of Federal Law Gazette 492/1991*[38] *(implementation of Council Directive 2004/42/CE)*

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[36] Verordnung des Bundesministers für Land- und Forstwirtschaft, Umwelt und Wasserwirtschaft über die Begrenzung der Emissionen flüchtiger organischer Verbindungen durch Beschränkung des Inverkehrsetzens und der Verwendung organischer Lösungsmittel in bestimmten Farben und Lacken (Lösungsmittelverordnung 2005 – LMV 2005), BGBl. II Nr. 398/2005; Umsetzung der Richtlinie 2004/42/EG

- Ordinance for paint finishing system (surface technology systems): limitation of emission of volatile organic compounds due to the use of organic solvents by activities such as surface coating, painting or varnishing of different materials and products along the entire chain in the painting process in order to combat acidification and ground-level ozone

  Federal Law Gazette 873/1995[39]*, amendment of Federal Law Gazette 27/1990*[40]
- Federal Ozone Law: establishes by various measures a reduction in emissions of ozone precursors NO_x and NMVOC

  Federal Law Gazette 309/199, amendment of Federal Law Gazette 210/1992[41]
- 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[42]
- Convention on Long-range Transboundary Air Pollution (LRTAP)[43], extended by eight protocols from which the following have relevance
  - The 1988 Protocol concerning the Control of Nitrogen Oxides or their Transboundary Fluxes[44]
  - The 1991 Protocol concerning the Control of Emissions of Volatile Organic Compounds or their Transboundary Fluxes[45]
  - The 1998 Protocol on Persistent Organic Pollutants (POPs)[46]
  - The 1999 Protocol to Abate Acidification, Eutrophication and Ground-level Ozone; 21 Parties.[47]

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

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

[39] 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

[40] 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

[41] 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)

[42] 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

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

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

[45] 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

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

[47] 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[48]*, amended by Federal Law Gazette*[49]
- Council Directive 1999/13/EC[50] 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[51] 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[52]

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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[48] 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

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

[50] 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

[51] 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

[52] 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 123 presents the trend in total greenhouse gas emissions by gas.

Table 123:Trend in greenhouse gas emissions of solvent and other product use 1990–2008.

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	192.62	232.50	425.12
2001	204.10	220.72	424.82
2002	225.85	208.94	434.79
2003	231.32	197.16	428.48
2004	198.72	185.38	384.10
2005	211.05	173.60	384.65
2006	247.67	164.30	411.97
2007	226.96	160.27	387.23
2008	231.86	156.55	388.41
Trend 2007–2008	2.2%	-2.3%	0.3%
Trend 1990-2008	-17.0%	-32.7%	-24.1%

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 124: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 / TA 08

LA90 = Level Assessment 1990; LA90 = Level Assessment 2008

5.1.3 Completeness

Table 125 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 125: 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 17 to Figure 19 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.

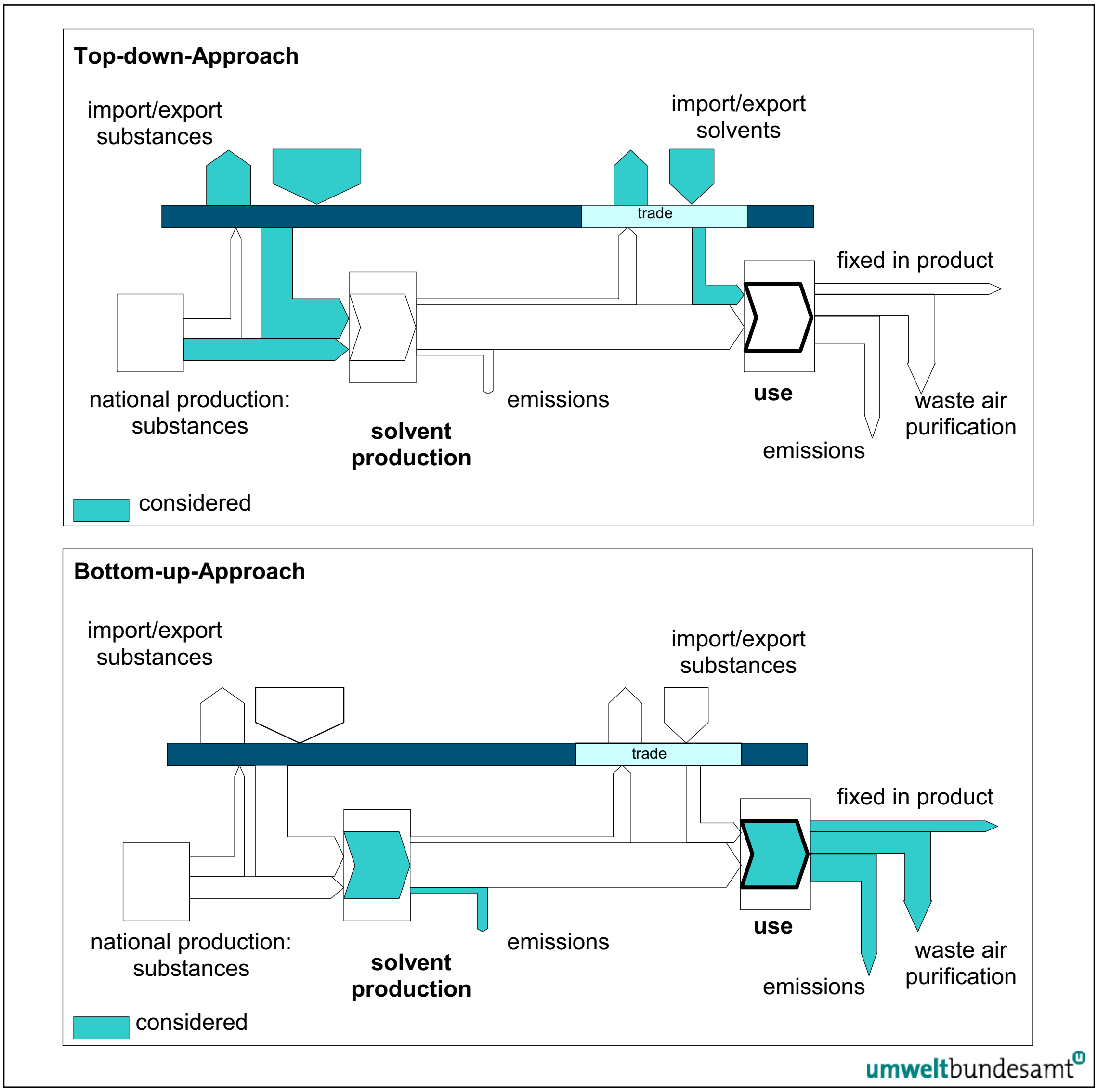
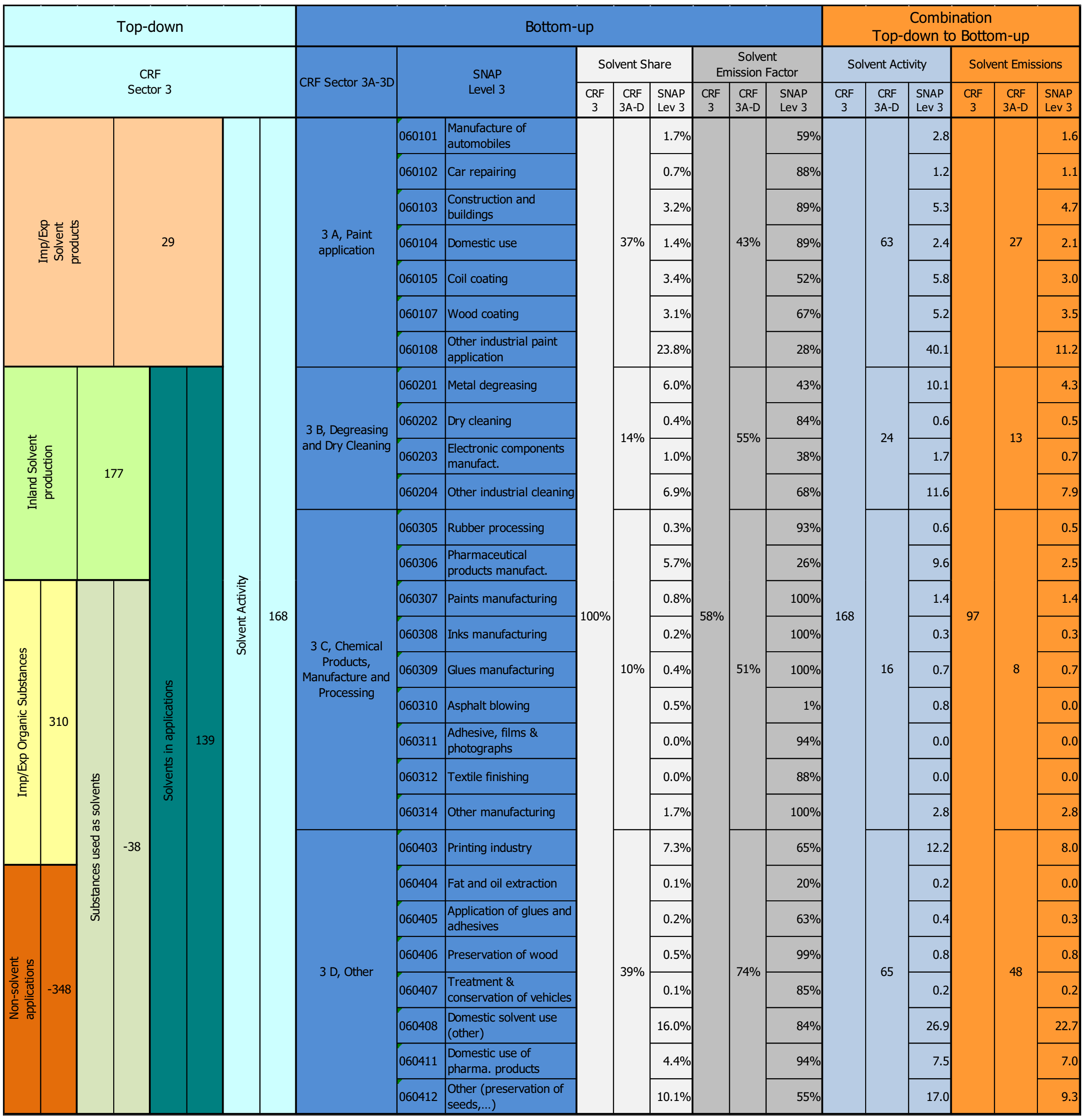


Figure 17: Top-down-Approach compared to Bottom-up-Approach.



Top-down	
CRF Sector 3	
Imp/Exp Solvent products	29
Inland Solvent production	177
Imp/Exp Organic Substances	310
Non-solvent applications	-348
Substances used as solvents	-38
Solvents in applications	139
Solvent Activity	168

Bottom-up									Combination Top-down to Bottom-up					
CRF Sector 3A-3D	SNAP Level 3		Solvent Share			Solvent Emission Factor			Solvent Activity			Solvent Emissions		
			CRF 3	CRF 3A-D	SNAP Lev 3	CRF 3	CRF 3A-D	SNAP Lev 3	CRF 3	CRF 3A-D	SNAP Lev 3	CRF 3	CRF 3A-D	SNAP Lev 3
3 A, Paint application	060101	Manufacture of automobiles	100%	37%	1.7%	58%	43%	59%	168	63	2.8	97	27	1.6
	060102	Car repairing			0.7%			88%			1.2			1.1
	060103	Construction and buildings			3.2%			89%			5.3			4.7
	060104	Domestic use			1.4%			89%			2.4			2.1
	060105	Coil coating			3.4%			52%			5.8			3.0
	060107	Wood coating			3.1%			67%			5.2			3.5
	060108	Other industrial paint application			23.8%			28%			40.1			11.2
3 B, Degreasing and Dry Cleaning	060201	Metal degreasing		14%	6.0%		55%	43%		24	10.1		13	4.3
	060202	Dry cleaning			0.4%			84%			0.6			0.5
	060203	Electronic components manufact.			1.0%			38%			1.7			0.7
	060204	Other industrial cleaning			6.9%			68%			11.6			7.9
3 C, Chemical Products, Manufacture and Processing	060305	Rubber processing		10%	0.3%		51%	93%		16	0.6		8	0.5
	060306	Pharmaceutical products manufact.			5.7%			26%			9.6			2.5
	060307	Paints manufacturing			0.8%			100%			1.4			1.4
	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%			2.8			2.8
3 D, Other	060403	Printing industry		39%	7.3%		74%	65%		65	12.2		48	8.0
	060404	Fat and oil extraction			0.1%			20%			0.2			0.0
	060405	Application of glues and adhesives			0.2%			63%			0.4			0.3
	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%			26.9			22.7
	060411	Domestic use of pharma. products			4.4%			94%			7.5			7.0
	060412	Other (preservation of seeds,...)			10.1%			55%			17.0			9.3

Figure 18: Combination of Top-down-Approach compared to Bottom-up-Approach for 2008 (in Gg).

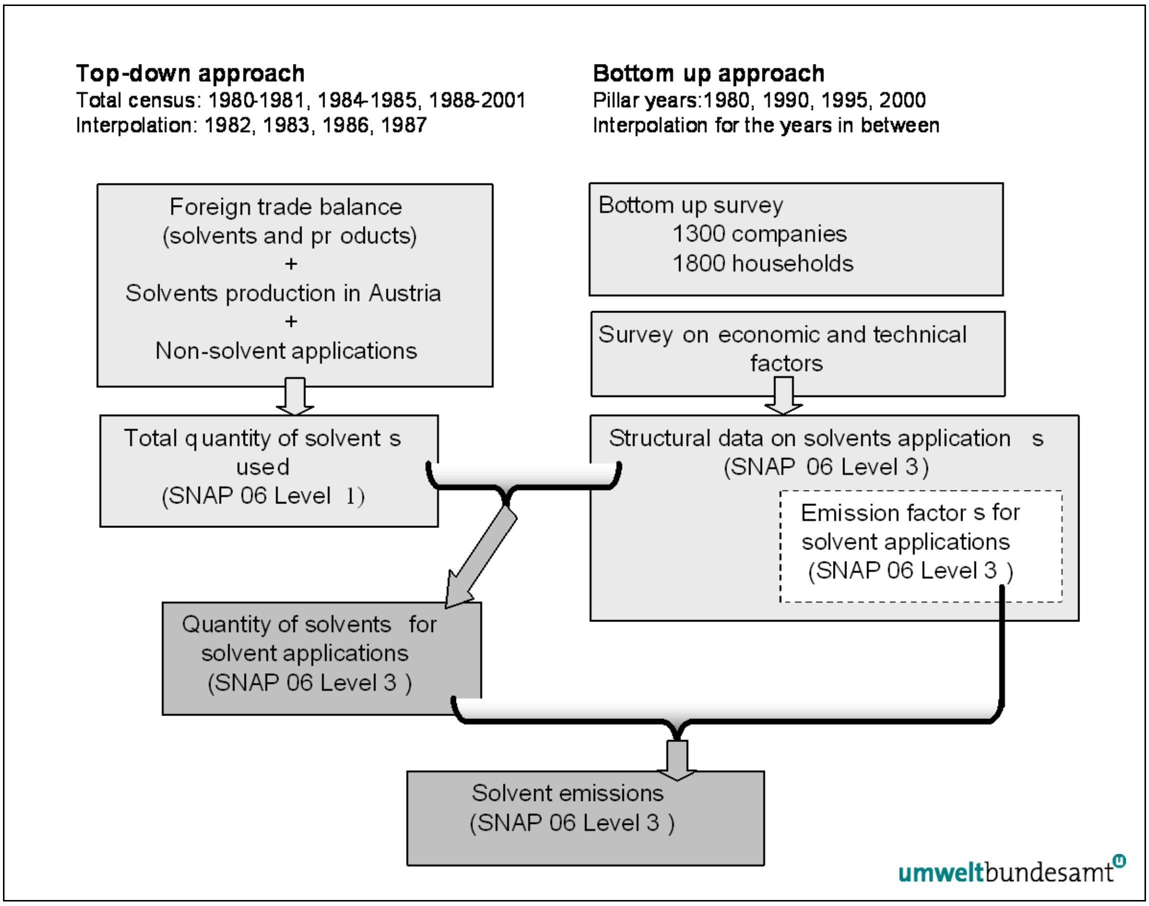


Figure 19: Overview of the methodology for solvent emissions.

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[53], ETBE[54], 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.

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[53] Methyl-tertiär-butylether

[54] Ethyl-*tert*-butylether

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.

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 126).

Table 126: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 127: 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 128: 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%
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%

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

Table 129: 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 130). 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 130 shows the range of the differences in the considered pillar years broken down to the 15 substance categories.

Table 130: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	░	░	░	▒	░	░	▒	░	░	░	░	░	▒	░	░	░	-24
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 131 presents activity data and implied emission factors.

The inventory has been updated with data from (WINDSPERGER et al. 2008).

Table 131: Activity data for solvent and other product use [Mg].

IPCC	**3.A**							
SNAP	**Total**	**060101**	**060102**	**060103**	**060104**	**060105**	**060107**	**060108**
Unit	**Mg Solvent**							
1990	54 665	1 785	995	3 827	4 535	5 626	7 002	30 896
1991	48 827	1 515	889	3 542	3 558	5 061	6 139	28 124
1992	41 825	1 230	763	3 140	2 627	4 366	5 160	24 540
1993	45 119	1 254	823	3 502	2 382	4 742	5 460	26 956
1994	45 044	1 179	823	3 609	1 929	4 767	5 345	27 392
1995	52 085	1 280	953	4 304	1 714	5 550	6 059	32 226
1996	49 249	1 303	904	4 073	1 666	5 177	5 537	30 589
1997	52 612	1 495	968	4 355	1 830	5 452	5 702	32 809
1998	47 117	1 435	870	3 904	1 686	4 809	4 907	29.505
1999	42 917	1 399	796	3 559	1 581	4 311	4 281	26 991
2000	50 391	1 755	938	4 183	1 911	4 976	4 794	31 834
2001	53 759	1 977	1 008	4 486	2 035	5 232	4 980	34 042
2002	59 892	2 318	1 130	5 023	2 264	5 744	5 400	38 013
2003	61 757	2 507	1 174	5 206	2.331	5.837	5 417	39 286
2004	53 410	2 268	1 022	4 524	2 013	4 974	4 556	34 053
2005	57 101	2 530	1 100	4 860	2 148	5 240	4 736	36 486
2006	67 010	2 969	1 291	5 704	2 521	6 150	5 557	42 818
2007	61 407	2 721	1 183	5 227	2 310	5 636	5 093	39 238
2008	62 733	2 780	1 208	5 340	2 360	5 757	5 203	40 085

IPCC	**3.B**				
SNAP	**Total**	**060201**	**060202**	**060203**	**060204**
Unit	**Mg Solvent**				
1990	15 926	9 258	459	2 191	4 017
1991	14 001	7 866	408	1 902	3 826
1992	11 803	6 394	348	1 582	3 479
1993	12 527	6 528	373	1 655	3 971
1994	12 302	6 149	370	1 602	4 181
1995	13 990	6 687	426	1 794	5 083
1996	13 989	6 626	417	1 694	5 252
1997	15 792	7 415	461	1 808	6 107
1998	14 933	6 955	428	1 617	5 933
1999	14 353	6 634	404	1 471	5 844
2000	17 773	8 155	492	1 725	7 401
2001	19 308	8 696	524	1 768	8 321
2002	21 892	9 682	582	1 890	9 738
2003	22 962	9 978	600	1 867	10 517
2004	20 190	8 625	518	1 545	9 501
2005	21 934	9 216	553	1 579	10 586
2006	25 741	10 816	648	1 853	12 424
2007	23 588	9 911	594	1 698	11 385
2008	24 098	10 125	607	1 735	11 630

IPCC	3.C								
SNAP	Total	060305	060306	060307	060308	060309	060310	060311	060312	060314
Unit	Mg Solvent									
1990	18 585	977	8 272	3 170	359	829	1 329	3	157	3 488
1991	15 609	853	6 886	2 582	313	743	1 158	3	131	2 940
1992	12 525	714	5 470	1 998	262	639	967	3	105	2 369
1993	12 603	752	5 440	1 926	275	691	1 017	3	104	2 394
1994	11 679	733	4 973	1 695	268	692	989	3	96	2 230
1995	12 465	826	5 223	1 697	302	803	1 114	4	101	2 395
1996	12 305	749	5 614	1 525	282	791	987	4	89	2 265
1997	13 722	764	6 749	1 541	297	879	980	4	87	2 420
1998	12 828	650	6 746	1 298	263	819	809	4	71	2 167
1999	12 196	561	6 812	1 104	236	777	671	4	57	1 974
2000	14 948	619	8 816	1 200	273	949	708	5	59	2 319
2001	15 523	623	9 163	1 256	290	928	742	5	58	2 457
2002	16 827	653	9 944	1 372	321	942	812	6	60	2 718
2003	16 877	632	9 983	1 387	328	877	822	6	57	2 784
2004	14 191	511	8 404	1 176	282	678	698	5	45	2 392
2005	14 744	508	8 742	1 233	300	640	733	5	44	2 540
2006	17 303	597	10 258	1 446	352	751	860	6	51	2 981
2007	15 856	547	9 401	1 326	322	688	788	6	47	2 732
2008	16 198	558	9 604	1 354	329	703	805	6	48	2 790

IPCC	3.D.5								
SNAP	Total	060403	060404	060405	060406	060407	060408	060411	060412
Unit	Mg Solvent								
1990	48 748	14 729	510	836	677	217	13 842	4 984	12 952
1991	44 506	13 050	442	717	601	197	13 305	4 578	11 617
1992	38 946	11 089	366	588	512	171	12 200	4 029	9 992
1993	42 897	11 865	382	607	549	186	14 023	4 462	10 823
1994	43 705	11 749	369	579	545	188	14 857	4 569	10 849
1995	51 548	13 474	412	637	627	220	18 167	5 416	12 595
1996	49 960	12 541	369	601	594	203	18 238	5 265	12 149
1997	54 728	13 177	370	640	637	211	20 664	5 784	13 245
1998	50 278	11 594	309	571	572	183	19 608	5 329	12 110
1999	46 998	10 364	261	519	522	162	18 907	4 996	11 267
2000	56 657	11 929	281	607	615	184	23 483	6 040	13 519
2001	59 520	12 268	269	587	666	195	24 647	6 433	14 456
2002	65 295	13 164	265	587	752	216	27 013	7 155	16 142
2003	66 294	13 061	239	538	785	221	27 401	7 366	16 681
2004	56 452	10 858	178	408	688	190	23 311	6 361	14 459
2005	59 422	11 147	159	375	745	203	24 513	6 790	15 491
2006	69 734	13 082	187	440	874	238	28 767	7 968	18 179
2007	63 903	11 988	171	403	801	218	26 362	7 302	16 659
2008	65 283	12 247	175	412	818	223	26 931	7 459	17 019

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 132) on the basis of the carbon content and the stoichiometrically formed CO_2.

Table 132: 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 133 the carbon dioxide emissions of Category 3 Solvent and Other Product Use for the years 1990 to 2008 are shown.

Table 133: CO_2 emission of Category 3 Solvent and Other Product Use 1990–2008.

IPCC	**3.A**							
SNAP	**Total**	**060101**	**060102**	**060103**	**060104**	**060105**	**060107**	**060108**
Unit	**Mg Solvent**							
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	58.52	2.68	2.19	10.24	4.56	7.29	8.39	23.17
2001	62.37	3.02	2.35	10.98	4.86	7.67	8.72	24.77
2002	69.41	3.54	2.64	12.29	5.41	8.42	9.45	27.66
2003	71.50	3.83	2.74	12.74	5.57	8.56	9.48	28.59
2004	61.78	3.46	2.39	11.07	4.81	7.29	7.98	24.78
2005	65.98	3.86	2.57	11.89	5.13	7.68	8.29	26.55

IPCC	3.A							
SNAP	**Total**	**060101**	**060102**	**060103**	**060104**	**060105**	**060107**	**060108**
Unit	**Mg Solvent**							
2006	77.43	4.53	3.01	13.96	6.02	9.01	9.73	31.16
2007	70.96	4.16	2.76	12.79	5.52	8.26	8.92	28.56
2008	72.49	4.25	2.82	13.07	5.64	8.44	9.11	29.17

IPCC	3.B				
SNAP	**Total**	**060201**	**060202**	**060203**	**060204**
Unit	**Mg Solvent**				
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	13.34
2001	27.55	10.12	0.77	1.66	14.99
2002	31.45	11.27	0.86	1.78	17.55
2003	33.20	11.61	0.88	1.76	18.95
2004	29.38	10.04	0.76	1.45	17.12
2005	32.10	10.73	0.81	1.48	19.07
2006	37.67	12.59	0.96	1.74	22.38
2007	34.52	11.54	0.88	1.60	20.51
2008	35.27	11.79	0.90	1.63	20.96

IPCC	3.C									
SNAP	**Total**	**060305**	**060306**	**060307**	**060308**	**060309**	**060310**	**060311**	**060312**	**060314**
Unit	**Mg Solvent**									
1990	27.94	2.82	8.21	8.80	0.64	2.22	0.04	0.01	0.33	4.87
1991	21.55	2.46	6.20	6.36	0.50	1.82	0.04	0.01	0.28	3.88
1992	15.48	2.04	4.39	4.17	0.36	1.35	0.03	0.01	0.22	2.92
1993	15.27	2.11	3.85	4.31	0.41	1.57	0.03	0.01	0.22	2.76
1994	13.37	2.01	3.03	3.78	0.39	1.55	0.03	0.01	0.20	2.37
1995	15.08	2.30	2.80	4.61	0.53	2.13	0.04	0.01	0.22	2.45
1996	13.48	1.99	2.92	3.80	0.46	1.93	0.03	0.01	0.18	2.16
1997	15.41	2.07	3.62	4.27	0.53	2.39	0.03	0.01	0.18	2.30
1998	13.38	1.77	3.65	3.28	0.43	2.05	0.03	0.01	0.15	2.02

IPCC	3.C									
SNAP	**Total**	**060305**	**060306**	**060307**	**060308**	**060309**	**060310**	**060311**	**060312**	**060314**
Unit	**Mg Solvent**									
1999	11.91	1.53	3.69	2.59	0.36	1.80	0.02	0.01	0.12	1.79
2000	15.03	1.71	4.82	3.23	0.49	2.55	0.02	0.01	0.13	2.07
2001	15.47	1.72	5.01	3.38	0.51	2.49	0.02	0.01	0.13	2.19
2002	16.63	1.81	5.43	3.69	0.57	2.53	0.03	0.01	0.13	2.43
2003	16.52	1.75	5.45	3.74	0.58	2.35	0.03	0.01	0.12	2.48
2004	13.76	1.41	4.59	3.17	0.50	1.82	0.02	0.01	0.10	2.13
2005	14.15	1.41	4.78	3.32	0.53	1.72	0.02	0.01	0.10	2.27
2006	16.60	1.65	5.60	3.89	0.62	2.02	0.03	0.01	0.11	2.66
2007	15.22	1.51	5.14	3.57	0.57	1.85	0.03	0.01	0.10	2.44
2008	15.54	1.55	5.25	3.65	0.58	1.89	0.03	0.01	0.11	2.49

IPCC	3.D.5								
SNAP	**Total**	**060403**	**060404**	**060405**	**060406**	**060407**	**060408**	**060411**	**060412**
Unit	**Mg Solvent**								
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	93.90	16.74	0.19	1.11	1.63	0.37	42.64	12.99	18.23
2001	98.71	17.21	0.18	1.08	1.77	0.40	44.75	13.83	19.49
2002	108.36	18.47	0.18	1.08	1.99	0.44	49.05	15.39	21.77
2003	110.09	18.32	0.16	0.99	2.08	0.45	49.75	15.84	22.49
2004	93.81	15.23	0.12	0.75	1.83	0.39	42.32	13.68	19.50
2005	98.82	15.64	0.11	0.69	1.98	0.41	44.51	14.60	20.89
2006	115.96	18.35	0.12	0.81	2.32	0.48	52.23	17.13	24.51
2007	106.27	16.82	0.11	0.74	2.13	0.44	47.86	15.70	22.46
2008	108.56	17.18	0.12	0.76	2.17	0.45	48.90	16.04	22.95

Table 134: Implied CO_2 Emission factors for Category 3 Solvent and Other Product Use 1990–2008.

IPCC				**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
2008	1.53	2.34	2.45	2.39	1.47	1.75	0.73

IPCC		**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
2008	1.16	1.47	0.94	1.80

IPCC				**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
2008	2.77	0.55	2.69	1.78	2.68	0.03	2.18	2.19	0.89

IPCC				**3.D.5**				
SNAP	**060403**	**060404**	**060405**	**060406**	**060407**	**060408**	**060411**	**060412**
Unit				**[tCO_2/t]**				
1990	1.98	0.66	2.55	2.70	1.89	1.87	2.15	2.13
1991	1.88	0.67	2.42	2.72	1.95	1.92	2.19	1.98
1992	1.77	0.66	2.29	2.69	1.96	1.92	2.19	1.82
1993	1.66	0.65	2.16	2.66	1.96	1.89	2.17	1.67
1994	1.54	0.64	2.02	2.59	1.93	1.82	2.11	1.52
1995	1.49	0.66	1.97	2.61	1.96	1.82	2.12	1.43
1996	1.41	0.63	1.86	2.51	1.88	1.74	2.04	1.36
1997	1.43	0.64	1.88	2.58	1.94	1.79	2.10	1.37
1998	1.42	0.65	1.86	2.60	1.96	1.80	2.11	1.36
1999	1.40	0.65	1.84	2.61	1.98	1.80	2.12	1.35

IPCC	3.D.5							
SNAP	**060403**	**060404**	**060405**	**060406**	**060407**	**060408**	**060411**	**060412**
Unit	[tCO_2/t]							
2000	1.40	0.66	1.84	2.65	2.03	1.82	2.15	1.35
2001	1.40	0.66	1.84	2.65	2.03	1.82	2.15	1.35
2002	1.40	0.66	1.84	2.65	2.03	1.82	2.15	1.35
2003	1.40	0.66	1.84	2.65	2.03	1.82	2.15	1.35
2004	1.40	0.66	1.84	2.65	2.03	1.82	2.15	1.35
2005	1.40	0.66	1.84	2.65	2.03	1.82	2.15	1.35
2006	1.40	0.66	1.84	2.65	2.03	1.82	2.15	1.35
2007	1.40	0.66	1.84	2.65	2.03	1.82	2.15	1.35
2008	1.40	0.66	1.84	2.65	2.03	1.82	2.15	1.35

5.2.6 QA/QC

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 Solvent and Other Product Use

The input data, estimates and results are checked as follows. The results of these checks are described in the QA/QC documentation:

Bottom-up check

Input data and emission factors

- Check for the plausibility of the activity data and their trend and check for plausibility of the emission factors as well as the related input data and their trends

  ✓ Documentation of the most important reasons for changes and non-changes of activity data

  ✓ Check and documentation, if these changes or non-changes of activity data fit to trends of underlying conditions

✓ If checks do not allow any explanation, further check of the used statistics and their estimates and/or communication with the data providers

- Check of input data for completeness

Emissions

- Check of the correctness of all equations in the estimate files
- Check of the correctness of all interim results
- Check of the plausibility of the results and their trends related to activity data and emission factors and documentation of the plausibility of changes and non-changes as above mentioned
- Check of the correctness of all data and results transfer

Top-down check

- Comparison of the used activity data with those from other statistics: Statistik Austria publication and EUROSTAT database. 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
- Comparison of the used activity data with those from relevant plant operators and associations. 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
- Comparison of the used emission factors and underlying input data with those of other data sources (e.g. from literature, association publications, results in NIRs of other comparable regions, IPCC default values). Documentation of the results of these comparisons. Further checks according to the points mentioned above as well as check on the suitability of the used input data in case of implausible differences. Documentation of this further check.

5.2.7 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 135 and Table 136 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 135: 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 136: 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 **Use of N_2O for anaesthesia**	**3.D.3** **Use of N_2O in aerosol cans**	**3.D.2** **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 2001–2008.	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.[55]		–
	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 1.00 Mg N_2O/Mg product use		–

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[55] EMEP/EEA air pollutant emission inventory guidebook — 2009. Technical report No 6/2009. Prepared by the UNECE/EMEP Task Force on Emissions Inventories and Projections (TFEIP) and published by the European Environment Agency (EEA).

Table 137: N_2O-consumption of anaesthesia and N_2O-consumption in aerosol cans.

	3 D	3.D.1	3.D.3
	Total (use of N_2O)	**use of N_2O for anaesthesia**	**use of N_2O in aerosol cans**
Unit		**Gg**	
1990	0.750	0.350	0.400
1991	0.750	0.350	0.400
1992	0.750	0.350	0.400
1993	0.750	0.350	0.400
1994	0.750	0.350	0.400
1995	0.750	0.350	0.400
1996	0.750	0.350	0.400
1997	0.750	0.350	0.400
1998	0.750	0.350	0.400
1999	0.750	0.350	0.400
2000	0.750	0.350	0.400
2001	0.712	0.312	0.400
2002	0.674	0.274	0.400
2003	0.636	0.236	0.400
2004	0.598	0.198	0.400
2005	0.560	0.160	0.400
2006	0.530	0.130	0.400
2007	0.517	0.117	0.400
2008	0.505	0.105	0.400

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 138: 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 Informative Inventory Report (IIR) 2010.

Update of activity data

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

The short term statistics for trade and services and the Austrian foreign trade statistics were updated from 2004 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.:

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

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 139: Recalculation difference with respect to submission 2009.

CO_2 Emission		**Absolute difference [Gg]**				**Relative difference [Δ%]**	
		1990	**2000**	**2006**	**2007**	**1990**	**2006**
3	Solvent and Other Product Use	0.00	0.06	-0.19	-21.57	=	-9%
3 A	Paint application	0.00	0.02	-0.06	-6.74	=	-9%
3 B	Degreasing and dry cleaning	0.00	0.01	-0.03	-3.28	=	-9%
3 C	Chemical products, manufacture and processing	0.00	0.00	-0.01	-1.45	=	-9%
3 D 5	Other solvent use	0.00	0.03	-0.09	-10.10	=	-9%

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.

As a result of the previous UNFCCC reviews the ERT recommended Austria to update its information on average waste management system (AWMS) distribution (ARR 2006, ARR 2008). Hence, in 2008 the Umweltbundesamt commissioned the University of Natural Resources and Applied Life Sciences with the revision of the national emission model of the sector agriculture (AMON & HÖRTENHUBER 2010). The new input-data on AWMS was taken from the research project "Animal husbandry and manure management systems in Austria" (AMON et al. 2007). This project provides a comprehensive survey on the agricultural practice in Austria.

The emission calculations within the revised agriculture GHG inventory follow the methodologies according to the Revised 1996 IPCC Guidelines and the IPCC Good Practice Guidance 2000.

For the calculation of the losses of gaseous N species the mass-flow procedure pursuant to EMEP/CORINAIR has been used. In 2009 a detailed emission model for NH_3, NMVOC und NO_x has been integrated into the national inventory (AMON, B. & HÖRTENHUBER, S. 2008). These studies are not published. A detailed description of the applied methods is given in Austria's Informative Inventory Report 2010 (UMWELTBUNDESAMT 2010).

To give an overview of Austria's agricultural sector some information is provided below (according to the 2005 Farm Structure Survey – full survey) (BMLFUW 2000-2009):

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

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

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

6.1.1 Emission Trends

In the year 2008 the sector agriculture contributed 8.8% to the total of Austria's greenhouse gas emissions (without LULUCF). The trend of GHG emissions from 1990 to 2008 shows a decrease of 10.8% for this sector (see Figure 20 and Table 141) due to a decrease in activity data.

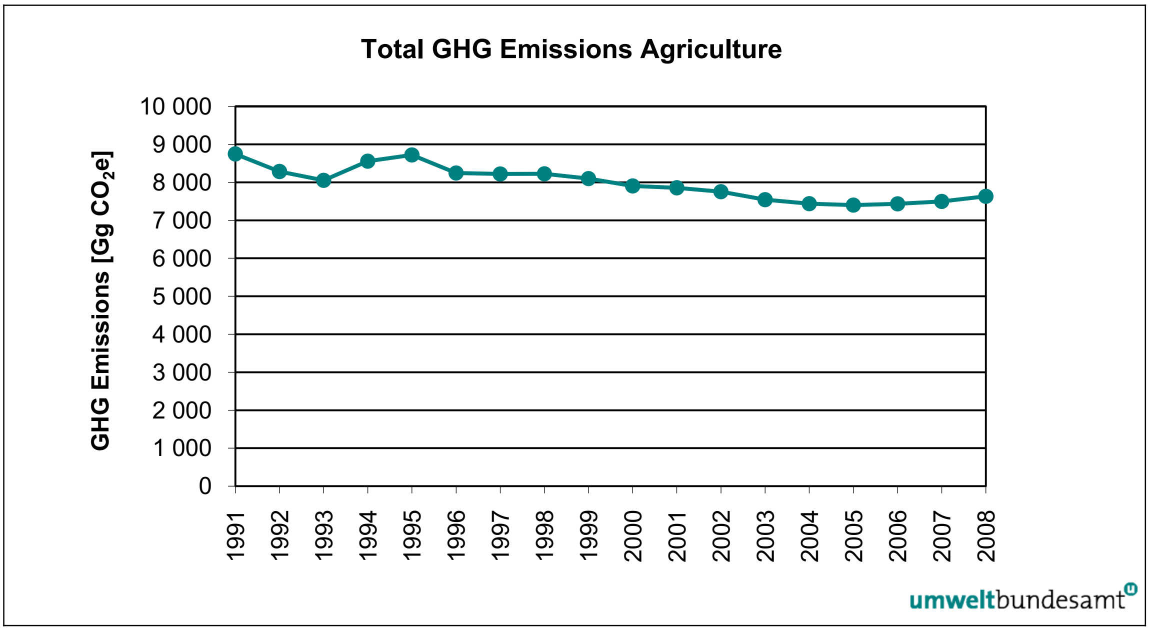

Figure 20: Trend of total GHG emissions from agriculture.

The fluctuations in the time series shown in Figure 20 are mainly due to fluctuations of N_2O emissions from agricultural soils. The increase from 2005 onwards is mainly due to an increased use of mineral fertiliser.

Emission trends per gas

From 1990 to 2008 CH_4 emissions from agriculture decreased by 15.4%, N_2O emissions decreased by 6.5%. The trends are presented in Table 140.

Table 140: Emissions of greenhouse gases from 1990–2008 from agriculture.

Year	GHG emissions [Gg]	
	CH_4	N_2O
1990	199.66	14.08
1991	196.70	14.89
1992	188.76	13.94
1993	188.92	13.17
1994	188.77	14.81
1995	192.01	15.12
1996	188.77	13.81
1997	185.48	13.95
1998	184.07	14.06
1999	181.86	13.81

Year	GHG emissions [Gg]	
	CH_4	N_2O
2000	180.38	13.28
2001	177.98	13.28
2002	174.08	13.21
2003	172.25	12.67
2004	171.85	12.35
2005	169.73	12.37
2006	169.04	12.53
2007	169.70	12.69
2008	168.98	13.17
Trend 90-08	*-15.4%*	*-6.5%*

Emission trends per sub category

Table 141 presents total GHG emissions and trend 1990–2008 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 (3.7%) followed by 4.B manure management (1.4%).

Table 141: GHG emissions 1990–2008 of agriculture by categories.

Year	GHG emissions [Gg CO_2 equivalent] by categories				
	4	4.A	4.B	4.D	4.F
1990	8 558.03	3 753.35	1 366.31	3 436.57	1.81
1991	8 747.46	3 698.38	1 358.99	3 688.31	1.78
1992	8 284.53	3 544.26	1 320.93	3 417.63	1.71
1993	8 050.63	3 542.65	1 332.88	3 173.41	1.69
1994	8 555.15	3 546.97	1 333.03	3 673.38	1.76
1995	8 718.84	3 613.63	1 362.81	3 740.64	1.77
1996	8 244.26	3 555.65	1 341.55	3 345.32	1.74
1997	8 220.97	3 492.76	1 334.54	3 391.84	1.84
1998	8 223.45	3 466.50	1 331.93	3 423.23	1.78
1999	8 098.73	3 436.75	1 309.61	3 350.54	1.83
2000	7 904.40	3 416.88	1 284.75	3 201.06	1.71
2001	7 855.62	3 370.08	1 278.40	3 205.33	1.81
2002	7 751.63	3 301.14	1 252.69	3 195.99	1.81
2003	7 543.49	3 269.81	1 246.82	3 025.22	1.64
2004	7 438.55	3 269.55	1 240.65	2 925.87	2.48
2005	7 398.79	3 228.63	1 229.68	2 938.87	1.62
2006	7 432.89	3 217.91	1 225.78	2 987.74	1.46
2007	7 497.40	3 230.73	1 234.21	3 030.92	1.54
2008	7 631.33	3 223.99	1 225.79	3 180.03	1.52
Share in Austrian Total 2008	*8.8%*	*3.7%*	*1.4%*	*3.7%*	*0.0%*
Trend 1990-2008	*-10.8%*	*-14.1%*	*-10.3%*	*-7.5%*	*-15.8%*

As can be seen in Figure 21 and Table 141 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). The increased use of mineral fertiliser is the driving force behind the increasing emissions from agricultural soils from 2005 onwards.

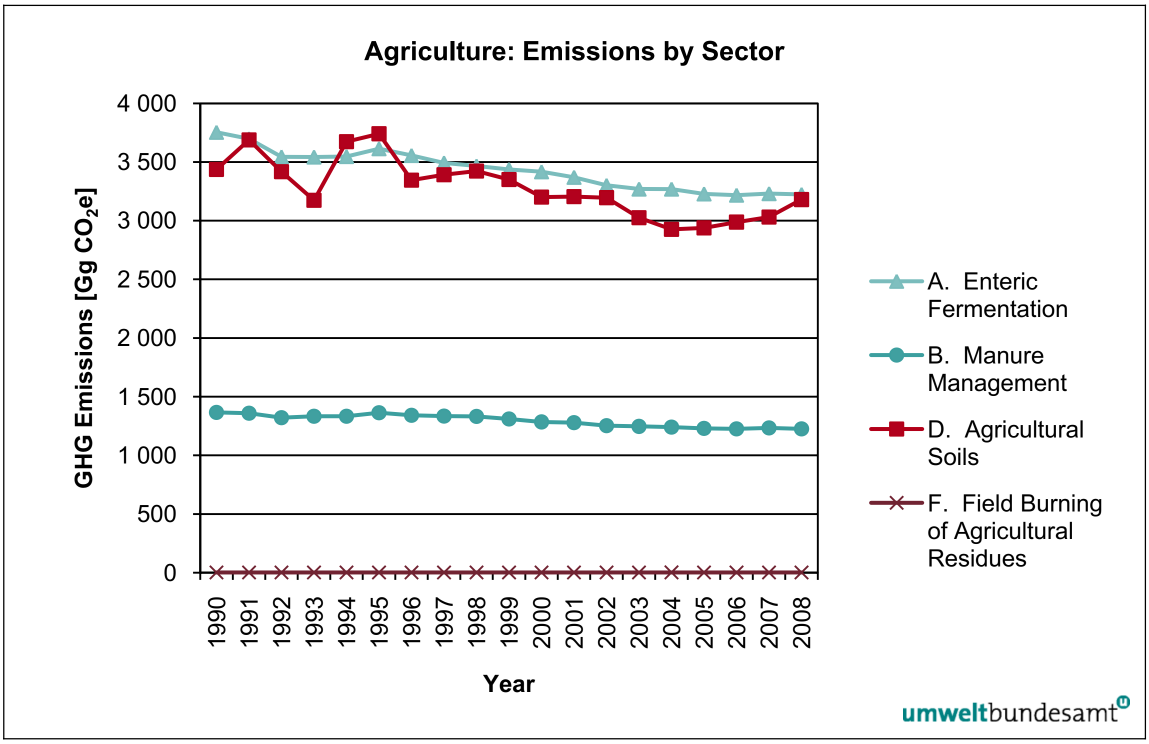

Figure 21: Emission trends of agriculture by categories.

As can be seen in Table 142, in 2008 about 42% of emissions from agriculture originate from enteric fermentation and agricultural soils. Manure management contributes 16% and field burning of agricultural wastes contributes only a negligible part (0.02% in 2008).

Table 142: Share of categories of agriculture, 1990 and 2008.

	GHG emissions [%] by sub categories				
Year	**4**	**4.A**	**4.B**	**4.D**	**4.F**
1990	100.0%	43.9%	16.0%	40.2%	0.0%
2008	100.0%	42.2%	16.1%	41.7%	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 143.

Table 143: Key sources of agriculture.

IPCC Category	**Source Categories**	**Key Sources**	
		GHG	**KS-Assessment***
4.A.1	Cattle	CH_4	LA90, LA08, TA
4.B.1	Cattle	N_2O	LA90, LA08
4.B.1	Cattle	CH_4	LA90
4.B.8	Swine	CH_4	Q
4.D.1	Direct Soil Emissions	N_2O	LA90, LA08, TA
4.D.2	Pasture, Range and Paddock Manure	N_2O	Q
4.D.3	Indirect Emissions	N_2O	LA90, LA08, 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 emission factors also used by Switzerland (gross energy intake, methane conversion rate) were used as Tier 1 because farming practices in Switzerland are very similar to the Austrian ones.

In response to a recommendation of the ERT Austria updated its figures on AWMS distribution within the inventory 2009 (submission 2010). The new distribution of housing systems is based on a comprehensive survey (Tierhaltung und Wirtschaftsdüngermanagement in Österreich - TIHALO) (AMON et al 2007).

For liquid systems of cattle and swine new country specific methane conversion factors (MCF) have been applied. The MCFs are based on studies carried out at the University of Natural Resources and Applied Life Science (BOKU), Department for Sustainable Agriculture, Division of Agricultural Engineering (DAE) (AMON et al. 2002a, AMON et al. 2006, AMON et al. 2007a).

New housing systems were introduced and new emission factors had to be applied. Except for the housing system 'deep litter', the emission factors of the IPCC good practice guidance have been used. For deep litter emission factors of the latest scientific literature available have been applied.

As recommended in the Centralized Review 2003 for the estimation of emissions from the category field burning of agricultural wastes the IPCC methodology using default emission factors was applied.

6.1.4 Quality Assurance and Quality Control (QA/QC)

The following sector specific QA/QC procedures have been carried out:

1) Activity data check

- ✓ Check for transcription errors, comparison with published data (BMLFUW 2000-2009)
- ✓ Consistency checks of sub-categories with totals
- ✓ Plausibility checks of dips and jumps

2) Emission factors

- ✓ Check of implied emission factors (time series) and CRF background data
- ✓ Comparison with IPCC default values and factors reported by other countries (S & A Reports)

3) Calculation by spreadsheets

- ✓ Consistent use of livestock characterisation
- ✓ Cross-checks through all steps of calculation
- ✓ Documentation of sources and correct use of units

3) Results (emissions)

- ✓ Check of recalculation differences
- ✓ Plausibility checks of dips and jumps

4) Documentation

- ✓ Findings and corrections marked in the spreadsheets
- ✓ Improvement list (internal and external findings)

Following a recommendation of the ARR 2009, source specific procedures are presented in the respective sub-chapters. A general description of Austria's QMS (Quality Management System) is presented in Chapter 1.6.

6.1.5 Uncertainty Assessment

The following chapter gives an estimate of uncertainties with respect to N_2O and CH_4 emissions from enteric fermentation, animal manures and agricultural soils. Overall uncertainties result from uncertainties in the activity data and from uncertainties in the emission factors.

The inventory revision within submission 2010 mainly concentrated on the integration of actual and more accurate data on manure management system distribution in Austria and could therefore reduce uncertainties in that area of the inventory. Additionally, uncertainties of MCFs from liquid systems could be reduced.

Animal waste management systems distribution (AWMS)

In the previous submission, AWMS distribution for the years 1989–1992 could be estimated with low uncertainty (± 10%) due to the survey of (KONRAD 1995). It must be assumed that AWMS distribution changed after 1992. Uncertainty increases the longer the time lag between the survey and the respective inventory year. Uncertainty of AWMS distribution in 2001 was estimated at 30%. TIHALO (AMON et al 2007) carried out a comprehensive survey on AWMS distribution on representative Austrian farms. The inventory revision integrated TIHALO data into the emission estimates. Uncertainty of AWMS distribution has therefore been reduced again to ± 10%.

Country specific MCF for liquid manure systems (new in this inventory update):

MCF values have a great impact on estimation of methane emissions from manure management. Default MCF values given in the IPCC-GPG are derived from a limited number of laboratory studies and theoretical considerations. The IPCC-GPG does not give numbers on uncertainties connected with default MCF values. Following the uncertainties of N_2O emission factors, we estimate MCF values to be –50 to +100% uncertain. For that reason it is highly necessary to measure MCF values under field conditions. At the University of Natural Resources and Applied Life Sciences a three-year measurement campaign on emissions from manure stores financed by the Federal Ministry of Agriculture, Forestry, Environment, and Water Management and the Federal Ministry for Education, Science, and Culture was carried out (AMON et al. 2002a, 2006, 2007a). The results have been published and are now integrated into the revised GHG inventory. The country specific MCFs reflect the agricultural practice and the climate conditions in Austria better than the default values. Thus, uncertainties could be reduced to ± 20% (AMON & HÖRTENHUBER 2010).

Activity data and emission factors

Animal numbers, in accordance to WINIWARTER & ORTHOFER (2000) have been 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 50% (expert judgement Barbara Amon, spring 2010), 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 144 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 144: 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	+/- 51.0%	+/- 100,5%	+/- 50%	+/- 100%
4.B.8	Swine	+/- 51.0%	–	+/- 50%	–
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.1.a Enteric Fermentation Dairy Cattle: The method of adjusting the GE-intake to the yearly milk yield of dairy cattle has been improved, resulting in slightly differing emissions compared to the previous submission.

4.A.1.b Enteric Fermentation Non-Dairy Cattle (suckling cows): The milk yield of suckling cows has been revised on the basis of the results of a new national study (HÄUSLER, J. 2009). The new data show an increased GE-intake and thus increased emissions in recent years.

4.B Manure Management: New national data on AWMS distribution have been implemented. A new time series of AWMS has been generated. The new AWMS data show an increased share of liquid systems and a decreased share of solid systems and pasture. Following new systems have been taken into account: yard, deep litter, composting, aerobic treatment and anaerobic digester. In the CRF table 4.B(a)s2 the new AWMS have been summarised under 'Other'.

4.B Manure Management – CH_4: In the new inventory for liquid systems new national methane conversion factors (MCF) for cattle and swine have been applied. The new factors have been obtained from a national peer reviewed study (AMON et al. 2002a, 2006, 2007a). The factors base on measurements and are considerable lower than the default value of the IPCC GPG for liquid systems. For yard (which is not included in the GPG 2000) the MCF of pasture, range and paddock has been taken. For deep litter the MCF of the 2006 IPCC Guidelines (17%) has been taken because the MCF of the GPG 2000 (39%) is not applicable to Austria's cold climate conditions.

4.B Manure Management – N_2O: deep litter: in consistency with the recalculations of CH_4, see above, the IPCC 2006 emission factor of 0.01 kg N_2O-N/kg N_2O has been used.

4.B.1.a Manure Management - Dairy cattle: VS excretion values were more exactly related to the yearly milk yields and therefore changed slightly compared to the previous submission.

4.B.8 Manure Management - Swine: In the new calculations of emissions from fattening pigs young swine from 20 to 50 kg were considered. In the previous submission these animals were treated like piglets and therefore not accounted (because the emission factor of breeding sows includes piglets). The consideration of pigs 20-50 kg in the fattening pigs category caused higher emissions from swine.

4.D.1 Direct Soil Emissions – Animal Manure Applied to Soils: In sector 4.B new data on animal waste management systems have been implemented. Especially the decreased share of pastured animals led to higher amounts of manure nitrogen left for spreading on soils resulting in higher N_2O emissions.

4.D.1 Direct Soil Emissions – Crop Residue: An error in the calculation of N_2O from certain crop residues was found and corrected, leading to higher N_2O emissions.

4.D.1 Direct Soil Emissions – Other direct emissions: The nitrogen amount of sewage sludge applied to soils was adjusted for volatilization. The consideration of NH_3-N and NO_x-N losses led to slightly reduced emissions from sewage sludge spreading.

4.D.2 Pasture, Range and Paddock Manure: The smaller share of grazed animals resulted in smaller emissions from pastures compared to the previous submission.

4.D.3 Indirect Emissions: The comprehensive revision of the agriculture model – including the emission calculation of NH_3 and NO_x – resulted in higher N_2O emissions compared to the previous submission.

6.1.7 Completeness

Table 145 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 145: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	IE1)	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

IPCC Category		SNAP		CH_4	N_2O
4.B.	**MANURE MANAGEMENT**	**1005** **1009**	**MANURE MANAGEMENT REGARDING ORGANIC COMPOUNDS** **MANURE MANAGEMENT REGARDING NITROGEN COMPOUNDS**	✓ **NO**	**NO** ✓
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
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

No further improvements are planned.

6.2 Enteric fermentation (CRF category 4.A)

This chapter describes the estimation of CH_4 emissions from enteric fermentation. In 2008 78.2% of agricultural CH_4 emissions arose from this category.

6.2.1 Source Category Description

CH_4 emissions amounted to 178.7 Gg in the 'Kyoto' base year and have decreased by 14.1% to 153.5 Gg in 2008. Almost all emissions of category 4.A (93.7% in 2008) 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 49.1% in 1990 to 39.9% in 2008.

Table 146: Greenhouse gas emissions from enteric fermentation by sub-categories 1990–2008.

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	178.73	169.08	87.84	81.24	2.48	0.19	0.89	5.53	0.27
1991	176.11	166.23	85.11	81.12	2.61	0.20	1.04	5.46	0.28
1992	168.77	158.84	82.28	76.56	2.50	0.20	1.11	5.58	0.26
1993	168.70	158.32	81.08	77.23	2.67	0.24	1.17	5.73	0.28
1994	168.90	158.55	80.07	78.47	2.74	0.25	1.20	5.59	0.27
1995	172.08	161.43	72.70	88.73	2.92	0.27	1.30	5.56	0.27
1996	169.32	158.60	72.04	86.56	3.05	0.27	1.32	5.50	0.25
1997	166.32	155.37	75.03	80.35	3.07	0.29	1.34	5.52	0.28
1998	165.07	154.16	76.64	77.52	2.89	0.27	1.36	5.72	0.28
1999	163.65	153.34	74.20	79.14	2.82	0.29	1.47	5.15	0.28
2000	162.71	152.69	66.90	85.79	2.71	0.28	1.47	5.02	0.23
2001	160.48	150.44	65.46	84.98	2.56	0.30	1.47	5.16	0.24
2002	157.20	147.50	64.99	82.50	2.43	0.29	1.47	4.96	0.24
2003	155.71	145.81	62.33	83.48	2.60	0.27	1.57	4.87	0.25
2004	155.69	145.96	60.91	85.05	2.62	0.28	1.57	4.69	0.25
2005	153.74	143.96	60.42	83.54	2.61	0.28	1.57	4.75	0.25
2006	153.23	143.61	60.21	83.41	2.50	0.27	1.57	4.71	0.25
2007	153.84	143.65	60.32	83.33	2.81	0.30	1.57	4.93	0.25
2008	153.52	143.80	61.29	82.51	2.67	0.31	1.57	4.60	0.25
Share 2008	*100%*	*39.9%*	*53.7%*	*1.7%*	*0.2%*	*1.0%*	*3.0%*	*0.2%*	*0.2%*
Trend 1990-2008	*-14.1%*	*-30.2%*	*1.6%*	*7.5%*	*67.3%*	*77.0%*	*-16.9%*	*-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 CH_4 emissions from *Non-Dairy Cattle* are reported separately:

Table 147: Greenhouse gas emissions from non-dairy cattle (4.A.1.b) by sub-categories 1990–2008.

	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**	**Breeding Heifers 1-2 yr**	**Fattening Heifers 1-2 yr**	**Other Cattle > 2 yr**
1990	81.24	4.35	30.67	16.77	20.04	9.41
1991	81.12	5.32	29.62	16.64	19.81	9.72
1992	76.56	5.62	27.44	15.69	18.43	9.37
1993	77.23	6.46	23.20	16.85	20.58	10.14
1994	78.47	8.40	23.15	17.19	20.19	9.54
1995	88.73	19.70	22.54	17.30	19.39	9.81
1996	86.56	19.95	21.83	16.88	18.04	9.86
1997	80.35	16.03	20.53	16.86	16.57	10.36
1998	77.52	14.53	20.67	16.52	15.72	10.08
1999	79.14	16.68	20.52	16.58	15.14	10.21
2000	85.79	23.92	21.33	16.01	14.30	10.24
2001	84.98	24.44	21.45	15.69	13.91	9.49
2002	82.50	23.28	20.83	15.38	13.85	9.16
2003	83.48	23.15	20.88	14.89	14.10	10.46
2004	85.05	24.96	21.02	14.97	13.64	10.46
2005	83.54	25.81	20.42	14.89	13.37	9.05
2006	83.41	25.90	20.51	14.39	13.79	8.83
2007	83.33	25.90	20.59	13.67	14.64	8.54
2008	82.51	25.43	20.65	13.00	14.92	8.51
Share 2008	*100%*	*30.8%*	*25.0%*	*15.8%*	*18.1%*	*10.3%*
Trend 1990-2008	*1.6%*	*484.3%*	*-32.7%*	*-22.5%*	*-25.6%*	*-9.5%*

The steady rise in suckling cow numbers (see Table 148) 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 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 emission factors (gross energy intake, methane conversion rate) applied by Switzerland have been chosen to be also applied for the Austrian emission inventory because the corresponding agricultural practices in Switzerland are very similar to those in Austria.

Activity data

The Austrian official statistics (STATISTIK AUSTRIA 2008) provides national data of annual livestock numbers on a very detailed level. These data are based on livestock counts held in December each year[56].

In Table 148 and Table 149 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.

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[56] 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).

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 behavior, milk quota, etc.

1998–2002: increasing/ decreasing swine numbers: The production of swine has a high elasticity to prices: Swine numbers are changing due to changing market prices very rapidly. Market prices change due to changes in consumer behavior, saturation of swine production, epidemics, etc.

Table 148: Domestic livestock population and its trend 1990–2008 (I).

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

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

The FAO agricultural data base (FAOSTAT) provides worldwide harmonized data (FAO AGR. STATISTICAL SYSTEM 2001). In the case of Austria, these data come from the national statistical system (Statistik Austria). However, there are inconsistencies between these two data sets. Analysis shows that there is often a time gap of one year between the two data sets. FAOSTAT data are seemingly based on the official Statistik Austria data but there is an annual attribution error. In the Austrian inventory Statistik Austria data is used, they are the best available.

Table 149: Domestic livestock population and its trend 1990–2008 (II).

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

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

Table 150: Domestic livestock population and its trend 1990–2008 (III).

	Population size [heads] * Livestock category				
Year	**Poultry**	**Chicken**	**Other Poultry**	**Horses**	**Other**
1990	13 820 961	13 139 151	681 810	49 200	37 100
1991	14 397 143	13 478 820	918 323	57 803	37 100
1992	13 683 900	12 872 100	811 800	61 400	37 100
1993	14 508 473	13 588 850	919 623	64 924	37 100
1994	14 178 834	13 265 572	913 262	66 748	37 736
1995	13 959 316	13 157 078	802 238	72 491	40 323
1996	12 979 954	12 215 194	764 760	73 234	41 526
1997	14 760 355	13 949 648	810 707	74 170	56 244
1998	14 306 846	13 539 693	767 153	75 347	50 365
1999	14 498 170	13 797 829	700 341	81 566	39 086
2000	11 786 670	11 077 343	709 327	81 566	38 475
2001	12 571 528	11 905 111	666 417	81 566	38 475

	Population size [heads] * Livestock category				
Year	**Poultry**	**Chicken**	**Other Poultry**	**Horses**	**Other**
2002	12 571 528	11 905 111	666 417	81 566	38 475
2003	13 027 145	12 354 358	672 787	87 072	41 190
2004	13 027 145	12 354 358	672 787	87 072	41 190
2005	13 027 145	12 354 358	672 787	87 072	41 190
2006	13 027 145	12 354 358	672 787	87 072	41 190
2007	13 027 145	12 354 358	672 787	87 072	41 190
2008	13 027 145	12 354 358	672 787	87 072	41 190
Trend 1990–2008	*-5,7%*	*-6.0%*	*-1.3%*	*77.0%*	*11.0%*

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

Information about the extent of organic farming in Austria was provided in the Austrian INVEKOS[57] 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 151 shows the results of the shares of organic farming in the relevant livestock categories for 1990, 1997–2000 and 2008:

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[57] 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 151:Share of cattle population under organic farming systems (calculations based on INVEKOS data).

IPCC Category	**% organic**	**% organic**	**% organic**
	1990	**1997–2000**	**2008**
CATTLE	1%	15%	18%
Dairy Cattle > 2 yr	1%	15%	16%
Suckling Cows > 2 yr	2%	25%	30%
Other Cattle > 2 yr	1.5%	20%	16%
Young Cattle < 1 yr	1%	13%	16%
Young Cattle 1–2 yr	1%	12%	16%

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 2000-2009) was used. In this report data on organic animal population is available for total cattle number, dairy cattle and suckling cows. The share of the other cattle categories under organic farming systems was derived from these data.

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) are 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 2008, emissions from enteric fermentation – cattle contributed 3.5% 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 148 and Table 149.

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).

$EF = (GE * Y_m * 365\ days/yr)/55.65$ 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 152: 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}	235.2	242.5	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 6 059 kg/cow (2008). The time series of average milk yields per dairy cow was taken from national statistics and are presented in Table 153. For dairy cattle there was a 19.0% increase of GE intake between 1990 and 2008 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 153: Annual milk yield, gross energy intake and emission factors of dairy cattle 1990–2008.

Year	Milk Yield	Gross Energy Intake	Emission Factor
	[kg/cow*yr]	[MJ/head*day]	[kg CH_4/head*yr]
1990	3 791	246.75	97.10
1991	3 800	246.88	97.16
1992	3 905	248.39	97.75
1993	3 948	248.79	97.91
1994	4 076	251.21	98.86
1995	4 619	261.47	102.90
1996	4 670	262.44	103.28
1997	4 787	264.65	104.15
1998	4 924	267.25	105.17
1999	5 062	270.17	106.32
2000	5 210	273.73	107.72
2001	5 394	278.17	109.47
2002	5 487	280.41	110.35
2003	5 638	283.92	111.73
2004	5 802	287.72	113.23
2005	5 783	287.28	113.05
2006	5 903	290.07	114.15
2007	5 997	292.26	115.01
2008	6 059	293.73	115.59

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. A new born calve has around 40 kg and suckles until it weighs about 350 kg. 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.

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.

Thus, for 1990 in the Austrian Greenhouse Gas Emission Inventory an average milk yield of 3 000 kg was applied, resulting in a Gross Energy Intake of 235.2 MJ per suckling cow and day (see Table 152).

In a new study (STEINWIDDER et al. 2006) with Austrian suckling cows (Simmental) carried out from 2004 to 2008, the influence of duration of suckling period (180 days and 270 days) 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 average milk yield per suckling period was on a high level: For 6 month of suckling an average milk yield of 2 245 kg, and for 9 month of suckling an average milk yield of 3 351 kg per cow has been measured (HÄUSLER 2009). The daily gains of the beef cattle (Simmental x Limousin steers and heifers) were 1.27 and 1.28 kg for the 180 or 270 days of suckling, respectively.

In consideration of the low forage quality identified in the study mentioned above, the suckling periods of up to 300 days and a calculated demand of 3 500kg milk per calve, an average milk yield of 3 500kg has been assumed for the years from 2004 onwards, resulting in a Gross Energy Intake of 242.5 MJ per suckling cow and day (see Table 152).

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 154 and Table 155 (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 154: 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 155: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 1990–2008, 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 156:Emission factors and gross energy intake of non-dairy cattle.

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 146, CH_4 emissions from sheep, goats, horses, swine, poultry and 'other' (deer) are only minor emission sources of enteric fermentation. Together they contributed 6.3% to total emissions from this category in 2008. The most important sub- category is swine, with a contribution of 3.0%, followed by sheep (1.7%), horses (1.0%) and 'Other' (deer), goats, poultry with each about 0.2% (figures are also presented in Table 146).

The IPCC Tier 1 methodology and default emission factors have been used (see Table 157):

Table 157: 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*

Other animals:

The other animal category is very inhomogeneous including roe deer, red deer, fallow deer and to some extent wild boars. As no further data on the exact composition of this animal category is available and the contribution to the overall emissions is very small, a simple conservative approach has been chosen: emissions from deer were estimated applying the default emission factor of sheep because sheep is the most similar animal category to deer.

The IPCC Guidelines don't provide specific methodologies for the estimation of emissions from poultry. For the calculation of emissions from poultry the Swiss values (Gross Energy Intake (GE), Methane Conversion Rate (Y_m)) were used as Tier 1. 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 148 and Table 149.

6.2.3 Source specific QA/QC

In category 4.A.1 the following source specific QA/QC procedures have been carried out:

- Gross energy intake data elaborated by scientific experts from the Agricultural Research and Education Centre (AREC) Raumberg-Gumpenstein, derived from peer reviewed sources.
- External review by Austrian agricultural experts (stakeholder meetings)
- Audit of data supplier in 2009: milk yield data (Statistik Austria), livestock data
- Differences to default values checked, explained and documented

Sector specific routine control procedures are provided in chapter 6.1.4

6.2.4 Uncertainties

Uncertainties are presented in Table 144.

6.2.5 Recalculations

4.A.1.a Dairy Cattle: GE intake values were more exactly related to the yearly milk yields and therefore changed slightly compared to the previous submission.

4.A.1.b Non-Dairy Cattle (suckling cows): The milk yield of suckling cows has been revised on the basis of the results of a new national study and expert judgment (HÄUSLER 2009). The new data show an increased GE-intake and thus increased emissions in recent years.

Table 158: Difference to submission 2009 of CH_4 emissions from category 4.A enteric fermentation.

	CH_4 emissions [Gg]		
	4.A Total	**4.A.1.a Dairy**	**4.A.1.b Non Dairy**
1990	-0.48	-0.48	0.00
1991	-0.60	-0.61	0.01
1992	-0.25	-0.27	0.02
1993	-0.28	-0.32	0.04
1994	-0.98	-1.05	0.07
1995	0.83	0.62	0.21
1996	0.49	0.23	0.25
1997	0.43	0.20	0.24
1998	0.51	0.27	0.25
1999	0.73	0.41	0.32
2000	0.76	0.25	0.51
2001	0.92	0.34	0.57
2002	0.52	-0.07	0.59
2003	0.83	0.19	0.64
2004	1.24	0.50	0.74
2005	0.68	-0.08	0.77
2006	0.79	0.02	0.77
2007	0.76	-0.01	0.77

6.3 Manure management (CRF category 4.B)

This chapter describes the estimation of CH_4 and N_2O emissions from animal manure. In 2008 8.9% of the agricultural CH_4 emissions and 22.3% of the agricultural N_2O emissions were caused by this category.

6.3.1 Source Category Description

From 1990 to 2008 CH_4 emissions from manure management decreased by 27.0% to 14.99 Gg.

Table 159: CH_4 emissions from manure management 1990–2008.

	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	20.53	7.89	5.55	0.06	0.00	0.07	5.87	1.08	0.01
1991	20.19	7.64	5.56	0.06	0.00	0.08	5.71	1.12	0.01
1992	19.61	7.36	5.26	0.06	0.00	0.08	5.76	1.07	0.01
1993	19.69	7.26	5.32	0.06	0.01	0.09	5.82	1.13	0.01
1994	19.40	7.07	5.44	0.07	0.01	0.09	5.62	1.10	0.01
1995	19.43	6.21	6.41	0.07	0.01	0.10	5.54	1.08	0.01
1996	18.94	6.12	6.25	0.07	0.01	0.10	5.37	1.00	0.01
1997	18.64	6.31	5.69	0.07	0.01	0.10	5.31	1.14	0.01
1998	18.48	6.37	5.45	0.07	0.01	0.10	5.38	1.10	0.01
1999	17.69	6.07	5.57	0.07	0.01	0.11	4.75	1.11	0.01
2000	17.16	5.40	6.16	0.06	0.01	0.11	4.52	0.89	0.01
2001	17.00	5.19	6.10	0.06	0.01	0.11	4.58	0.95	0.01
2002	16.44	5.09	5.88	0.06	0.01	0.11	4.35	0.94	0.01
2003	16.07	4.81	5.90	0.06	0.01	0.11	4.20	0.97	0.01
2004	15.70	4.62	6.01	0.06	0.01	0.11	3.90	0.97	0.01
2005	15.56	4.57	5.92	0.06	0.01	0.11	3.92	0.97	0.01
2006	15.34	4.50	5.90	0.06	0.01	0.11	3.79	0.96	0.01
2007	15.38	4.46	5.90	0.07	0.01	0.11	3.87	0.96	0.01
2008	14.99	4.50	5.82	0.06	0.01	0.11	3.52	0.96	0.01
Share 2008	*100%*	*30.0%*	*38.8%*	*0.4%*	*0.1%*	*0.7%*	*23.5%*	*6.4%*	*0.1%*
Trend 1990–2008	*-27.0%*	*-42.9%*	*4.9%*	*7.5%*	*67.3%*	*58.4%*	*-40.0%*	*-11.2%*	*11.0%*

From 1990 to 2008 the N_2O emissions from manure management decreased by 2.6% to 2.94 Gg. Emissions of cattle dominate the trend. The reduction of dairy cows is partly counterbalanced by an increase in emissions per animal (because of the increasing gross energy intake, milk production and N excretion of dairy cattle since 1990).

Table 160: N_2O Emissions from manure management 1990–2008.

	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	3.02	1.25	1.20	0.06	0.01	0.06	0.28	0.15	0.01
1991	3.02	1.22	1.20	0.07	0.01	0.07	0.28	0.16	0.01
1992	2.93	1.19	1.15	0.06	0.01	0.07	0.28	0.16	0.01
1993	2.97	1.19	1.15	0.07	0.01	0.08	0.29	0.17	0.01
1994	2.99	1.19	1.18	0.07	0.01	0.08	0.28	0.17	0.01
1995	3.08	1.11	1.34	0.08	0.01	0.09	0.28	0.18	0.01
1996	3.04	1.11	1.32	0.08	0.01	0.09	0.27	0.17	0.01
1997	3.04	1.17	1.23	0.08	0.01	0.09	0.27	0.19	0.01
1998	3.04	1.20	1.20	0.07	0.01	0.09	0.27	0.19	0.01
1999	3.03	1.18	1.23	0.07	0.01	0.09	0.24	0.20	0.01
2000	2.98	1.07	1.34	0.07	0.01	0.09	0.23	0.16	0.01
2001	2.97	1.06	1.33	0.07	0.01	0.09	0.23	0.18	0.01
2002	2.93	1.06	1.30	0.06	0.01	0.09	0.22	0.18	0.01
2003	2.93	1.02	1.33	0.07	0.01	0.10	0.21	0.19	0.01
2004	2.94	1.01	1.36	0.07	0.01	0.09	0.20	0.19	0.01
2005	2.91	1.01	1.33	0.07	0.01	0.09	0.20	0.19	0.01
2006	2.92	1.01	1.34	0.06	0.01	0.09	0.19	0.20	0.01
2007	2.94	1.02	1.34	0.07	0.01	0.09	0.19	0.20	0.01
2008	2.94	1.04	1.33	0.07	0.01	0.09	0.18	0.21	0.01
Share 2008	*100%*	*35.6%*	*45.3%*	*2.3%*	*0.4%*	*3.1%*	*6.0%*	*7.0%*	*0.3%*
Trend 1990–2008	*-2.6%*	*-16.3%*	*11.0%*	*7.5%*	*67.3%*	*54.9%*	*-37.6%*	*38.6%*	*11.0%*

6.3.2 Methodological Issues

The IPPC-Tier 2 methodology has been 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 poultry and horses in addition the treatment of manure in anaerobic digesters has been considered.

The inventory update carried out within submission 2010 concentrated on the following improvements:

- implementation of more accurate data on manure management system distribution gathered through an Austrian survey (Amon et al. 2007);
- improved consideration of the amount of slurry stored under cool and under warm conditions;
- new country specific emission factors for slurry storage;
- introduction of deep litter systems with best available emission factors.

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.

Animal Waste Management Systems (AWMS)

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

As noted in several review reports (ARR 2006, ARR 2008), the distribution of housing and storage systems has undergone major changes, which should be reflected in the inventory. Austria therefore was recommended to update its information on animal waste management systems (AWMS) distribution. Hence, in 2008 the Umweltbundesamt commissioned the University of Natural Resources and Applied Life Sciences with the revision of the national emission model of sector agriculture (AMON & HÖRTENHUBER 2010).

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

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

For the Tier 1 livestock categories sheep, goats, horses, other animals and poultry country specific AWMS data based on expert judgement has been applied (PÖLLINGER 2008; poultry: FRANKHAUSER 2007). Except for poultry, where a time series has been generated, the AWMS distribution of these animal categories has been kept constant over the entire time series. Data on anaerobic digestion were derived from data provided by the Austrian Energy Regulator E-Control in the Ökostrombericht 2009 (E-CONTROL 2009). 1990 data are based on (AMON 2002).

The new AWMS data reflects the situation in Austria much better than the IPCC default AWMS distribution and the distribution from the study by (KONRAD 1995) used in the previous submission.

Table 161:Manure Management System distribution in Austria 1990.

Livestock category	Liquid/ Slurry	Solid Storage	Pasture/ Range/ Paddock	Other Systems
	[%]	**[%]**	**[%]**	**[%]**
Dairy cattle	32.6	49.4	10.7	7.3
Non-dairy cattle	24.5	46.4	8.6	20.6
Suckling cows	17.2	46.0	10.7	26.2
Cattle < 1 year	16.9	51.0	4.8	27.3
Breeding heifers 1-2 years	25.7	37.9	26.2	10.2
Fattening heifers, bulls and oxen 1-2 years	46.2	41.1	0.6	12.1
Non-dairy cattle > 2 years	27.3	42.6	17.8	12.2
Sheep	0.0	50.0	50.0	0.0
Goats	0.0	50.0	50.0	0.0
Horses	0.0	79.6	20.0	0.4
Breeding sows	66.6	18.4	0.0	15.1
Young and fattening pigs	69.5	8.0	0.0	22.5
Swine (Total)	69.1	9.5	0.0	21.4
Chicken	44.2	55.7	0.0	0.1
Other poultry	0.0	99.9	0.0	0.1
Other animals	0.0	50.0	50.0	0.0

Table 162:Other systems 1990 in detail.

Livestock category	Yard	Composting	Deep Litter	Aerobic Treatment	Anaerobic Digestion
	[%]	**[%]**	**[%]**	**[%]**	**[%]**
Dairy cattle	0.9	3.1	1.3	2.0	0.0
Non-dairy cattle	0.9	2.8	15.4	1.4	0.0
Suckling cows	1.1	2.9	21.2	1.1	0.0
Cattle < 1 year	0.8	3.2	22.0	1.2	0.0
Breeding heifers 1-2 years	0.8	2.4	5.9	1.1	0.0
Fattening heifers, bulls and oxen 1-2 years	1.5	1.9	6.7	2.0	0.0
Non-dairy cattle > 2 years	1.0	2.6	6.2	2.4	0.0
Sheep	0.0	0.0	0.0	0.0	0.0
Goats	0.0	0.0	0.0	0.0	0.0
Horses	0.0	0.0	0.0	0.0	0.4
Breeding sows	1.2	1.2	10.8	1.7	0.1
Young and fattening pigs	0.6	0.4	20.2	1.3	0.1
Swine (Total)	0.6	0.5	18.8	1.4	0.1

Livestock category	Yard	Composting	Deep Litter	Aerobic Treatment	Anaerobic Digestion
	[%]	[%]	[%]	[%]	[%]
Chicken	0.0	0.0	0.0	0.0	0.1
Other poultry	0.0	0.0	0.0	0.0	0.1
Other animals	0.0	0.0	0.0	0.0	0.0

Small farms more frequently use solid manure systems, whereas large farms make more use of slurry systems. Compared to the previous submission for dairy cattle the share of liquid systems has been increased significantly. For non-dairy cattle and swine the share of solid systems has been reduced, mainly due to the considerable share of deep litter in solid storage (reported under 'other systems').

For sheep, goats, horses and other animals the new data show an increased share of solid storage systems and a decreased share of pasture.

Table 163:Manure Management System distribution in Austria 2008.

Livestock category	Liquid/ Slurry	Solid Storage	Pasture/Range/ Paddock	Other Systems
	[%]	[%]	[%]	[%]
Dairy cattle	30.1	49.0	2.9	17.9
Non-dairy cattle	20.7	44.3	4.9	30.1
Suckling cows	12.6	40.0	14.3	33.1
Cattle < 1 year	13.3	48.0	1.9	36.8
Breeding heifers 1-2 years	28.5	44.4	5.8	21.3
Fattening heifers, bulls and oxen 1-2 years	41.5	38.8	0.2	19.4
Non-dairy cattle > 2 years	24.9	44.1	7.1	23.9
Sheep	0.0	50.0	50.0	0.0
Goats	0.0	50.0	50.0	0.0
Horses	0.0	69.2	20.0	10.8
Breeding sows	49.6	20.3	0.0	30.1
Young and fattening pigs	82.7	0.3	0.0	17.0
Swine (Total)	78.4	2.9	0.0	18.7
Chicken	3.9	90.2	0.0	5.9
Other poultry	0.0	94.1	0.0	5.9
Other animals	0.0	50.0	50.0	0.0

Table 164:Other systems 2008 in detail.

Livestock category	Yard	Composting	Deep Litter	Aerobic Treatment	Anaerobic Digestion
	[%]	[%]	[%]	[%]	[%]
Dairy cattle	2.0	7.4	1.4	4.6	2.6
Non-dairy cattle	1.8	6.3	16.1	3.2	2.6
Suckling cows	2.3	6.0	20.0	2.2	2.6
Cattle < 1 year	1.8	7.2	22.5	2.7	2.6
Breeding heifers 1-2 years	1.7	6.5	7.5	3.0	2.6
Fattening heifers, bulls and oxen 1-2 years	1.5	4.2	6.8	4.3	2.6
Non-dairy cattle > 2 years	2.1	6.3	7.0	5.9	2.6
Sheep	0.0	0.0	0.0	0.0	0.0
Goats	0.0	0.0	0.0	0.0	0.0
Horses	0.0	0.0	0.0	0.0	10.8
Breeding sows	2.5	3.5	13.9	3.3	6.9
Young and fattening pigs	1.2	0.2	5.0	3.7	6.9
Swine (Total)	1.4	0.7	6.2	3.6	6.9
Chicken	0.0	0.0	0.0	0.0	5.9
Other poultry	0.0	0.0	0.0	0.0	5.9
Other animals	0.0	0.0	0.0	0.0	0.0

The new time series on AWMS shows for cattle a decreasing share of pasture and an increasing share of 'other systems'. Young and fattening pigs are increasingly held on liquid systems, whereas in the breeding sows category a trend from liquid systems to 'other systems' was identified.

Deep litter dominates the other system category for non-dairy cattle and breeding sows. Additionally, 2008 a considerable part of swine, poultry and horses manure is digested in biogas plants.

Influence of application time on stored liquid slurry

Cattle

The evaluation of the TIHALO questionnaires (AMON et al. 2007) produced the following results: 32% of the slurry is applied in spring, 42% in summer and 25% in autumn (n=933 farms, projected by Statistik Austria to representative Austrian conditions). Following data on the storage of slurry were derived:

On average are

- in spring 55% of the stores' capacity filled
- in summer 45% of the stores' capacity filled
- in autumn 37.5% of the stores' capacity filled
- in winter 62.5% of the stores' capacity filled

Swine

The evaluation of the TIHALO questionnaires (AMON et al. 2007) produced the following results: 57% of the slurry is applied in spring, 27% in summer and 16% in autumn (n=628 farms, projected by Statistik Austria to representative Austrian conditions). Following data on the storage of slurry were derived:

On average are:

- in spring 43% of the stores' capacity filled
- in summer 41% of the stores' capacity filled
- in autumn 50% of the stores' capacity filled
- in winter 75% of the stores' capacity filled

Emission measurements under field conditions showed, that an increase in methane emissions during slurry storage was only observed during the summer season. The following table presents the slurry stored in cold and warm season per animal category as used in the national inventory:

Table 165:Liquid slurry – percentage storage in cold and warm season according to TIHALO.

Livestock category	**Liquid slurry storage**	
	warm season [%]	**cold season [%]**
Dairy cattle	21.4	78.6
Suckling cows	18.7	81.3
Cattle < 1 year	21.9	78.1
Breeding heifers 1-2 years	20.0	80.0
Fattening heifers, bulls and oxen 1-2 years	22.4	77.6
Non-dairy cattle > 2 years	20.1	79.9
Breeding sows	19.6	80.4
Young and fattening pigs	19.6	80.4

Activity data

(STATISTIK AUSTRIA 2008) provides national data of annual livestock numbers on a very detailed level (see Table 148, Table 149, Table 150). These data are basis for the estimation.

Young and Fattening Pigs

The emission factors for breeding sows already include nursery and growing pigs (SCHECHTNER 1991). Thus, the animal number of piglets up to 20 kg is not taken into account. In the previous submissions also young swine from 20 to 50 kg were treated like piglets and therefore not accounted. These animals are now shifted to the fattening pigs category (now 'Young and Fattening Pigs'). Thus, in submission 2010 the animal number of the fattening pig category increased significantly (see chapter 6.3.5)

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*

Methane conversion factors (MCF)

The default MCF values for 'cool climate regions' presented in the IPCC GPG 2000 (Table 4.10) were used for the following systems:

- Pasture, Range, Paddock (MCF: 1%)
- Solid Storage (MCF: 1%)
- Anaerobic digester (MCF: 0%)
- Composting (MCF: 0.5%)
- Aerobic Treatment (MCF: 0.1%)
- Yard: the MCF of Pasture, Range, Paddock was applied (MCF: 1%)

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).

Country specific MCF for liquid systems of cattle and swine

IPCC encourages measurements of emissions from manure management under field conditions in order to improve the basis of emission estimates. The Division of Agricultural Engineering (DAE) at the University of Natural Resources and Applied Life Sciences (BOKU) has carried out a three-year measurement campaign on emissions from manure stores financed by the Federal Ministry of Agriculture, Forestry, Environment, and Water Management and the Federal Ministry for Education, Science, and Culture. Emission rates have now been published in peer reviewed publications (AMON et al. 2002a, 2006, 2007a). They can therefore be used for calculating MCF values for liquid manure systems.

Table 166:Country specific MCFs for liquid systems (AMON et al. 2006, AMON et al. 2007a).

Animal Category	**cold season [%]**	**warm season [%]**
Cattle	0.97	37.22
Swine	3.27	3.87

The country specific MCFs have been applied to the amounts of liquid manure storage under cold and warm climate conditions (see Table 166). The extensive emission measurements under field conditions showed, that an increase in methane emissions during slurry storage was only observed during the summer season. The low air temperatures in all other seasons in Austria reduces significantly methane formation during slurry storage. Emission measurements were carried out in one of the warmest Austrian region and therefore may tend to overestimate MCF values. The following table presents average values for liquid systems for the years 1990 and 2008.

Table 167:average MCFs for liquid systems 1990 and 2008

Animal Category	**1990 [%]**	**2008 [%]**
Dairy Cattle	8.7	8.6
Other Cattle	8.7	8.3
Swine	3.4	3.4

The following table presents the average MCFs for other systems for the years 1990 and 2008.

Table 168:average MCFs for other systems 1990 and 2008

Animal Category	**1990 [%]**	**2008 [%]**
Dairy Cattle	3.3	1.9
Other Cattle	12.3	10.1
Swine	14.7	9.5

For deep litter the MCF of the 2006 IPCC Guidelines (17%) has been applied because the MCF of the GPG 2000 (39%) neither fits to Austrian conditions nor is it in line with the latest scientific literature.

The big share of deep litter in the other system category is responsible for the high MCF values of other cattle and swine.

Maximum methane producing capacity (B_{0i})

IPCC default values were used (Appendix B, IPCC Guidelines, Reference Manual)

6.3.2.1.1 Cattle (4.B.1)

Key Source: Yes (CH_4, N_2O)

Volatile solid (VS) excretion – dairy cows

Austrian specific values for dairy cows are calculated dependend on annual milk yields and corresponding feed intake data (gross energy intake, feed digestibility, ash content, see Table 152 and Table 169). 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 169: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**	**6 500**
GE intake	[MJ/day]	235.32	242.55	249.77	259.23	268.68	280.72	292.32	304.21
feed digestibility	[%]	65.7	66.0	66.3	67.3	68.2	69.1	70.0	70.6
ash content	[%]	11	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	4.31

A time series was generated by adjusting these data to the yearly milk yields (see Table 170).

Table 170:VS excretion of Austrian diary cows for the period 1990–2008.

Year	**Milk yield *[kg yr^{-1}]***	***VS excretion* [kg/cow*day]**	**Year**	**Milk yield *[kg yr^{-1}]***	***VS excretion* [kg/cow*day]**
1990	3 791	4.03	2000	5 210	4.15
1991	3 862	4.03	2001	5 394	4.17
1992	3 934	4.04	2002	5 487	4.18
1993	4 005	4.06	2003	5 638	4.20
1994	4 076	4.06	2004	5 802	4.21
1995	4 619$^{1)}$	4.10	2005	5 783	4.21
1996	4 670	4.10	2006	5 903	4.22
1997	4 787	4.11	2007	5 997	4.23
1998	4 924	4.12	2008	6 059	4.24
1999	5 062	4.13			

1) *From 1995 onwards data have been revised by Statistik Austria*

Volatile solid (VS) excretion – suckling cows

For the year 1990 an average milk yield of 3 000 kg was assumed, resulting in a daily VS excretion of 3.90 kg (see Table 169). From 2004 to 2008 a new study (Steinwidder et al. 2006) with Austrian suckling cows (Simmental) was carried out, determining the influence of duration of suckling period (180 days and 270 days) on milk yield and body weight of cows and weight gain of calves. The results of this study and a calculated demand of 3 500kg milk per calve resulted in an increased milk yield for suckling cows: From 2004 onwards a milk yield of 3 500kg has been assumed, resulting in a daily VS excretion of 3.98 kg (see Table 169).

Volatile solid (VS) excretion – other non-dairy cattle

Austrian specific values on VS excretion for all other non-dairy cattle categories were calculated from typical Austrian diets under organic and conventional management (see Table 154).

As no major changes in diets of *Non-Dairy Cattle* occurred in the period from 1990–2008, 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 171 presents data for the calculation of VS excretion of the livestock categories *Non-Dairy Cattle*.

Table 171: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%.

6.3.2.1.2 Swine (4.B.8)

Key Source: Yes (CH_4)

Volatile solid (VS) excretion – swine

VS excretion of swine was derived 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 172: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

Piglets were not taken into account because the emission factors for breeding sows already include nursery and growing pigs (SCHECHTNER 1991).

6.3.2.1.3 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 173: 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.

The 'other animal' category is very inhomogeneous including roe deer, red deer, fallow deer and to some extent wild boars. As no further data on the exact composition of this animal category is available and the contribution to the overall emissions is very small, a simple conservative approach has been chosen: emissions from deer were estimated applying the default emission factor of sheep because sheep is the most similar animal category to deer.

Digested manure

Operators of biogas plants report the amount of digested manure to the Austrian Energy Regulator E-Control (E-Control 2009). On the basis of these data for 2008 the share of manure digested in biogas plants was derived. Data for 1990 were obtained from (AMON et al 2002).

The reported data show, that part of poultry and horses manure is used in biogas plants. As no CH_4-emissions get lost in Austrian biogas plants, in the calculations the share of manure used for digestion was subtracted (see following formula):

$$CH_4\text{-}emissions_{4.B(i)} = Population_{(i)} * EF_{IPCC\ default\ (i)} * (100\text{-}share_{dig\ (i)})/100$$

(i) = horses (4.B.6) and poultry (4.B.9)

$share_{dig}$ = % of manure digested

The share of anaerobic digesters is presented in Table 162 and Table 164.

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 systems 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 161 - Table 164).

N excretion

As recommended in the Centralized Review 2004, in the year 2005 Austrian N excretion values were reviewed and recalculated. The revision resulted in higher N excretion rates of dairy and suckling cows (see Table 174).

Table 174:Austria specific N excretion values of dairy cows for the period 1990–2008.

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

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

N excretion values as shown in Table 174 and Table 175 are based on the following literature: (GRUBER & PÖTSCH 2006, PÖTSCH et al. 2005, STEINWIDDER & GUGGENBERGER 2003, UNTERARBEITSGRUPPE N-ADHOC 2004 and ZAR 2004).

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

Cattle: Feed rations represent data of commercial farms consulting representatives of the working groups "Dairy production". These groups are managed by well-trained advisors. Their members, i.e. farmers, regularly exchange their knowledge and experience. Forage quality is based on field studies, carried out in representative grassland and dairy farm areas. The calculations depend on feeding ration, gain of weight, nitrogen and energy uptake, efficiency, duration of livestock keeping etc.

Sheep and goats: life weight, daily gain of weight, degree of pregnancy or lactating, feeding rations.

Pigs: breeding pigs, piglets, boars, fattening pigs: number and weight of piglets, daily gain of weight, energy content of feeding, energy and nitrogen uptake, N-reduced feeding.

Poultry: feeding ration, duration of keeping, nitrogen uptake, nitrogen efficiency.

Horses: feeding ration per horse category, weight of horses.

Table 175:Austria specific N excretion values of other livestock categories.

Livestock category	***Nitrogen excretion* [kg/animal*yr]**
suckling cows 1) (1990)	69.5
suckling cows 2) (2008)	74.0
cattle 1–2 years	53.6
cattle < 1 year	25.7
cattle > 2 years	68.4
breeding sows	29.1

Livestock category	***Nitrogen excretion*** **[kg/animal*yr]**
fattening pigs	10.3
sheep	13.1
goats	12.3
horses	47.9
chicken[3]	0.52
other poultry[4]	1.1
other livestock/ deer[5]	13.1

[1] *Annual milk yield: 3 000 kg*

[2] *Annual milk yield: 3 500 kg*

[3] *Weighted average of hens and broilers*

[4] *Weighted average of turkeys and other (ducks, gooses)*

[5] *N-ex value of sheep applied*

Livestock numbers per category can be found in Table 148, Table 149 and Table 150. Data on manure management system distribution is presented in Table 161, Table 162, Table 163 and Table 164.

Emission factors

N_2O emission factors of the IPCC GPG have been used for all AWMS except for the new implemented system 'deep litter': in consistency with the applied MCF, for deep litter the best available emission factor has been used (IPCC 2006).

Emission factors applied in the Austrian inventory are listed in the following table:

Table 176:Emission factors for N_2O from manure management

Animal Waste Management System	**Emission factor [kg N_2O-N per kg N excreted]**	**Reference**
Liquid/Slurry	0.001	IPCC GPG, Table 4.12
Solid Storage	0.020	IPCC GPG, Table 4.12
Pasture/Range/Paddock	0.020	IPCC GPG, Table 4.12
Composting	0.020	IPCC GPG, Table 4.13
Aerobic Treatment	0.020	IPCC GPG, Table 4.13
Anaerobic Digester	0.001	IPCC GPG, Table 4.12
Deep Litter	0.010	IPCC 2006, Table 10.21

Yard

In the IPCC guidelines no emission factor for yard is available. It is assumed, that the storage of the yard manure equals the average waste management systems distribution in Austria (see Table 161 to Table 164). Thus, the implied N_2O emission factor of all systems (except pasture) has been used.

Table 177:N_2O emission factors used for the calculation of N_2O from yards 1990–2008.

Year	Dairy	Non-Dairy	Swine
	[kg N_2O-N per kg N excreted]		
1990	0.011	0.011	0.005
1991	0.012	0.011	0.005
1992	0.012	0.011	0.005
1993	0.012	0.011	0.005
1994	0.012	0.011	0.005
1995	0.012	0.011	0.005
1996	0.012	0.011	0.005
1997	0.012	0.012	0.005
1998	0.012	0.012	0.005
1999	0.012	0.012	0.005
2000	0.012	0.012	0.005
2001	0.012	0.012	0.005
2002	0.012	0.012	0.005
2003	0.013	0.012	0.005
2004	0.013	0.012	0.005
2005	0.013	0.012	0.005
2006	0.013	0.012	0.005
2007	0.013	0.012	0.005
2008	0.013	0.012	0.005

For the calculation of the losses of gaseous N species (NH_3-N and NO_x-N) the mass-flow procedure pursuant to EMEP/CORINAIR (EEA 2007) has been applied. In 2009 new data on agricultural practice in Austria (AMON et al. 2007) has been integrated to the ammonia emission model (AMON & HÖRTENHUBER 2008). A brief description of methodologies and emission factors applied in the Austrian NH_3 and NO_x inventory under the UN/LRTAP convention is provided in chapter 6.4.2.1.

6.3.3 Source specific QA/QC

In the categories 4.B.1 and 4.B.8 the following source specific QA/QC procedures have been carried out:

- ✓ VS and N excretion data elaborated by national experts (Agricultural Research and Education Centre Raumberg-Gumpenstein, University of Natural Ressources and Applied Life Sciences), derived from peer reviewed sources
- ✓ Survey on AWMS conducted by scientific experts
- ✓ Country specific MCF derived from peer reviewed studies
- ✓ Differences to default values explained and documented
- ✓ Rationale for selecting MCFs and EFs explained and documented
- ✓ Audit of data supplier in 2009: milk yield data (Statistik Austria), livestock data
- ✓ External review by Austrian agricultural experts (stakeholder meetings)

Sector specific routine control procedures are provided in chapter 6.1.4.

6.3.4 Uncertainties

Uncertainties are presented in Table 144.

6.3.5 Recalculations

4.B.1.a Dairy cattle: VS excretion values were more exactly related to the yearly milk yields and therefore changed slightly compared to the previous submission.

4.B.1.b Non-dairy cattle (suckling cows): The milk yield of suckling cows has been revised on the basis of the results of a new national study and expert judgement (HÄUSLER 2009). The new data show an increased milk yield in recent years. Revised VS and N excretion values resulted in higher emissions.

Activity data of swine (4.B.8):

In the new calculations of emissions from fattening pigs young swine from 20 to 50 kg are considered. In the previous submission these animals were treated like piglets and therefore not accounted (because the emission factor of breeding sows includes piglets).

Table 178:Difference to submission 2009 of animal number of fattening pigs

	Population size [heads]		
	Fattening Pigs > 50 kg	**Young Pigs 20-50kg**	**Young & Fattening Pigs > 20 kg**
1990	1 308 525	1 038 475	2 347 001
1991	1 290 785	1 024 396	2 315 181
1992	1 319 744	1 047 379	2 367 123
1993	1 355 295	1 070 557	2 425 852
1994	1 323 145	1 044 916	2 368 061
1995	1 312 334	1 044 654	2 356 988
1996	1 262 391	1 049 597	2 311 988
1997	1 268 856	1 061 478	2 330 334
1998	1 375 037	1 081 898	2 456 935
1999	1 250 775	975 532	2 226 307
2000	1 211 988	948 350	2 160 338
2001	1 264 253	956 512	2 220 765
2002	1 187 908	959 060	2 146 968
2003	1 243 807	881 564	2 125 371
2004	1 159 501	856 504	2 016 005
2005	1 224 053	867 172	2 091 225
2006	1 197 124	841 046	2 038 170
2007	1 272 889	898 630	2 171 519

The main reason of the considerable lower emissions from cattle and swine is the use of lower national MCFs for liquid systems. The decrease in emissions was counterbalanced by an increased share of liquid systems and the consideration of deep litter systems in solid storage.

The reason for the decreased CH_4 emissions from horses and poultry is the consideration of anaerobic digesters.

Table 179:Difference to submission 2009 of CH_4 emissions from manure management.

	CH_4 Emissions [Gg]					
	4.B Total	**4.B.1.a Dairy**	**4.B.1.b N.-Dairy**	**4.B.6 Horses**	**4.B.8 Swine**	**4.B.9 Poultry**
1990	-29.96	-9.71	-4.81	0.00	-15.45	0.00
1991	-29.59	-9.43	-4.84	0.00	-15.32	0.00
1992	-29.41	-9.06	-4.60	0.00	-15.74	0.00
1993	-29.70	-8.93	-4.51	0.00	-16.26	0.00
1994	-29.46	-8.81	-4.50	0.00	-16.15	-0.01
1995	-29.05	-7.70	-5.06	0.00	-16.29	-0.01
1996	-28.61	-7.63	-5.02	0.00	-15.94	-0.01
1997	-28.84	-7.92	-4.86	0.00	-16.04	-0.01
1998	-29.46	-8.06	-4.74	0.00	-16.64	-0.02
1999	-27.78	-7.77	-4.89	-0.01	-15.09	-0.02
2000	-27.07	-6.98	-5.32	-0.01	-14.73	-0.03
2001	-27.46	-6.79	-5.09	-0.01	-15.54	-0.03
2002	-26.62	-6.77	-4.94	-0.01	-14.86	-0.04
2003	-27.07	-6.45	-5.23	-0.01	-15.34	-0.04
2004	-26.11	-6.26	-5.35	-0.01	-14.45	-0.05
2005	-26.35	-6.27	-5.04	-0.01	-14.98	-0.05
2006	-26.32	-6.22	-5.02	-0.01	-15.02	-0.05
2007	-26.79	-6.22	-4.97	-0.01	-15.53	-0.06

N_2O emissions

The decreased share of solid systems (cattle and swine) and pasture (cattle) is responsible for the lower N_2O emissions compared to the previous submission. The increased animal number of fattening pigs partly counterbalances this effect.

Table 180:Difference to submission 2009 of N_2O emissions from manure management (I).

	N_2O Emissions [Gg]				
	4.B Total	**4.B.1.a Dairy**	**4.B.1.b N.-Dairy**	**4.B.3 Sheep**	**4.B.8 Goats**
1990	**-0.23**	-0.31	-0.18	0.06	0.01
1991	**-0.19**	-0.30	-0.17	0.06	0.01
1992	**-0.15**	-0.28	-0.15	0.06	0.01
1993	**-0.13**	-0.27	-0.15	0.06	0.01
1994	**-0.10**	-0.25	-0.15	0.06	0.01

	N_2O Emissions [Gg]				
	4.B Total	**4.B.1.a Dairy**	**4.B.1.b N.-Dairy**	**4.B.3 Sheep**	**4.B.8 Goats**
1995	**-0.08**	-0.22	-0.16	0.07	0.01
1996	**-0.06**	-0.22	-0.15	0.07	0.01
1997	**-0.02**	-0.22	-0.13	0.07	0.01
1998	**-0.02**	-0.21	-0.12	0.07	0.01
1999	**0.01**	-0.20	-0.11	0.07	0.01
2000	**0.00**	-0.17	-0.11	0.06	0.01
2001	**0.02**	-0.16	-0.11	0.06	0.01
2002	**0.03**	-0.16	-0.10	0.06	0.01
2003	**0.06**	-0.14	-0.09	0.06	0.01
2004	**0.08**	-0.13	-0.08	0.06	0.01
2005	**0.09**	-0.13	-0.08	0.06	0.01
2006	**0.09**	-0.12	-0.07	0.06	0.01
2007	**0.11**	-0.11	-0.07	0.07	0.01

Within the revision of the AWMS the share of pasture has been reduced for sheep, goats, horses and other animals causing higher N_2O emissions from manure management. The increased share of solid systems resulted in higher N_2O emissions from poultry.

Table 181:Difference to submission 2009 of N_2O emissions from manure management (II)

	N_2O Emissions [Gg]				
	4.B Total	**4.B.6 Horses**	**4.B.8 Swine**	**4.B.9 Poultry**	**4.B.10 Other**
1990	**-0.23**	0.06	0.03	0.09	0.01
1991	**-0.19**	0.07	0.03	0.11	0.01
1992	**-0.15**	0.07	0.03	0.10	0.01
1993	**-0.13**	0.08	0.02	0.12	0.01
1994	**-0.10**	0.08	0.02	0.12	0.01
1995	**-0.08**	0.08	0.02	0.12	0.01
1996	**-0.06**	0.08	0.02	0.12	0.01
1997	**-0.02**	0.09	0.01	0.13	0.01
1998	**-0.02**	0.09	0.01	0.13	0.01
1999	**0.01**	0.09	0.00	0.14	0.01
2000	**0.00**	0.09	0.00	0.12	0.01
2001	**0.02**	0.09	-0.01	0.13	0.01
2002	**0.03**	0.09	-0.01	0.13	0.01
2003	**0.06**	0.09	-0.02	0.14	0.01
2004	**0.08**	0.09	-0.02	0.14	0.01
2005	**0.09**	0.09	-0.02	0.14	0.01
2006	**0.09**	0.09	-0.03	0.15	0.01
2007	**0.11**	0.09	-0.03	0.15	0.01

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 2008 77.7% of total N_2O emissions from agriculture (55.8% 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 3.7% (3 180.03 Gg CO_2 equivalents) to Austria's total greenhouse gas emissions in the year 2008. This is 41.7% of total GHG emissions of the sector agriculture.

The trend of N_2O emissions from this category is decreasing: in 2008 emissions were 7.5% below 1990 levels.

Table 182 presents N_2O emissions of agricultural soils by sub-category as well as their trends and their share in total N_2O emissions.

Table 182:N_2O emissions from agricultural soils, 1990–2008.

	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	11.06	6.16	2.62	2.37	0.82	0.33	0.02	0.54	4.36	3.55	0.81
1991	11.88	6.72	3.07	2.35	0.92	0.36	0.02	0.53	4.63	3.81	0.82
1992	11.00	6.25	2.60	2.29	0.88	0.46	0.02	0.50	4.26	3.46	0.80
1993	10.21	5.76	2.05	2.32	0.91	0.45	0.03	0.49	3.95	3.15	0.80
1994	11.82	6.87	2.88	2.32	1.19	0.45	0.02	0.48	4.47	3.65	0.82
1995	12.04	6.99	2.92	2.37	1.36	0.32	0.03	0.50	4.55	3.72	0.83
1996	10.76	6.09	2.42	2.34	0.96	0.34	0.03	0.48	4.19	3.38	0.81
1997	10.91	6.23	2.45	2.33	1.02	0.40	0.03	0.47	4.21	3.40	0.82
1998	11.01	6.35	2.47	2.34	1.08	0.43	0.03	0.44	4.22	3.40	0.82
1999	10.78	6.26	2.35	2.29	1.20	0.39	0.03	0.43	4.09	3.29	0.80
2000	10.30	5.88	2.30	2.25	0.92	0.37	0.03	0.42	4.00	3.22	0.78
2001	10.31	5.94	2.28	2.25	1.02	0.36	0.03	0.40	3.97	3.19	0.78
2002	10.28	5.96	2.34	2.21	1.01	0.38	0.02	0.37	3.96	3.19	0.77
2003	9.73	5.55	2.12	2.20	0.82	0.39	0.03	0.36	3.82	3.05	0.77
2004	9.41	5.42	1.86	2.19	0.95	0.40	0.02	0.36	3.63	2.87	0.76
2005	9.46	5.47	1.90	2.17	0.94	0.42	0.02	0.34	3.65	2.89	0.76
2006	9.61	5.62	1.93	2.17	1.05	0.45	0.03	0.32	3.66	2.90	0.76
2007	9.75	5.71	1.96	2.19	1.09	0.44	0.03	0.32	3.72	2.94	0.78
2008	10.23	6.06	2.25	2.17	1.19	0.42	0.03	0.30	3.87	3.09	0.78
Share 2008	*100.0%*	*59.2%*	*22.0%*	*21.2%*	*11.6%*	*4.1%*	*0.2%*	*3.0%*	*37.8%*	*30.2%*	*7.6%*
Trend 1990–2008	*-7.5%*	*-1.6%*	*-13.9%*	*-8.1%*	*44.9%*	*25.8%*	*24.3%*	*-44.5%*	*-11.3%*	*-12.8%*	*-4.8%*

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 0.41 Gg CH_4 2008). This is about 0.2% of total CH_4 from the agriculture sector.

Table 183:CH_4 emissions from agricultural soils, 1990–2008.

	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
2008	0.41	0.41
Share 2008	*100.0%*	*100.0%*
Trend 1990–2008	*24.3%*	*24.3%*

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 184: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		
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		
Atmospheric deposition	0.01/ t of volatized nitrogen	IPCC GPG (Table 4.18)
Nitrogen leaching (and run-off)	0.025/ 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 185: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 2000-2009) [1]; urea application in Austria: expert judgement based on sales data (RWA 2009) [2]
Animal waste applied to soils	Calculations within source category 4.B
N-fixing crops	Cropped area legume production: (BMLFUW 2000-2009) [1]
Crop residue	Harvested amount of agricultural crops: (BMLFUW 2000-2009) [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 December 2009 (UMWELTBUNDESAMT 2009b)
4.D.2 Pasture, range and paddock manure	
Grazing Animals	Calculations within source category 4.B
4.D.3 Indirect soil emissions	
Athmospheric deposition	The amount of manure left for spreading was calculated within source category 4.B. Mineral fertilizer data: (BMLFUW 2000-2009)
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 intensified this effect at the beginning of the 1990ies. Considering this effect, the arithmetic average of each two years is used as fertilizer application data.

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 186.

Table 186:Mineral fertilizer N consumption in Austria 1990–2008 and arithmetic average of each two years.

Year	Annual Nutrient Sales Data [t N/yr]	of which Urea	Data Source	Weighted Nutrient Consumption [t N/yr]	Weighted Urea Consumption [t N/yr]
1989	133 304	1.700	FAO		
1990	140 379	3 965	estimated, GB	136 842	2 833
1991	180 388	3 965	GB	160 384	3 965
1992	91 154	3 886	GB	135 771	3 926
1993	123 634	3 478	GB, RWA	107 394	3 682
1994	177 266	4 917	GB, RWA	150 450	4 198
1995	128 000	5 198	GB, RWA	152 633	5 058
1996	125 300	4 600	GB, RWA	126 650	4 899
1997	131 800	6 440	GB, RWA	128 550	5 520
1998	127 500	6 440	GB, RWA	129 650	6 440
1999	119 500	6 808	GB, RWA	123 500	6 624
2000	121 600	3 848	GB, RWA	120 550	5 328
2001	117 100	3 329	GB, RWA	119 350	3 589
2002	127 600	4 470	GB, RWA	122 350	3 900
2003	94 400	6 506	GB, RWA	111 000	5 488
2004	100 800	7 293	GB, RWA	97 600	6 900
2005	99 700	7 673	GB, RWA	100 250	7 483
2006	103 700	11 310	GB, RWA	101 700	9 491
2007	103 300	11 500	GB, RWA	103 500	11 405
2008	134 400	9 568	GB, RWA	118 850	10 534

GB:	*(BMLFUW 2000-2009): www.gruenerbericht.at*
RWA:	*Raiffeisen Ware Austria, sales company*

Values of Table 186 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 2000-2009).

Table 187: Cropped area legume production, 1990–2008.

	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
2008	22 306	18 419	3 695	98 966

Harvest Data

Harvest data were taken from (BMLFUW 2000-2009) and the datapool of (BUNDESANSTALT FÜR AGRARWIRTSCHAFT 2009) and are presented in Table 188.

Table 188: Harvest Data I, 1990–2008.

	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

	Harvest [1 000 t]								
	corn	wheat	rye	barley	oats	maize (corn)	potato	sugar beet	fodder beet
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
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
2008	5 714	1 690	219	968	108	2 449	757	3 091	14

Table 189: Harvest Data II, 1990–2008.

	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
2008	3 949	1 605	175	80	54	8	45	426	8

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 2008 data from the National Austrian Waste Water Database operated by the Umweltbundesamt was used (data query December 2009, UMWELTBUNDESAMT 2009b).

The federal provinces (Bundesland) Burgenland and Steiermark did not report 2008 data. The values of 2007 have been used for the year 2008.

Table 190: Amount of sewage sludge (dry matter) produced in Austria, 1990–2008.

Year	**Total [t dm]**	**agriculturally applied [t dm]**	**agriculturally applied [%]**
1990	161 936	31 507	19.5
1991	161 936	31 507	19.5
1992	200 000	30 000	15.0
1993	300 000	45 000	15.0
1994	350 000	38 500	11.0
1995	390 500	42 400	10.9
1996	390 500	42 955	11.0
1997	390 500	42 955	11.0
1998	392 909	43 220	11.0
1999	392 909	43 220	11.0
2000	392 909	43 220	11.0
2001	398 800	41 600	10.4
2002	322 096	36 065	11.2
2003	315 130	39 186	12.4
2004	294 942	35 357	12.0
2005	290 110	35 541	12.3
2006	235 364	39 514	16.8
2007	239 102	40 858	17.1
2008	248 169	39 247	15.8

6.4.2.1 Direct soil emissions (4.D.1)

Key Source: Yes (N_2O)

Direct soil emissions are the most important sub-category of 4.D Agricultural Soils. 59.2% (6.06 Gg in 2008) of N_2O emissions from agricultural soils arise from this sub-category (see Table 182).

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) but with Austria specific consideration of nitrogen losses (NH_3-N, NO_x-N).

$$F_{SN} = N_{FERT} * (1 - Frac_{GASF})$$

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 186)

$Frac_{GASF}$ =*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 (see below)*

NH_3-N and NO_x-N volatilization losses from mineral fertilizer application ($Frac_{GASF}$)

With regard to a comprehensive treatment of the nitrogen budget, 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 $Frac_{GASF}$.

NH_3 and NO_x emissions from Sector 4 Agriculture are estimated according to the EMEP/CORINAIR atmospheric emission inventory guidebook (EEA 2007). For the calculation of NH_3-N losses from synthetic fertilizers the CORINAIR detailed methodology was applied. This method uses specific NH_3 emission factors for different types of synthetic fertilizers and for different climatic conditions. For urea the CORINAIR default value of 0.15 t NH_3-N per ton of fertilizer-N was applied. As calcium-ammonium-nitrate and ammonium-nitrate fertilizers represent the dominant form of non-urea synthetic fertilizers being used in Europe (FREIBAUER & KALTSCHMITT 2001), an average emission factor of 0.02 t NH_3-N per ton of fertilizer-N is applied for fertilizers other than urea (STREBL et al. 2003).

For the calculation of NO_X-N losses the CORINAIR simple methodology is applied. Emissions are calculated as a fixed percentage of total fertilizer nitrogen applied to soil. For all mineral fertilizer types the CORINAIR recommended emission factor of 0.3% (i.e. 0.003 t NO_x-N per ton applied fertilizer-N) is used (EEA 2007).

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). 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-N, NO_x-N and N_2O-N losses that depend on the amount of manure N. With regard to a comprehensive treatment of the nitrogen budged, Austria established a link between the ammonia and nitrous oxide emissions inventory. This procedure enables the use of country specific data, which is more accurate than the use of the default value for $Frac_{GASM}$.

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
- NO_X-N losses from manure management
- N_2O-N losses from manure management
- The remaining N is applied to agricultural soils.

NH_3-N and NO_X-N losses from housing and storage were calculated following the CORINAIR EMEP – methodology. The CORINAIR detailed methodology was applied for the calculation of NH_3-N emissions from cattle and swine, for the estimation of NO_X-N emissions the CORINAIR simple methodology was applied.

Table 191: Animal manure left for spreading on agricultural soils per livestock category 1990–2008 (I).

year	**Nitrogen left for spreading [Mg N per year]**					
	IPCC Livestock Categories					
	total	**dairy cattle**	**suckling cows**	**all other cattle**	**breeding sows**	**young & fattening pigs**
1990	145 596	55 314	2 590	50 641	8 858	19 285
1991	144 460	53 813	3 161	50 120	8 733	19 042
1992	140 798	52 527	3 337	47 172	8 923	19 489
1993	142 520	52 125	3 828	47 457	9 158	19 993
1994	142 635	51 915	4 975	47 102	9 129	19 537
1995	145 580	48 244	11 644	46 696	9 275	19 465
1996	143 426	48 060	11 776	45 224	9 203	19 113
1997	143 010	50 428	9 449	43 852	9 177	19 284
1998	143 281	51 929	8 553	43 048	8 908	20 352
1999	140 274	50 617	9 802	42 821	7 924	18 461
2000	137 765	45 880	14 034	42 562	7 700	17 932
2001	137 475	45 153	14 317	41 684	8 062	18 453
2002	134 953	45 036	13 615	40 902	7 847	17 858
2003	134 526	43 437	13 519	42 017	7 688	17 697
2004	133 547	42 692	14 551	42 030	7 286	16 804
2005	132 676	42 478	14 990	40 337	7 252	17 449
2006	132 319	42 546	14 979	40 309	7 388	17 023
2007	133 932	42 829	14 921	40 365	7 304	18 156
2008	132 571	43 693	14 596	40 262	6 829	16 936

Table 192: Animal manure left for spreading on agricultural soils per livestock category 1990–2008 (II).

year	Nitrogen left for spreading [Mg N per year]					
	IPCC Livestock Categories					
	total	poultry	sheep	goats	horses/solipeds	other animals
1990	145 596	4 803	1 928	218	1 728	231
1991	144 460	5 063	2 028	238	2 031	231
1992	140 798	4 791	1 941	230	2 157	231
1993	142 520	5 095	2 076	276	2 281	231
1994	142 635	4 981	2 128	290	2 346	235
1995	145 580	4 870	2 272	316	2 548	251
1996	143 426	4 533	2 369	317	2 574	258
1997	143 010	5 138	2 386	340	2 607	350
1998	143 281	4 968	2 244	316	2 649	313
1999	140 274	5 008	2 191	338	2 868	243
2000	137 765	4 113	2 110	327	2 869	239
2001	137 475	4 358	1 993	346	2 870	239
2002	134 953	4 356	1 893	337	2 870	239
2003	134 526	4 506	2 025	318	3 065	256
2004	133 547	4 504	2 035	324	3 065	256
2005	132 676	4 502	2 026	321	3 066	256
2006	132 319	4 500	1 943	310	3 066	256
2007	133 932	4 497	2 185	353	3 067	256
2008	132 571	4 495	2 072	364	3 067	256

Values of Table 191 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 volatilization losses occurring during manure application are subtracted.

A more detailed description of the methods applied for the calculation of NH_3 and NO_x emissions is given in the report "Austria's Informative Report 2010 – Submission under the UNECE Convention on Long-range Transboundary Air Pollution". Austria's Informative Report 2010 will be published in May 2010. 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).

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

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). Losses of nitric oxide (NO_x-N) were considered for manure management and field spreading of manure (4).

1) NH_3 emissions from housing (cattle and swine)

Table 193 gives NH_3 emission factors for emissions from animal housing. As far as possible, Swiss default values as given in the EMEP/CORINAIR atmospheric emission inventory guidebook (EEA 2007) have been chosen. Due to similar management strategies and geographic structures, Swiss animal husbandry is closest to Austrian animal husbandry. If no CORINAIR emission factors from Switzerland were available, the CORINAIR German default values were used.

Table 193: Emission factors for NH_3 emissions from animal housing.

Manure management system	CORINAIR Emission factor [kg NH_3-N (kg N excreted)$^{-1}$]
Cattle, tied systems, liquid slurry system	0.040
Cattle, tied systems, solid storage system	0.039
Cattle, loose houses, liquid slurry system	0.118
Cattle, loose houses, solid storage system	0.118
Fattening pigs, liquid slurry system	0.150
Fattening pigs, solid storage system	15% of total N + 30% of the remaining TAN
Sows plus litter, liquid slurry system	0.167
Sows plus litter, solid storage system	0.167

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

NH_3-N losses are estimated with CORINAIR default emission factors given in *Table 194*.

Table 194: NH_3 emission factors for manure storage.

Manure storage system	CORINAIR Emission factor [kg NH_3-N (kg TAN)$^{-1}$]
Cattle, liquid slurry system	0.15
Cattle, solid storage system	0.30
Pigs, liquid slurry system	0.12
Pigs, solid storage system	0.30

* 15% + 0.3 % of remaining TAN for deep litter (as used for fattening pigs in agriculture), otherwise 15% for daily removal of solid manure

TAN content in excreta

The detailed method makes use of the total NH_3 nitrogen (TAN) when calculating emissions. TAN content for Austrian cattle and swine manure is given in SCHECHTNER 1991.

Table 195: 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

Table 196 shows correction factors (CF) to emission factors (EF) for a range of manure treatment options. Untreated variants systems, for example uncomposted solid manure, give the reference value '1'. EF for other treatment options, managements and systems get an associated CF, e.g. +20% for the composting of solid manure (CF = 1.2). The CF is multiplied with the EF. Factors were taken from the Swiss ammonia inventory which is calculated with the computer based programme 'DYNAMO' (MENZI et al. 2003, REIDY et al. 2007, REIDY & MENZI 2005). Due to similar management strategies and geographic structures, Swiss animal husbandry is closest to Austrian animal husbandry.

DYNAMO is based on the N flow model and estimates ammonia emissions for each stage of the manure management continuum. Animal categories, manure management systems and a range of additional parameters are considered within DYNAMO. DYNAMO parameters were adapted to Austrian specific conditions. The DYNAMO model is peer reviewed by the EAGER[58] group and published in (REIDY et al. 2008, 2009).

Table 196: Correction factors (CF) for NH_3 emissions from manure storage

Manure storage	[CF]
Uncomposted solid manure	1
Composted solid manure	1.2
Uncovered tank	1
Solid cover – liquid system	0.2
Aerated open tank – liquid system	1.1
Straw cover – liquid system	0.6
Plastic foil cover – liquid system	0.4
Natural crust – liquid system	0.6

Sheep, goats, horses, poultry and other animals

The CORINAIR simple methodology uses an average emission factor per animal for each livestock category. Table 197 presents the recommended ammonia emission factors for the different livestock categories given in the CORINAIR guidelines (EEA 2007). Emission factors include emissions from housing and storage.

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[58] European Agricultural Gaseous Emissions Inventory Researchers Network (EAGER)

Table 197: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 volatilization losses occurring during manure application

CORINAIR default NH_3 emission factors for spreading of slurry and farmyard manure (expressed as share of TAN) have been applied:

Table 198: Emission factors for NH_3 emissions from animal waste application

Application technique	CORINAIR Emission factor [kg NH_3-N (kg TAN)$^{-1}$]
spreading solid manure cattle	0.79
spreading solid manure pigs	0.81
broadcast spreading liquid manure cattle	0.50
broadcast spreading liquid manure pigs	0.25

Table 199 presents the correction factor (CF) for band spreading. The CF is multiplied with the EF of broadcast spreading (reference value: 1). Factors were taken from the Swiss computer based programme "DYNAMO" (Menzi et al. 2003, Reidy et al. 2007, Reidy & Menzi 2005).

Table 199: Correction factors for NH_3 emissions from animal waste application

Application technique	[%]
Broadcast spreading	0
Band spreading	0.7

4) NO_x-N volatilization losses from animal husbandry

NO_X-N emissions from manure management

NO_x-N-losses from manure management were calculated using the default Tier 1 emission factors per animal category as outlined in the EMEP/ EEA emission inventory guidebook 2009 (EEA 2009, Table 3-2).

NO_X-N emissions from animal manure spreading

NO_x-N-losses were estimated using a conservative emission factor of 1% of manure and sewage sludge 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 1990–2008 can be found in Table 187.

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 188)

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 2000-2009) and the datapool of (BUNDESANSTALT FÜR AGRARWIRTSCHAFT 2009) and are presented in Table 188. The other parameters used are presented in the following table:

Table 200: 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 CRF 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 kg N input to agricultural soils, corrected for volatilisation. NH_3-N and NO_x-N volatilisation losses were calculated following the CORINAIR EMEP methodology.

In Austria fertilisation by sewage sludge is very small. In 2008 N_2O emissions from sewage sludge contributed only 0.2% 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 190)

Annual agricultural consumption of sewage sludge, nitrogen and volatilization losses are presented in the following table.

Table 201: Sewage sludge application and volatilization losses

Year	Applied sewage sludge N [Mg N]	NH_3-N losses [Mg N]	NO_x-N losses [Mg N]	Sewage sludge N minus N losses [Mg N]	$Frac_{SEWSL}$ (N_{losses}/N_{SEWSL})
1990	1 231.52	184.73	12.32	1 034.48	0.16
1991	1 231.52	184.73	12.32	1 034.48	0.16
1992	1 170.00	175.50	11.70	982.80	0.16
1993	1 755.00	263.25	17.55	1 474.20	0.16
1994	1 501.50	225.23	15.02	1 261.26	0.16
1995	1 653.92	248.09	16.54	1 389.30	0.16
1996	1 675.25	251.29	16.75	1 407.21	0.16
1997	1 675.25	251.29	16.75	1 407.21	0.16
1998	1 685.58	252.84	16.86	1 415.89	0.16
1999	1 685.58	252.84	16.86	1 415.89	0.16
2000	1 685.58	252.84	16.86	1 415.89	0.16
2001	1 622.40	243.36	16.22	1 362.82	0.16

Year	Applied sewage sludge N [Mg N]	NH_3-N losses [Mg N]	NO_x-N losses [Mg N]	Sewage sludge N minus N losses [Mg N]	$Frac_{SEWSL}$ (N_{losses}/N_{SEWSL})
2002	1 406.55	210.98	14.07	1 181.50	0.16
2003	1 528.26	229.24	15.28	1 283.74	0.16
2004	1 378.93	206.84	13.79	1 158.30	0.16
2005	1 386.11	207.92	13.86	1 164.33	0.16
2006	1 541.04	231.16	15.41	1 294.47	0.16
2007	1 593.47	239.02	15.93	1 338.51	0.16
2008	1 530.62	229.59	15.31	1 285.72	0.16

NH_3-N and NO_x-N volatilization losses from sewage sludge application

For the calculation of NH_3-N emissions the CORINAIR default emission factor for slurry spreading (0.15 kg NH_3-N per kg sewage sludge N) was applied (EEA 2007).

NO_x-N losses were estimated using the conservative emission factor of 1% of sewage sludge nitrogen (FREIBAUER & KALTSCHMITT 2001).

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 202*

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 202:Nitrogen excreted during grazing (N_{exGRAZ}) 1990–2008.

Year	N excretion grazing [Mg]	Year	N excretion grazing [Mg]
1990	17 312	2000	13 303
1991	16 832	2001	12 625
1992	15 757	2002	11 864
1993	15 699	2003	11 608
1994	15 364	2004	11 360
1995	15 751	2005	10 854
1996	15 298	2006	10 308
1997	14 848	2007	10 157
1998	14 047	2008	9 604
1999	13 608		

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):

$$F_{AD} = [(N_{FERT} * Frac_{GASF}) + (N_{ex} * Frac_{GASM}) + (N_{SEWSL} * Frac_{GASSEWSL})] * EF_{AD}$$

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 186)

$Frac_{GASF}$ = 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.10–15, table 5.1.

N_{ex} = Total nitrogen annually produced in animal waste management systems [t N] (N excretion values see Table 174 and Table 175)

$Frac_{GASM}$ = 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)

N_{SEWSL} = nitrogen in agriculturally applied sewage sludge [t N] (see Table 201)

$Frac_{GASSEWSL}$= Fraction of sewage sludge N 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) (see Table 201)

Total N excretion by livestock that volatizes ($Frac_{GASM}$) includes:

- NH_3-N losses from housing, storage, grazing
- NO_X-N losses from manure management
- NH_3-N and NO_X-N losses from animal waste application

Table 203:NH_3-N and NO_X-N volatilisation losses of mineral fertilizers and livestock N excretion 1990 to 2008.

Year	N losses mineral fertilizer (incl. urea)	$Frac_{GASF}$	N losses from livestock excretion	$Frac_{GASM}$
	[Mg N/yr]	**(N_{losses}/N_{FERT})**	**[Mg N/yr]**	**(N_{losses}/N_{ex})**
1990	3 516	0.03	48 130	0.26
1991	4 204	0.03	48 029	0.26
1992	3 633	0.03	46 938	0.26
1993	2 949	0.03	47 871	0.26
1994	4 006	0.03	47 833	0.26
1995	4 168	0.03	48 558	0.26
1996	3 550	0.03	47 721	0.26
1997	3 674	0.03	48 096	0.26
1998	3 819	0.03	48 247	0.26
1999	3 702	0.03	47 118	0.26
2000	3 465	0.03	45 758	0.26
2001	3 212	0.03	46 001	0.26
2002	3 321	0.03	45 274	0.27
2003	3 266	0.03	45 278	0.27
2004	3 142	0.03	44 921	0.27
2005	3 279	0.03	44 794	0.27
2006	3 573	0.04	44 767	0.27
2007	3 863	0.04	45 453	0.27
2008	4 103	0.03	44 984	0.27

The difference to the IPCC default values ($Frac_{GASF} = 0.1$, $Frac_{GASM} = 0.2$) is a result of the comprehensive treatment of the N-flux in the Austrian inventory. Information on the calculation of volatilization ratios is provided in chapter 6.4.2.1.

A detailed description of the method applied for NH_3 and NO_X is given in the report 'Austria's Informative Report 2010 – Submission under the UNECE Convention on Long-range Transboundary Air Pollution'. Austria's Informative Report 2010 will be published in May 2010.

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] (seeTable 186)

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 191)

N_{exGRAZ} = Annual amount of animal manure nitrogen produced by grazing animals and directly dropped on agricultural soils during grazing [t N] (see Table 202)

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 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-GPG TABLE 4-18)

6.4.3 Source specific QA/QC

In the categories 4.D. the following source specific QA/QC procedures have been carried out:

- ✓ NH_3-N and NO_X-N losses calculated in compliance to the obligations under UNECE/CLRTAP
- ✓ Methods and emission factors reviewed by the EAGER[59] network
- ✓ Plausibility of CRF N-fractions checked
- ✓ Differences to IPCC default values explained and documented
- ✓ External review by Austrian agricultural experts (stakeholder meetings)

Sector specific routine control procedures are provided in chapter 6.1.4.

6.4.4 Uncertainties

Uncertainties are presented in Table 144.

6.4.5 Recalculations

Following recalculations have been made in sector 4.D agricultural soils:

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[59] European Agricultural Gaseous Emissions Inventory Researchers Network (EAGER)

Table 204: Difference to submission 2009 of N_2O emissions from agricultural soils category 4.D.1, 4.D.2 and 4.D.3

	N_2O emissions [Gg]								
	4.D Agric Soils Total	**4.D1 Direct Total**	**4.D.1 Animal waste appl.**	**4.D.1 Crop residues**	**4.D.1 Sewage Sludge appl.**	**4.D.2 Pasture, range, paddock**	**4.D.3 Indirect Total**	**4.D.3 Leaching**	**4.D.1 Athmosp. deposition**
1990	**0.31**	**0.34**	0.09	0.25	0.00	**-0.16**	**0.14**	-0.01	0.15
1991	**0.28**	**0.34**	0.08	0.26	0.00	**-0.19**	**0.13**	-0.03	0.16
1992	**0.28**	**0.34**	0.09	0.25	0.00	**-0.20**	**0.14**	-0.02	0.16
1993	**0.27**	**0.36**	0.09	0.27	-0.01	**-0.24**	**0.15**	-0.04	0.18
1994	**0.29**	**0.40**	0.10	0.30	0.00	**-0.26**	**0.15**	-0.04	0.19
1995	**0.30**	**0.43**	0.11	0.32	-0.01	**-0.28**	**0.15**	-0.04	0.19
1996	**0.26**	**0.39**	0.12	0.28	-0.01	**-0.29**	**0.15**	-0.04	0.19
1997	**0.26**	**0.40**	0.10	0.30	-0.01	**-0.30**	**0.16**	-0.05	0.21
1998	**0.28**	**0.43**	0.12	0.31	-0.01	**-0.31**	**0.16**	-0.05	0.21
1999	**0.26**	**0.43**	0.11	0.32	-0.01	**-0.32**	**0.15**	-0.06	0.20
2000	**0.23**	**0.40**	0.13	0.27	-0.01	**-0.31**	**0.14**	-0.04	0.18
2001	**0.24**	**0.42**	0.14	0.29	-0.01	**-0.32**	**0.14**	-0.04	0.18
2002	**0.25**	**0.44**	0.15	0.29	0.00	**-0.33**	**0.14**	-0.04	0.18
2003	**0.18**	**0.38**	0.13	0.25	0.00	**-0.35**	**0.14**	-0.05	0.20
2004	**0.20**	**0.42**	0.13	0.28	0.00	**-0.35**	**0.14**	-0.06	0.20
2005	**0.20**	**0.43**	0.14	0.29	0.00	**-0.37**	**0.14**	-0.06	0.20
2006	**0.19**	**0.43**	0.15	0.29	0.00	**-0.38**	**0.14**	-0.06	0.20
2007	**0.20**	**0.44**	0.15	0.30	0.00	**-0.40**	**0.15**	-0.06	0.22

4.D.1 Animal Manure Applied to Soils: In sector 4.B new data on animal waste management systems have been implemented. Especially the decreased share of pastured animals led to higher amounts of manure nitrogen left for spreading on soils resulting in higher N_2O emissions.

4.D.1 Crop Residue: An error in the calculation of N_2O from certain crop residues was found and corrected, leading also to higher N_2O emissions.

4.D.1 Other direct emissions: The nitrogen amount of sewage sludge applied to soils was corrected for volatilization. The consideration of NH_3-N and NO_x-N losses led to slightly reduced emissions from sewage sludge spreading.

4.D.2 Pasture, Range and Paddock Manure: The smaller share of grazed animals led to smaller emissions from pastures.

4.D.3 Indirect Emissions: The comprehensive revision of the agriculture model – including the emission calculation of NH_3 and NO_x – led to higher N_2O emissions from atmospheric deposition and slightly smaller emissions from leaching compared to the previous submission.

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 2008 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 2008 are presented in Table 205.

Table 205:Emissions from field burning (4.F) 1990–2008.

	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
2008	0.06	0.001
Trend 1990–2008	*-15.7%*	*-15.9%*
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 1 141 ha were burnt in 2008. The extrapolation to Austria's total cereal production area results in 1 790 ha burnt in 2008. This value was applied for the national inventory and corresponds to about 0.2% of total area under cereals 2008. For 1990 an average value of 2 500 ha was indicated (Dr. Reindl 2004), the extrapolation to Austria's total cereal production area gives a value of 2 630 ha.

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 2000-2009). According to an expert judgement from the *Federal Association of Viniculture* (Bundesweinbauverband Österreich) the amount of residual wood per hectare viniculture is 1.5 to 2.5 t residual wood and the part of it that is burnt is estimated to be 1 to 3%. For the calculations the upper limits (3% of 2.5 t/ha) have been used resulting in a factor of 0.075 t burnt residual wood per hectare viniculture area.

Table 206: Activity data for field burning of agricultural residues 1990–2008.

Year	Viniculture Area [ha]	Burnt Residual Wood [t]
1990	58 364	4 377
1991	58 364	4 377
1992	58 364	4 377
1993	57 216	4 291
1994	57 216	4 291
1995	55 628	4 172
1996	55 628	4 172
1997	52 494	3 937
1998	52 494	3 937
1999	51 214	3 841
2000	51 214	3 841
2001	51 214	3 841
2002	51 214	3 841
2003	47 572	3 568
2004	47 572	3 568
2005	50 119	3 759
2006	50 119	3 759
2007	49 842	3 738
2008	49 842	3 738

The 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.

6.5.3 Source specific QA/QC

Sector specific routine control procedures are provided in chapter 6.1.4.

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 207: 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	-13 319	-15 913	1 846	-1 022	200	759	810
1991	-19 233	-21 955	1 844	-1 011	216	844	829
1992	-14 182	-16 890	1 867	-1 002	232	763	849
1993	-18 077	-20 864	1 889	-995	248	776	868
1994	-16 735	-19 545	1 889	-1 012	254	846	833
1995	-16 154	-18 605	1 911	-1 135	256	675	744
1996	-11 113	-13 636	1 918	-1 157	282	779	701
1997	-20 050	-22 488	1 930	-1 179	288	744	657
1998	-18 180	-20 388	1 934	-1 201	273	588	614
1999	-22 567	-24 780	1 939	-1 211	283	606	596
2000	-17 191	-19 340	1 929	-1 221	293	568	578
2001	-19 903	-22 014	1 911	-1 208	302	545	561
2002	-16 095	-18 195	1 984	-1 269	310	531	543
2003	-17 539	-19 647	1 981	-1 259	318	542	525
2004	-17 539	-19 620	2 000	-1 291	327	534	512
2005	-17 359	-19 593	2 018	-1 266	319	665	498
2006	-17 383	-19 566	2 008	-1 288	338	641	484
2007	-17 421	-19 539	1 986	-1 264	372	554	470
2008	-17 382	-19 512	2 062	-1 284	377	517	457
Trend By- 2008	*30.5%*	*22.6%*	*11.7%*	*25.7%*	*88.7%*	*-31.8%*	*-43.6%*

[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 and 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 (forest land) corresponded to 20.9% of total GHG in Austria (without LULUCF), compared to 20.1% in the base year. The removals increased by 30.5% from the base year to 2008, mainly due to an increase of the carbon stock in forest land.

The net carbon stock changes in forest biomass (sector 5.A.1) have a major impact on the overall results in sector 5. These changes vary considerable between single years and outliers exist. The reason is that the figures for annual growth and for annual harvest of forest biomass differ significantly year by year due to annual variations of influencing factors on growth and harvest like weather conditions, timber demand and prices or wind throws. These reasons for different growth and different harvest in single years explain the high annual variations as well as single outlier years in the CO_2 net removals of this sector. The rather constant values from 2003 on are due the use of averages of the last NFI (2000/02) for the forest biomass gains and losses for the estimates of the years after 2002.

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 detail 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. The next two chapters give a brief overview on the used methods.

7.1.2.1 Activity data

For a complete time series from 1990 to 2008 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. Austria reports LUC areas with a transition period of 20 years, starting 20 years before 1990.

The keypoints of the applied area 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 and land use change areas 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 the results for the NFI 2000/02.

Data for the total cropland area are available annually from STATISTIK AUSTRIA (STATISTIK AUSTRIA 1990-2008). 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.

The area of other land is reported in accordance to the IPCC-GPG. So, other land is understood to be the difference of the area of all other categories and the whole area of Austria in order to avoid double accounting or omission of an area. The LUC areas from forest land to other land are based on the NFIs. Other LUCs to other land do not occur.

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

All this information was merged and based on annually land use changes, a matrix for a LUC transition period over 20 years starting 20 years before 1990 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 are given in each land use chapter.

The digital cadastral data base of Austria allows an assessment of the area of the category "other land". If the areas for "other land" were taken from this database (instead calculating the "other land" area as the difference between the area sum of all land categories except other land and the area of total Austria) the resulting area sum of all land use categories would be each year 1 to 2 % higher than the real area of total Austria. From that small difference we assume that the used statistics (though different data bases for all land uses) give a rather good picture of the areas of the Austrian land use. The occurring difference may have several reasons. The resulting higher area gives evidence for a double accounting of some areas by two or more statistics. Such double accounting could occur for abandoned remote Alpine pastures that are in the meanwhile stocked by forests (and as such detected by the NFI), but are still counted as grassland in the agricultural statistics. Another such possibility could be the assessment of "other land" in remote upland areas by the cadastral maps while these areas meet in the real world the forest definition and count as forest land according to Austrian law and the at-site-assessments by the NFI.

Table 208 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 208: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	981 861	934 190	-47 671
perennial converted to annual	9 451	9 419	-32
annual converted to perennial	11 309	12 294	984
2. Land converted to cropland	504 912	504 164	-748
2.1 Forest land converted to cropland	9 650	6 759	-2 892
2.2 Grassland converted to cropland	493 736	495 583	1 847
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	–

Area in ha	1990	2001	Diff 1990–2001
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	38 022	45 661	7 639
2.3 Grassland converted to settlements	106 084	65 856	- 40 228
2.4 Wetlands converted to settlements	NO	NO	–
2.5 Other land converted to settlements	17525	45 423	27 898
5 F Other land – total area	478 236	435 695	- 42 541
2.1 Forest land converted to other land	46 322	32 441	-13 881
Total area	**8 387 000**	**8 387 000**	**–**

Table 209 shows the reported data as land-use change matrix for the years 1990 and 2008. There is a slight inconsistency of the reported areas of LUCs between cropland and grassland and the year-to-year changes of the reported total cropland and total grassland areas across the time series (see Table 209). This missing fit results also in the slight inconsistency of the year to year changes of the area of other land and the LUC areas to this category. The reason lies in the two different statistics for the total cropland and grassland areas (Statistik Austria) and for the LUC areas between cropland and grassland (IACS) which do not exactly fit. We work on a solution.

Table 209:Land use and land-use change matrix for Austria 1990 - 2008

in 1 000 ha	Forest-land	Crop-land	Grass-land	Wet-lands	Settlements	Other land	Total 2008
Forest land	3 799	31	115	10	27	12	**3 994**
Cropland	5	953	486	NO	NO	NO	**1 444**
Grassland	48	427	1 321	NO	NO	NO	**1 796**
Wetlands	3	NO	13	123	NO	5	**144**
Settlements	14	46	54	NO	357	42	**513**
Other land	22	NO	NO	NO	NO	474	**496**
Total 1990	**3 891**	**1 508**	**1 993**	**133**	**384**	**478**	**8 387**
net change 1990-2008	*103*	*-64*	*-197*	*11*	*129*	*18*	

7.1.2.2 Emission factors

The calculations of the emissions follow to a very large extent the methods described in the IPCC GPG. Wherever possible, higher tiers are used and the emission factors are derived from national data. Austria tries to consistently close gaps of national input data for relevant sub-sectors with surveys and studies. The most important national statistics and data sources for the used emission factors are the Austrian national forest inventory, agricultural statistics and studies for the cropland and grassland biomass and the results of the country-wide soil surveys. Furthermore, specific national studies are available to come up with emission factors for the sectors "settlement" and "other land".

7.1.3 Completeness

Table 210 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 210:IPCC categories according to the IPCC-Good Practice Guidance for Land-Use, Land-Use Change and Forestry.

IPCC categories[60]/ 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	✓	

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[60] IPCC categories – applied according to the "Good Practice Guidance for LULUCF (2003)"

IPCC categories[60]/ Sub division for calculation	**Description**	**Status for CO_2**	**Other GHG**
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	✓	
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	✓	

IPCC categories[60]/ Sub division for calculation	Description	Status for CO$_2$	Other GHG
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	✓	
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$_2$O ✓ 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)

7.2.1 Category description

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 1990–2008[61] range from 13 636 Gg CO_2 to 24 780 Gg CO_2 (mean: 19 584 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.

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 2008 the total annual net CO_2 removals (biomass and soil) from land use changes to forest range from about 2 538 Gg CO_2 to 4 813 Gg CO_2. The total annual emissions (biomass and soil) from land use changes from forests vary between 1 252 Gg CO_2 and 2 326 Gg CO_2 (Table 211). These figures are in the order of 7 to 36% of the annual net CO_2 removals of IPCC Sector 5.

The net carbon stock changes of sector 5.A vary considerable between single years and outliers exist. The reason is that the figures for annual growth and for annual harvest differ significantly year by year due to variations of influencing factors on growth and harvest like weather conditions, timber demand and prices or wind throws. The forest biomass changes in sector 5.A.1 have a major impact on the overall results in sector 5.A. (and total sector 5). Therefore, such

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[61] For the years 2003 to 2008 the means for the last period (2000 to 2002) of the National Forest Inventory (NFI) have been reported

reasons for different growth and different harvest in single years explain the high annual variations as well as single outlier years in the CO_2 net removals of this sector. The rather constant values from 2003 on are due the use of averages of the last NFI (2000/02) for the estimates of the years after 2002.

The variation within the time trend for LUCs to forest land is mainly due to the change of LUC areas and its composition of previous land use types across the time series.

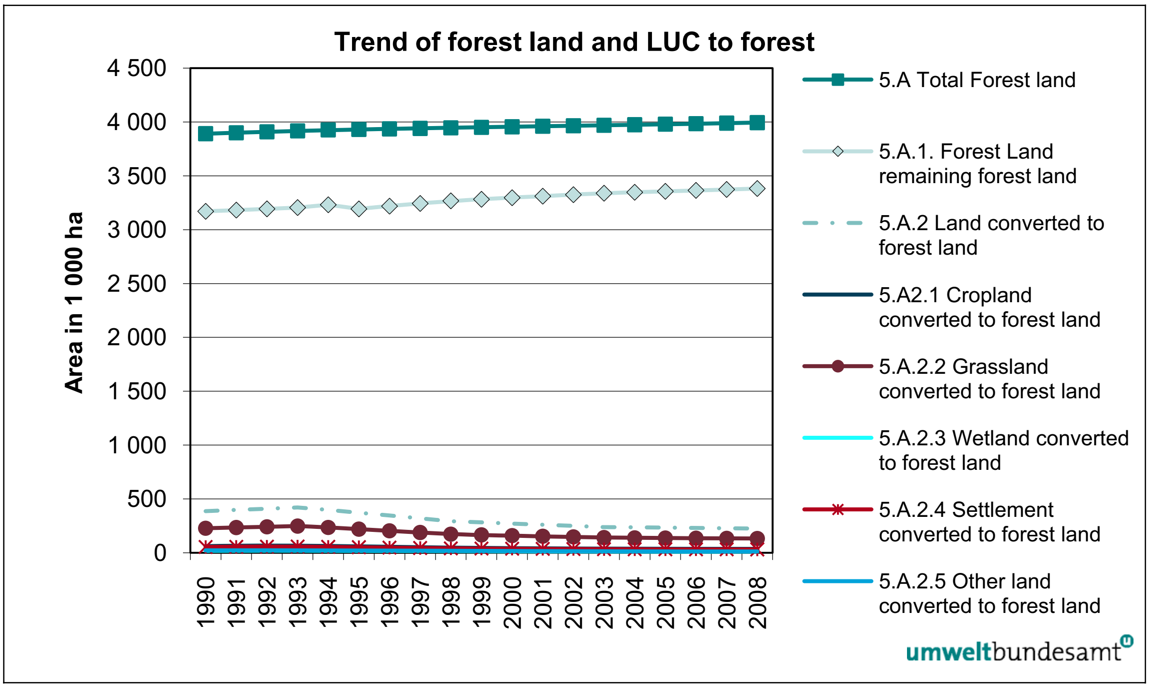

Figure 22: Trend of forest land and LUC to forest (covering a conversion period of 20 years) from 1990 to 2008 in 1 000 ha (Total forest land includes also unmanaged forest).

Table 211: CO_2 removals/emissions from IPCC Category 5 A Forest Land and Forest land conversions from 1990–2008 (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	0.582	0.135	2 186
1991	-21 955	-17 416	-4 539	-979	-1 847	-418	-793	-502	IE	0.154	0.036	2 233
1992	-16 891	-12 215	-4 676	-1 007	-1 900	-430	-823	-517	IE	0.384	0.089	2 279
1993	-20 864	-16 051	-4 813	-1 035	-1 953	-442	-852	-531	IE	0.326	0.076	2 326
1994	-19 545	-14 992	-4 553	-982	-1 853	-419	-796	-504	IE	0.169	0.039	2 242
1995	-18 605	-14 288	-4 317	-916	-1 730	-391	-809	-470	IE	0.093	0.022	1 947
1996	-13 636	-9 638	-3 998	-851	-1 606	-364	-740	-437	IE	0.084	0.020	1 842

1997	-22 488	-18 809	-3 679	-786	-1 483	-336	-670	-403	IE	0.058	0.014	1 737
1998	-20 388	-17 028	-3 360	-721	-1 360	-308	-601	-370	IE	0.271	0.063	1 632
1999	-24 780	-21 550	-3 230	-694	-1 310	-297	-573	-356	IE	0.023	0.005	1 589
2000	-19 340	-16 239	-3 100	-668	-1 260	-285	-545	-343	IE	0.122	0.028	1 546
2001	-22 014	-19 043	-2 971	-641	-1 210	-274	-517	-329	IE	0.070	0.016	1 503
2002	-18 195	-15 355	-2 841	-614	-1 160	-263	-488	-315	IE	0.559	0.130	1 461
2003	-19 647	-16 937	-2 711	-588	-1 110	-251	-460	-302	IE	0.533	0.124	1 418
2004	-19 620	-16 944	-2 676	-581	-1 096	-248	-453	-298	IE	0.049	0.011	1 385
2005	-19 593	-16 952	-2 642	-574	-1 083	-245	-445	-295	IE	0.090	0.021	1 352
2006	-19 566	-16 959	-2 607	-567	-1 070	-242	-438	-291	IE	0.215	0.050	1 319
2007	-19 539	-16 967	-2 572	-560	-1 056	-239	-430	-287	IE	0.108	0.025	1 285
2008	-19 512	-16 974	-2 538	-553	-1 043	-236	-423	-284	IE	0.146	0.034	1 252

7.2.2 Information on approaches used for representing land areas and on land-use databases used for the inventory preparation

The information on forest area is based on data of 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. The NFI provides representative and systematically measured data for the total Austrian forest area and for all Austrian areas of LUCs from and to forests. This includes the areas of the complete sector 5.A and the areas of the subsectors 5.B.2.1, 5.C.2.1, 5.D.2.1, 5.E.2.1 and 5.F.2.1. The NFI grid covers the whole area of Austria and provides measured data on the total Austrian forest area with a statistical error of ±1.2% (Figure 23). Each grid point is terrestrially inspected during each NFI assessment for a potential af-/reforestation except grid points that are not suited to cover forests (e.g. grid points at glaciers or at permanent surface water bodies).

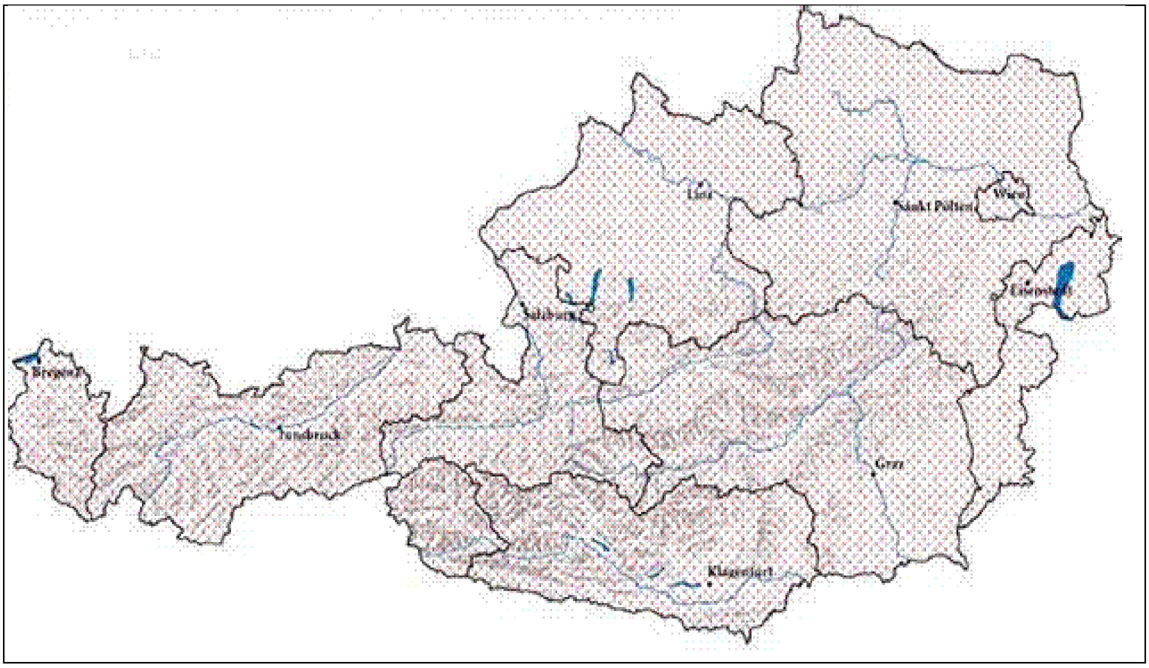

Figure 23: Systematic sample grid of the Austrian NFI (Federal Research and Training Centre for Forests, Natural Hazards and Landscape, 2005).

Due to its representativeness and coverage the NFI data allow an unbiased reporting of the complete Austrian forest area and its change by LUCs from and to forests. This is also of relevance for the reporting of the Austrian Art. 3.3 areas which are also based on the NFI data only.

The NFI assessments related to the UNFCCC- and Kyoto-Protocol-reporting-period were carried out so far in the periods 1986/90, 1992/96 and 2000/02. Actually, the NFI assessment period 2007/09 is running. The forest areas measured for these periods were located in the mean year of the NFI period and the areas for the other years were estimated by linear interpolation.

Areas were land use changes to and from forests take place are generally very small in Austria (see Figure 22). By means of the NFI, which follows a regular grid of 4 x 4 km 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 Table 212 and Table 213. 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 212: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 213: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 212 and Table 213 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.

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. Figure 24 gives an overview of the LUCs to and from forests from 1970 and 1990 on, respectively. LUC areas are in the LUC subcategory for a transition period of 20 years starting 20 years before 1990.

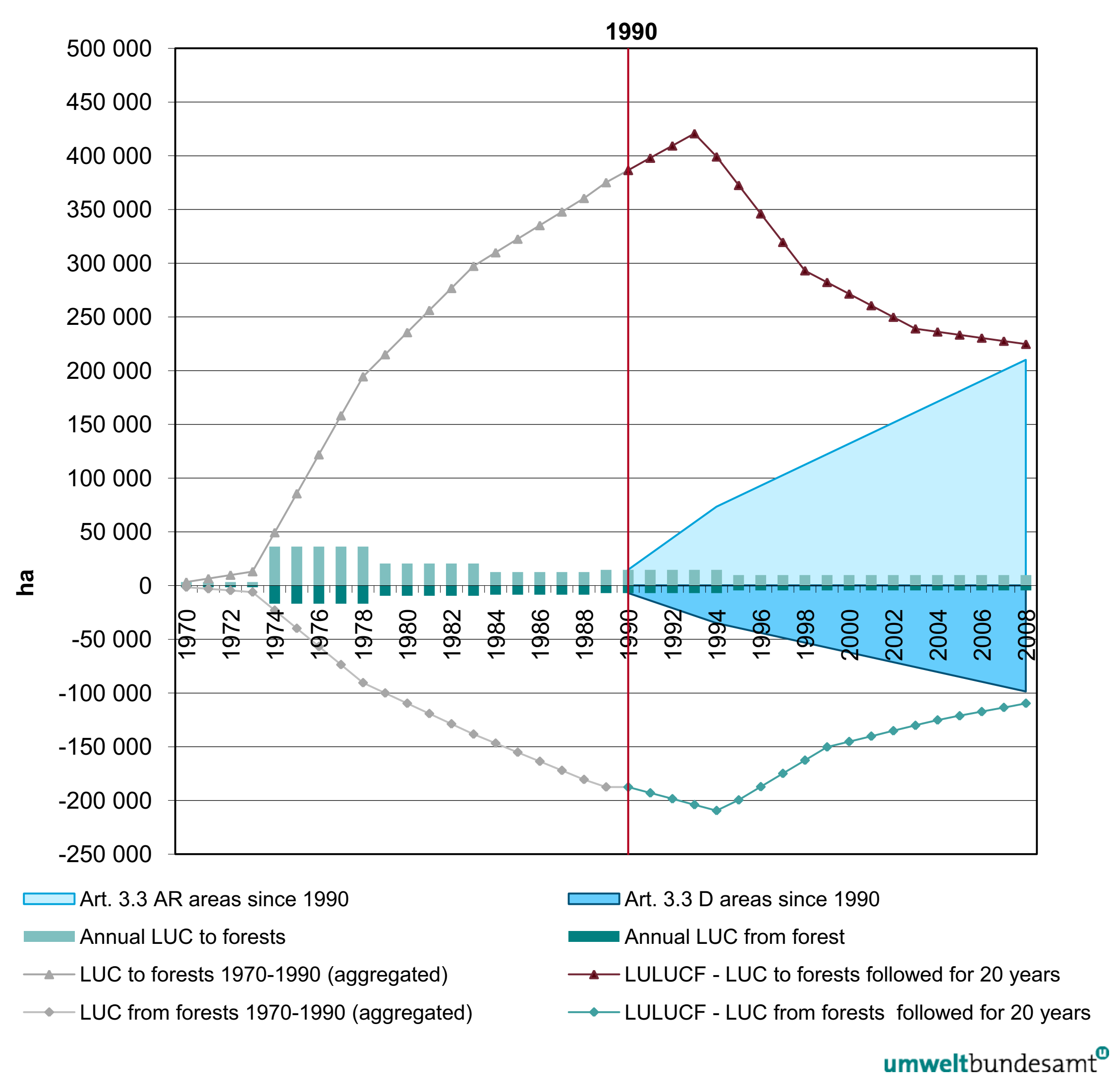

Figure 24: Areas of LUC from and to forests and ARD areas since 1970 and 1990, respectively.

7.2.3 Land-use definitions and the classification systems used and their correspondence to the LULUCF categories

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:

- Minimum land area: 0.05 ha
- Minimum crown cover: 30%
- Minimum height: 2 m
- Average width of more than 10 m

Permanently unstocked basal areas that are directly connected with forest in terms of space and forestry enterprise and contribute directly to its management (such as forestal hauling systems, wood storage places, forest glades, forest roads) also represent forests. Areas which are used in short rotation with a rotation period of up to thirty years as well as forest arboretums, forest seed orchards, Christmas tree plantations and plantations of woody plants for the purpose of obtaining fruits such as walnut or sweet chestnut do not account as forests but represent cropland. Rows of trees (except shelter belts for wind protection) and areas with woody plants in a park structure are not forest land.

7.2.4 Methodological Issues

7.2.4.1 Forest Land remaining Forest Land (5.A.1)

7.2.4.1.1 Biomass

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.

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). Table 214 gives an overview of the different harvest statistics in Austria. The year 2001 was chosen for NFI and HEM, because it refers to the mean year of the last NFI period (2000-02).

Table 214:Overview of the different harvest statistics in Austria.

Statistics	Characteristics/methodological approach	Amount	Units
		of drain or harvested wood	
NFI – national forest inventories	Uses permanently marked grid (4x4 km) all over Austria, periodical investigation of sampling sites; measurements of increment and total stemwood drain (and other parameters) at permanent sampling plots in the forest.	~18 Mio (2001)	m³ over bark (Vfm in R.)
National annual records of wood felled (HEM)	No measured data, annual reporting on wood disposal and wood going into self consumption, declaration provided by forest authorities, wood from non-forest soils is not included; there is some underestimation of harvest in small-sized forest (private owners).	~ 13 Mio. (2001)	m³ under bark (Efm ohne R.)
National wood balance (HB)	No measured data, calculations based on NFI and HEM; includes also wood from non-forest areas and takes more possible and suspected domestic wood sources than HEM into account, available for specific years	~ 22 Mio (1995)	m³ under bark (Efm ohne R.)

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 7.2.4.2.

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[62] 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 may differ significantly year by year thus the net carbon stock changes between single years vary considerable and outliers exist. Several reasons influence the factors on growth and harvest differences like weather conditions, timber demand and prices or 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.

Wood densities

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 wood densities 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 215). 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 (UMWELTBUNDESAMT 2000).

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[62] Values for the relative variation in the individual years of the time series

Table 215: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 216) 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 216: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 217: 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.

In addition, we report now the area of forests out of yield. This part of the Austrian forests has limited access and there is no management of timber harvesting there. In line with the IPCC GPG, we assume that there is no change in the C-stocks of these forests, so they have no impact on the GHG balance of sector LULUCF.

7.2.4.1.2 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.

Based on the data of the NFI the stock of dead wood (on average of all tree species) is 4.5 m^3 ha^{-1} for the inventory period 1992/96 and 6.1 m^3 ha^{-1} for the inventory period 2000/02. Consequently, 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 215 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.

7.2.4.1.3 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 including the litter pool in sense of IPCC-GPG (total humus layer) 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.

7.2.4.1.4 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 2008 and range between 8 – 200 ha/year. According to the references in the IPCC GPG a mean value of 19.8 t ha^{-1} biomass consumption was applied. This represents the product of available biomass density on the land before combustion (B) and the combustion efficiency (C). The emission factors (D) for N_2O and CH_4 were 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 0.005 and 0.58 Gg CO_2 equivalents. This is due to the small area concerned.

7.2.4.2 Land Use Changes to Forest Land (5.A.2)

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. The area of conversion status is followed for 20 years, thus all LUC since 1970 are taken into consideration for the LUC areas since 1990.

7.2.4.2.1 Biomass

On basis of results from the NFIs the experts of the Federal Research and Training Centre for Forests, Natural Hazards and Landscape provided the following values for increment and drain at areas of LUC to and from forests (Schadauer, pers. comm.):

The annual increment of stemwood over bark (o.b.) on LUC areas to forests was estimated with 3 m^3 ha^{-1}. This value is used for the LUCs to forests from all previous land use types

The annual average loss of stemwood o.b. on LUC areas from forests to other land uses was estimated with 60 m^3 ha^{-1} on average for deciduous and coniferous trees. This value is used for the LUCs from forests to all other land use types.

Conversion factors (BEF)

In Table 218 the applied conversion factors for increment and harvest of the total living biomass (above and belowground biomass with no further division into coniferous and deciduous) are given. These factors are only applied for LUC areas from and to forests and are used to convert the increment and loss values in m^3 stemwood (as described in the paragraphs before) to the t C of total tree biomass.

Table 218: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)	
increment	0.8
harvest	0.72
t dm whole tree → t C whole tree	0.49

For areas with LUC to forests the calculation leads then to the following result of annual stock change in living biomass per ha and year:

$3*0.8*0.49=1.176$ t C ha^{-1} a^{-1}

This constant value is used for the annual changes for the whole 20 years LUC transition period and for the LUCs to forests from all previous land use types. It is multiplied with the total LUC area in transition that became forests.

The calculation leads to the following result of stock change in living biomass per ha and year at areas with LUC from forests to other uses:

$60*0.72*0.49=21.168$ t C ha^{-1} a^{-1}

This value is then multiplied with the actual annual LUC area from forest to another land use.

An overview of the emissions/removals from land use changes from and to forests is given in Table 211.

7.2.4.2.2 Dead wood

The assessment of stemwood stocks of the NFI also accounts for standing dead trees. Therefore, the estimated stemwood losses at areas of LUC from forests to other land uses also account for the loss of dead wood.

Due to the young age of the forests at areas of LUC to forests and the assumed lack of dead wood at areas of all other land uses it is assumed that a stock change of dead wood does not occur at areas of LUCs to forests.

7.2.4.2.3 Soil

The estimates of the soil C stock changes of land use change areas from and to forests include also changes in the litter and follow the equation below. The changes are estimated annually for a LUC transition period of 20 years.

$$\Delta\ SOC = (SOC_O - SOC_{O\text{-}T})/20$$

Δ SOC = average annual carbon stock change in soils and litter (t C ha^{-1} a^{-1}) over the LUC transition period of 20 years

SOC_O = carbon stock in soils and litter after conversion (e.g forest land→121 t C ha^{-1})

$SOC_{O\text{-}T}$ = carbon stock in soils and litter 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 soils and litter converted from and to forest land equals Δ SOC * conversion area for a transition period of 20 years.

The input data for forest soil C stocks (121 t C ha^{-1}) represent 0–50 cm depth of mineral soil plus the complete humus layer (litter in sense of IPCC GPG) above the mineral soil. Therefore, the C stock changes described under soil C stock changes also account for the changes in litter at lands converted to or from forests (litter exists only in forest land).

Estimates for the soil C stock changes of and between the other land use categories than forests are based on a soil depth of 0–30 cm (see chapters 7.3.4.2, 7.4.4.2, 7.5.4.1, 7.6.4.1, 7.7.4.1). Therefore, the following soil C stocks for a mineral soil depth of 0–50 cm have been used to calculate emissions/removals of LUC from and to forests:

- Forests: 121 t C ha^{-1}, represents 0–50 cm depth of mineral soil plus the complete humus layer (litter in sense of IPCC GPG) above the mineral soil (UMWELTBUNDESAMT 2000)
- Cropland: 60 t C ha^{-1}, (GERZABEK et al. 2005)
- Vineyards: 58 t C ha^{-1}, (GERZABEK et al. 2005)
- Orchards/garden land: 78 t C ha^{-1}, (GERZABEK et al. 2005)
- Grassland (intensive use): 81 t C ha^{-1}, (GERZABEK et al. 2005)
- Grassland (extensive use) 119 t C ha^{-1} (GERZABEK et al. 2005).
- Bogs: 150 t C ha^{-1} (expert judgement)
- Surface waters and reed beds: 0 t C ha^{-1} (expert judgement)
- Settlements and traffic area: 60 t C ha^{-1} (expert judgement)
- Industrial and mining areas, dumps: 0 t C ha^{-1} (expert judgement)
- Alpine shrub lands: 119 t C ha^{-1} (KÖRNER et al. 1993)
- Rocks and stone slopes: 0 t C ha^{-1} (expert judgement)
- Other land uses: 30 t C ha^{-1} (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). The approaches for the estimates and expert judgements of the soil C stocks in areas of settlement and other land are provided in the chapters 7.6.4.1 and 7.7.4.1.

Based on these soil C stock data and the measured land use change areas by the NFI, which specifies the types of land use changes from and to forest land in a more detailed way than the existing six major land use categories (according to the list of the soil C stocks above), an area weighted mean value of soil C stock was calculated for each land use change category of the IPCC GPG.

Table 219: Area weighted mean values for carbon stocks in mineral soils (0–50 cm)[1] 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)[1]**	
	LUC to forest land	**LUC from forest land**
Forest land[1]	121	121
Cropland	61	62
Grassland	102	104
Wetland	30	0
Settlements	43	32
Other land	30	41

[1] The value for forest land represents 0–50 cm depth of mineral soil plus the complete humus layer (litter in sense of IPCC GPG) above the mineral soil

7.2.5 Uncertainty Assessment

An uncertainty estimate for the carbon stock changes of living biomass has been carried out several years ago (UMWELTBUNDESAMT 2000) (see Table 220). 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 220. 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[63]
- and the uncertainty of each conversion and expansion factor.

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[63] 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.

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 220), 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 220:Relative uncertainties of the previous biomass estimates of sector 5.A.1 (Umweltbundesamt 2000).

	Relative uncertainties [%]				
	Forest inventory	**Uncertainty related to the calculation of annual data and to the necessary consistency of different statistics**	**Conversion factor „m^3 o.b. → t dm“**	**Conversion factor „t dm stemwood → t dm whole tree“**	**Conversion factor „t dm → t C“**
Increment	2.0	3.2	11.1	6.5	2.0
Harvest	3.5	12.2			

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).

7.2.6 QA/QC and Verification

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 is embedded in the overall QA/QC-system of the Austrian GHG inventory (see chapter 7.8).

7.2.7 Recalculations

There was a mistake in estimating the emissions from forest fires due to a misunderstanding of the IPCC GPG. The equation was corrected and the time series of the emissions from forest fires was revised.

The current submission includes now information on the area of "protective forests out of yield" (non-productive forest).

7.2.8 Planned improvements

See Chapter 7.9

7.3 Cropland (5.B)

7.3.1 Category description

In Sector 5.B the estimate of emissions from cropland remaining cropland, land converted to cropland and liming is carried out. The calculations were made for the individual years from 1990 to 2008. 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. Organic soils occur only in the grassland category in Austria, and dead wood and litter is assumed to occur not at cropland areas.

Emissions/Removals were estimated for the sub categories and related sources/sinks as shown in Table 221.

Table 221: 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

In 2008 1.44 Mio ha of Austria were arable land including annual and permanent crops (STATISTIK AUSTRIA 2009). The land use changes are derived from the IACS data base, in 2008 the land use change area to cropland was 55 000 ha. The annual emissions from 1990-2008 range between 1 846.3 Gg CO_2 equivalent and 2 062.4 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.

Table 222:Activity data for cropland (1990–2008) in ha –conversion status 20 years.

	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**	**2.3 Wetland converted to Cropland**	**2.4 settlement converted to cropland**	**2.5 Other Land converted to cropland**
1990	1 507 533	981 861	9 451	11 309	504 912	9 650	493 736	1 526	NO	NO	NO
1991	1 526 723	1 001 381	9 439	11 395	504 507	9 924	493 033	1 550	NO	NO	NO
1992	1 518 074	993 181	9 427	11 478	503 989	10 198	492 218	1 573	NO	NO	NO
1993	1 500 454	975 606	9 419	11 567	503 862	10 472	491 793	1 597	NO	NO	NO
1994	1 501 453	977 408	9 411	11 655	502 978	9 978	491 379	1 621	NO	NO	NO
1995	1 492 280	969 476	9 399	11 738	501 667	9 362	490 662	1 644	NO	NO	NO

	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	2.3 Wetland converted to Cropland	2.4 settlement converted to cropland	2.5 Other Land converted to cropland
1996	1 491 907	969 829	9 394	11 828	500 856	8 745	490 443	1 668	NO	NO	NO
1997	1 481 910	960 522	9 389	11 919	500 079	8 129	490 259	1 691	NO	NO	NO
1998	1 470 763	950 440	9 380	12 003	498 940	7 512	489 713	1 715	NO	NO	NO
1999	1 470 396	950 065	9 379	12 099	498 853	7 261	489 853	1 739	NO	NO	NO
2000	1 462 108	942 151	9 374	12 188	498 395	7 010	489 623	1 763	NO	NO	NO
2001	1 460 067	934 190	9 419	12 294	504 164	6 759	495 583	1 822	NO	NO	NO
2002	1 459 095	934 864	9 277	12 454	502 500	6 507	494 151	1 841	NO	NO	NO
2003	1 459 991	938 481	9 392	12 496	499 622	6 256	491 526	1 839	NO	NO	NO
2004	1 454 572	929 282	9 339	12 453	503 497	6 062	495 616	1 819	NO	NO	NO
2005	1 455 984	930 936	9 329	12 381	503 338	5 867	495 655	1 816	NO	NO	NO
2006	1 453 893	932 913	9 283	12 272	499 425	5 672	491 955	1 797	NO	NO	NO
2007	1 451 900	918 345	9 475	12 507	511 572	5 478	504 247	1 848	NO	NO	NO
2008	1 443 738	878 211	9 245	12 471	543 812	5 283	536 650	1 879	NO	NO	NO

Table 223:Emissions from cropland management (1990–2008) in Gg CO_2; other land use changes are not occurring.

	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 annual Cropland	Grassland converted to perennial Cropland	N_2O (in CO_2 equiv)
1990	1 846.33	-429.75	90.30	112.12	-2.41	2 076.06	131.17	1 688.86	4.99	251.04
1991	1 843.89	-432.57	91.06	112.84	-2.43	2 074.99	134.12	1 685.12	5.05	250.70
1992	1 866.88	-408.88	90.72	112.50	-2.57	2 075.12	137.08	1 682.65	5.11	250.29
1993	1 889.09	-388.16	90.69	111.62	-2.79	2 077.73	140.03	1 682.47	5.15	250.08
1994	1 888.88	-381.28	90.73	111.65	-2.90	2 070.68	134.70	1 680.89	5.21	249.88
1995	1 911.45	-341.20	91.97	110.60	-3.13	2 053.21	118.54	1 679.90	5.25	249.52
1996	1 918.34	-326.71	91.95	110.51	-3.26	2 045.84	111.90	1 679.22	5.30	249.42
1997	1 929.91	-307.82	92.08	110.47	-3.38	2 038.56	105.25	1 678.61	5.36	249.34
1998	1 933.83	-294.67	91.64	110.03	-3.54	2 030.37	98.61	1 677.29	5.41	249.07
1999	1 939.34	-286.97	91.63	110.01	-3.66	2 028.34	95.90	1 677.82	5.47	249.14
2000	1 929.28	-292.31	90.35	109.37	-3.86	2 025.73	93.19	1 677.98	5.52	249.04
2001	1 910.86	-315.02	90.27	119.66	-3.71	2 019.66	90.49	1 670.96	6.13	252.08
2002	1 984.19	-229.36	90.23	81.17	-2.91	2 045.06	87.78	1 700.28	5.64	251.36
2003	1 981.39	-278.99	90.27	126.91	-5.86	2 049.07	85.08	1 708.68	5.28	250.03
2004	2 000.16	-206.84	90.22	92.47	-7.29	2 031.60	82.98	1 691.52	5.01	252.10
2005	2 018.16	-214.68	90.28	101.36	-7.72	2 048.92	80.88	1 710.71	5.22	252.11
2006	2 008.05	-216.73	90.09	93.43	-8.29	2 049.54	78.78	1 715.56	4.96	250.23
2007	1 986.18	-268.00	90.04	142.59	-2.40	2 023.95	76.68	1 684.77	6.00	256.48
2008	2 062.40	-135.58	88.28	56.34	-7.17	2 060.53	74.59	1 707.19	5.82	272.94

7.3.2 Information on approaches used for representing land areas and on land-use databases used for the inventory preparation

The data of the total cropland areas were taken from STATISTIK AUSTRIA (STATISTIK AUSTRIA 1990–2009). The area of cropland remaining cropland represents the total cropland area minus land converted to cropland.

These cropland area statistics of "Statistik Austria" are based on the IACS database (Integrated Administrative Control System). Since joining the EU Austria is committed to run this data base. It covers detailed information on cropland areas (see explanation below). For some crops, which are not fully covered by the IACS (vegetable, flowers and floriculture) the data are revised and in addition estimated by expert judgement. For the years 1995 and 1999 there was a full survey available, in between there are random sample surveys. The next full survey will be in 2010 (VO (EG) Nr. 1166/2008). Areas for land use change between and within grassland and cropland were also taken from IACS - The IACS is based on two directives of the European Union and exists in all member states of the European Union. This database for market organisation premiums and direct compensation for farmers is a central information system about agriculture. The data represent a GIS-based agricultural administration of the field uses per farm. 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 years 2001–2006, the calculation of land use changes between and within grassland and cropland was estimated with a sample survey representing more than 4.600 cadastral municipalities. For the period after 2000 annual activity data are available. Based on these results, the land use changes in Austria were extrapolated (except for alpine meadows, which were not part of IACS). The LUC areas between cropland and grassland for the years before 2001 were estimated on basis of an average "land use change factor" derived from the IACS data from 2001 to 2003. This is the reason for the rather stable values between 1990 and 2000 and for higher fluctuations after 2000 which are caused by the area (activity) data for the subcategory for LUCs from grassland to cropland.

Since 2007 the complete survey of 7777 cadastral municipalities is provided and in the future the calculation of these 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. Nevertheless, it is planned to obtain the full survey data from 2001 on and to recalculate the land use change areas.

In 2008 about 89% of the agriculturally used areas showed no land use change, 0.3% represented cropland converted to grassland, 2 % grassland converted to cropland and non corresponding area[64] represents 9.1 % of total agricultural area

There is a slight inconsistency of the reported areas of LUCs between cropland and grassland and the year-to-year changes of the reported total cropland and total grassland areas across the time series (see Table 209). The reason lies in the two different statistics for the total cropland and grassland areas (Statistik Austria) and for the LUC areas between cropland and grassland (IACS) which do not exactly fit.

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[64] The field parcel ID has changed between the years and the corresponding pair of areas cannot be identified clearly in the observed years.

On expert judgement there is also a bias in the land use change data of grassland to cropland in the years from 2005 because of a change in the common EU agricultural policy (CAP). The obligations of the EU Cross Compliance Regulations introduce protection of grassland. It is not allowed to change grassland to cropland by more than 10% of grassland. To administrate such prohibition, an earmark system for turned over grassland fields was established. Within five years the former grassland has to be changed to grassland again. Otherwise a real land use change occurs with strong obligation for the farmer involved and the EU-Member State. These leads to a higher fluctuation of grassland change to cropland and backward. For economic reason (advantages) the land use changes from grassland to cropland tend to increase at the expense of grassland. This has been observed in the last two years. In addition, an assessment of LUC areas via IACS may lead to a repeated accounting of single areas as LUC areas within a period of 20 years leading to a too high amount of land use change areas between cropland and grassland. We are recently trying to model and handle the problems of overestimating land use change areas and in the same context underestimating cropland remaining cropland and grassland remaining grassland.

The LUC areas from forest land to cropland are based on the NFI data (see chapter 7.2.2).

LUCs from wetland, from settlement and from other land to cropland do not occur in Austria. This assumption is based on the fact that the cropland area shows a steady decrease. In addition, wetland, settlement and other land areas are not suited (anymore) for a land use as cropland: 1) Settlement areas increased steadily in the last decades mainly by LUC from agricultural areas. 2) Settlement areas and soils – once converted - are usually not more usable for cropland management. 3) There is also a higher economic factor for land dedicated to settlements area than agricultural land which makes a reconversion very unlikely. 4) "Other lands" are the highest located areas of Austria or very steep areas, all in all, areas of very unfavorable ecological conditions that do not allow any agricultural use.

7.3.3 Land-use definitions and the classification systems used and their correspondence to the LULUCF categories

The STATISTIK AUSTRIA classification was used for land use definitions:

- Annual Cropland
- Perennial cropland (viticulture, horticulture, Christmas tree, energy crops)
- House garden

7.3.4 Methodological Issues

7.3.4.1 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).

The C stock changes in the areas of "annual cropland remaining annual cropland" are estimated to be zero. At these areas, the annual crops are harvested every year and there is no long term change in the carbon storage. According to GPG (IPCC 2003) the emissions/removals of land use change from annual cropland to perennial cropland and vice versa have to be considered in this category. For that purpose, the carbon stocks of annual crops and perennial crops as well as the related soil C stocks were estimated. The biomass stocks of Christmas tree cultures, energy crops and annual crops as well as the soil carbon stocks were estimated on basis of country specific values. The biomass carbon stock of orchards, vineyards and house garden were estimated applying the default values of IPCC GPG and an IPCC Tier 1 methodology.

The annual removals of 5.B.1 range between 429.8 Gg CO_2 and 135.6 Gg CO_2.

In the following sub chapters the methodologies and used emission factors for the estimates are explained.

7.3.4.1.1 Changes of carbon stock in biomass of perennial cropland

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 annually and cause emissions.

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 224:Estimated area of perennial crops from 1990–2008 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	57462	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	49 981	14 952	4 818	915	2 449	73 113
2008	49 842	14 507	4 444	1 335	2 849	72 977

Figure 25 indicates the decrease of the total perennial cropland area from 1960 to 2008. This trend was mainly caused by the continuous 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 leads to a living biomass change from a sink to a source after 1993. 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). For Christmas trees and energy crops a country specific steady state of biomass increase in the 10 years and 6 years, respectively, of rotation period was assumed. The energy crop cultivation was assumed to start in 1990 (according to Statistik Austria). So, from 1996 on the energy crops cause also emissions.

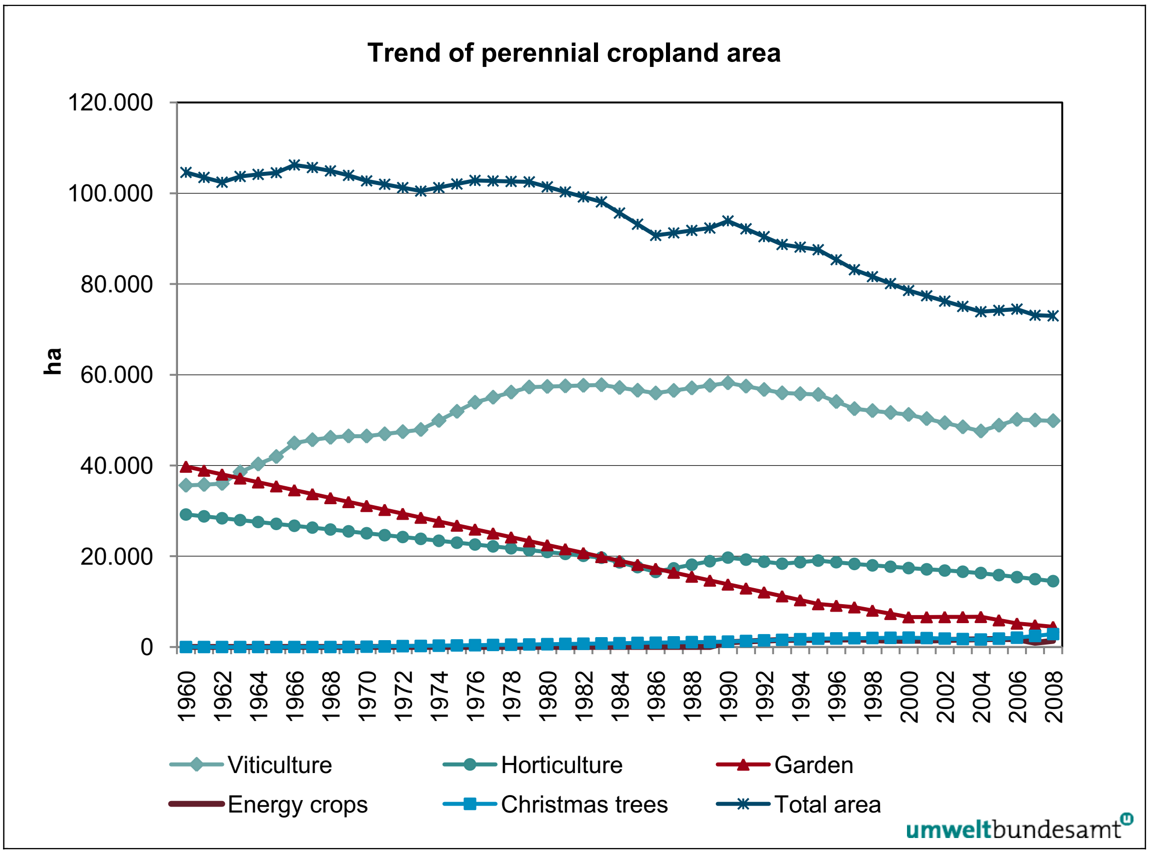

Figure 25: Trend of perennial cropland area (ha) from 1960–2008.

The reason for the inter annual changes of emissions/removals within this category lies mainly within the area decrease (changes) of the perennial cropland subcategory: The area of vineyards increased until the 90ies but decreased thereafter, the areas of orchard and house garden decreased, the annual LUC-area from perennial cropland to annual cropland changed from 397 ha in 2006 to 635 ha in 2007. The related losses of perennial biomass due to these land use changes within the cropland remaining cropland category causes the changes in emissions of living biomass within the time series. For calculating the carbon stock change of living biomass of viticulture, horticulture and house gardens the following Tier 1 equation was applied:

> *Annual change in biomass = (area of perennial cropland remaining perennial cropland * Carbon accumulation rate) – (area of perennial cropland before 30 years*[a] ** 0.033 * biomass carbon stock at harvest)*
>
> [a] *excluding perennial cropland areas lost by LUCs*

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. It is planned to assess and report national data for viticulture and horticulture.

The estimates of the subcategory "cropland remaining cropland" included some double accounting of biomass increment and biomass losses in perennial cropland due to the use of the whole perennial cropland area of Austria for the estimates of biomass changes in this subcategory. As a consequence, these estimates in this subcategory also accounted for losses of perennial cropland to other land uses and gains at areas that changed from other land uses to perennial cropland, which both are already accounted for in the related LUC transition categories. In the new estimates these areas were subtracted and the time series of emissions/removals from perennial cropland remaining perennial cropland was revised.

For some perennial cropland types (Christmas trees, energy plants) country specific carbon biomass stocks were applied:

For calculating the carbon stock change of living biomass from Christmas trees the following equation was applied using country specific data:

> *Annual change in biomass = (area of Christmas tree cultures remaining Christmas tree cultures * 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 a 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 equation was applied:

> *Annual change in biomass of energy crops = (area of energy crops remaining energy crops * 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 225: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

7.3.4.1.2 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 2008 was 217 ha.

For the calculation of the annual change in carbon stocks of living biomass of land converted to cropland the IPCC GPG equation 3.3.8 was applied (IPCC 2003). For annual cropland the country specific value was used. 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 annual 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. Root/shoot ratios of the United States Department of Agriculture were applied to estimate the total plant biomass. Since the U.S. are located also in 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 annual aboveground and below ground biomass of the crops (resulting from data 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 annual cropland of 6.99 t C ha^{-1}. This country specific value is 40% higher than the IPCC-GPG (2003) default value. According to the IPCC GPG the gains of the annual cropland biomass during LUCs to annual cropland are accounted only once, in the year of LUC to annual cropland:

*Annual change in biomass = annual area of actually converted land * (L* $_{conversion}$ + ΔC_{growth}*)*

$L_{conversion} = C_{after} - C_{before}$

C_{after} *= carbon stock immediately after conversion is 0*

ΔC_{growth} *= country specific value for annual crops carbon accumulation rate is 6.99 t C* $ha^{-1}a^{-1}$*(accounted only for the year of LUC)*

C_{before} *= IPCC default value for carbon stock of perennial cropland biomass before conversion is 63 t C* ha^{-1}*(accounted only for the year of LUC)*

7.3.4.1.3 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 2008 was 493 ha.

For the calculation of the annual change in carbon stocks in living biomass of land converted to cropland the IPCC GPG equation 3.3.8 was applied (GPG; IPCC 2003). For perennial cropland an annual growth according to IPCC GPG (2.1 t C $ha^{-1}a^{-1}$) was assumed for each year of the whole LUC transition period of 20 years. For the biomass losses in annual cropland in the year of LUC the country specific biomass stock in annual cropland biomass was used (see chapter 7.3.4.1.2):

*Annual change in biomass = conversion area for a transition period of 20 years * (*$L_{conversion} + \Delta C_{growth}$*)*

L conversion= C after –C before

C_{after} = carbon stock immediately after conversion is 0

ΔC_{growth} = IPCC default value for perennial crops carbon accumulation rate is 2.1 t C $ha^{-1}a^{-1}$ (annual growth rate in each year of the whole LUC transition period of 20 years)

C_{before} = country specific value of carbon stock of annual crops before conversion is 6.99 t C $ha^{-1}a^{-1}$ (biomass loss accounted only for the year of LUC)

7.3.4.1.4 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^{-1} 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 equation 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 226).

Table 226: Weighted mean values of management factors for cropland in Austria on basis of the IPCC GPG default values and Austrian agricultural statistics for cropland management.

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. Furthermore, we assumed that this Austrian specific soil C stock for arable land of 50 t C ha^{-1} represents a steady state that already includes the effects of the management factors for the period before 1990 and that cropland management was rather stable in that period. The average cropland management factors of Table 226 were calculated with the soil management factors of IPCC GPG (table 3.3.4) considering the Austrian cropland management situation in these years. These averages represent the change in the Austrian cropland management between the years 1990 and 2003 and take into account set aside areas for F_{LU} and the increase of organic agriculture area for F_{MG} and F_I. The carbon stock changes of cropland soil (50 t C ha^{-1}) from 1990–2008 were calculated on basis of the difference of these management factors. The relationship of the management factors from 2003/1990 is above 1 and over a period of 20 years this results in an annual increase of the soil C stock of 0.07 t C ha^{-1}.

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 equation used for calculating the change in carbon stocks of cropland soils was:

$$SOC_{1990+20} = SOC_{1990} + (SOC_{1990} \times ((Flu \times Fmg \times Fi)_{2003}/(Flu \times Fmg \times Fi)_{1990})$$

$$\Delta\ SOC_{20} = (SOC_{1990+20} - SOC_{1990})/\ 20 = 0.07t\ C\ ha^{-1}\ a^{-1}$$

Annual change in carbon stock of mineral soils in cropland remaining cropland = $\Delta\ SOC_{20}$ ** area of cropland remaining cropland*

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 annual carbon stock change in Austrian cropland soils (t C* ha^{-1} a^{-1}*) over a period of 20 years*
$(Flu \times Fmg \times Fi)_{1990}$.	*Management factor 1990*
$(Flu \times Fmg \times Fi)_{2003}$.	*Management factor 2003*

Currently, a research project is running to assess agricultural soil management factors for Austria on basis of long-time experiment plots and to compare the fit between these and the used IPCC GPG default values.

7.3.4.1.5 Changes of carbon stocks 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 9 245 ha for the period 1990 to 2008.

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, 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 annual 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 transition period (20 years)
- Step 5: multiply the average annual change in soil C stock by the conversion area.

  $\Delta\ SOC_{20} = (SOC_0 - SOC_{\ 0-T})/\ 20 =-\ 0.35\ t\ C\ ha^{-1}\ a^{-1}$

Annual change in carbon stock of mineral soils in perennial cropland converted to annual cropland =

*Δ SOC * conversion area for a transition period of 20 years*

Δ SOC_{20}...average annual carbon stock change in soils of perennial cropland converted to annual cropland ($t\ C\ ha^{-1}\ a^{-1}$) over a LUC transition period of 20 years

7.3.4.1.6 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 12 471 ha for the years 1990 to 2008.

Emissions/removals were calculated by country specific values for carbon stocks in mineral soils of perennial cropland and annual cropland, respectively.

Annual change in carbon stock of mineral soils in annual cropland converted to perennial cropland =

*Δ SOC_{20} * conversion area for a transition period of 20 years*

$$\Delta SOC = (SOC_0 - SOC_{0\text{-}T}) / 20 = 0.35\ t\ C\ ha^{-1}\ a^{-1}$$

Δ SOC_{20}...average annual carbon stock change in soils of annual cropland converted to perennial cropland ($t\ C\ ha^{-1}\ a^{-1}$) over a LUC transition period of 20 years

SOC_0...... carbon stock in soils 20 years after conversion from annual to perennial cropland →57 $t\ C\ ha^{-1}$

$SOC_{0\text{-}T}$..... carbon stock in Austrian cropland soils before conversion→ 50 $t\ C\ ha^{-1}$

Calculation steps see chapter 7.3.4.1.5.

7.3.4.1.7 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 227: Area with lime application in ha.

Land use (ha)	1990	2008
Cropland	1,406,394	1,369,021
Grassland	884,124	870,112
Total	2,290,518	2,239,133

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.

7.3.4.2 Land use changes to Cropland (5.B.2)

7.3.4.2.1 Forest Land converted to Cropland (5.B.2.1)

The methodology and activity data are described in chapters 7.2.2 and 7.2.4.2. For a time period of 20 years the area in conversion status from forest land to cropland ranges from 5 283 ha to 10 472 ha for the period 1990 and 2008 causing annual emission rates due to the loss of biomass and C stock changes in soil and litter from 74.6 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 7.2.4.2).

7.3.4.2.2 Grassland converted to Cropland (5.B.2.2)

The average annual land use change area from grassland to cropland from 1990–2008 is 26 844 ha. The area in conversion status for a time period of 20 years ranges from 493 736 ha to 536 650 ha for the period 1990 to 2008. Considering the area of the 20 year time period this leads to emissions between 1 688.7 and 1 707.2 Gg CO_2.

The average annual land use change area from grassland to perennial cropland from 1990–2008 is 95 ha. Data for land use change from grassland to cropland were estimated from IACS as described in chapter 7.3.2.

Considering that not all LUC from areas from grassland to cropland stay within the conversion status for 20 years the LUC area could be overestimated with related consequences to the emissions/removals. It is planned to verify in the next submission whether a specific amount of areas leave the conversion status before the 20 year time period is over.

Activity data of grassland converted to cropland in the 20 year conversion status see Table 222. Emissions were estimated applying a country specific methodology (Tier 2) for both biomass carbon stocks and for soil carbon stocks.

Changes of carbon stock in biomass of grassland converted to annual cropland

The IPCC default value for grassland 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 the aboveground grassland biomass a value of 3.1 t C ha^{-1} was applied (detailed description see chapter 7.4.4.2.2). 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 equation was applied – GPG IPPC (equation 3.3.8):

*Annual change in biomass = annual area of actually converted land * (*$L_{conversion} + \Delta C_{growth}$*)*

$L_{conversion} = C_{after} - C_{before}$

ΔC_{growth}= country specific value for annual carbon accumulation rate in annual crops is 6.99 t C $ha^{-1}a^{-1}$(see chapter 7.3.4.1.2, accounted only for the year of LUC)

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} (biomass loss accounted only in the year of LUC)

6.2 t DM ha^{-1} = country specific above ground living biomass for grassland

4.2 t DM ha^{-1} = country specific root biomass for grassland

1.0 t DM ha^{-1} = country specific stubble biomass for grassland

0.5 t C/t DM default carbon content of biomass

Changes of carbon stock in biomass of grassland converted to perennial cropland

The annual land use change area from grassland to perennial cropland in 2008 is 102 ha.

For perennial cropland an annual growth according to the IPCC GPG (2.1 t C $ha^{-1}a^{-1}$) was used for the whole LUC transition period of 20 years:

*Annual change in biomass = conversion area for a transition period of 20 years * (*$L_{conversion} + \Delta C_{growth}$*)*

$L_{conversion} = C_{after} - C_{before}$

For the calculation the following values were used:

ΔC_{growth} = IPCC default value for annual carbon accumulation rate in perennial crops is 2.1 t C $ha^{-1}a^{-1}$(annual growth rate in each year of the whole LUC transition period of 20 years)

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 7.4.4.2.2, biomass loss accounted only in the year of LUC).

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.

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^{-1} for 0–30 cm depth of grassland and 50 t C ha^{-1} 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 equation according to IPCC GPG (2003) was applied.

$$\Delta\ SOC = (SOC_0 - SOC_{0-T})/\ 20 = -\ 1.0\ t\ C\ ha^{-1}\ a^{-1}$$

*annual change in carbon stock of mineral soils converted from grassland to cropland = Δ SOC * conversion area for a transition period of 20 years*

Δ SOC = average annual carbon stock change in soils of grassland converted to annual cropland (t C ha^{-1} a^{-1}) over a LUC transition period of 20 years

SOC_0 = carbon stock in soils 20 years after conversion from grassland to annual cropland →50 t C ha^{-1}

SOC_{0-T} = carbon stock in Austrian grassland soils before conversion →70 t C ha^{-1}

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 1 879 ha for the period 1990–2008 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^{-1} for 0–30 cm depth of grassland and 57 t C ha^{-1} 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 equation was applied.

$$\Delta\ SOC = (SOC_0 - SOC_{0-T})/20 = -\ 0.65\ t\ C\ ha^{-1}\ a^{-1}$$

*annual change in carbon stock of mineral soils converted from grassland to perennial cropland = Δ SOC * conversion area for a transition period of 20 years*

Δ SOC = average annual carbon stock change in soils of grassland converted to perennial cropland (t C ha^{-1} a^{-1}) over a LUC transition period of 20 years

SOC_0 = carbon stock in perennial cropland soils 20 years after conversion from grassland →57 t C ha^{-1}

SOC_{0-T} = carbon stock in 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.

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 222. 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).

7.3.5 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%
- converted area: perennial cropland to annual cropland +/- 20%
- converted area grassland to cropland: +/- 16%
- 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 GPG guidance (2003):

Table 228: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 the category cropland remaining cropland ranges between +40 and -130% (expert judgement).

The estimated total uncertainties for liming range between +/- 50% (expert judgement).

The total uncertainty of the subcategory LUC grassland to cropland is estimated by expert judgement with +/- 40%.

7.3.6 QA/QC and Verification

The calculation of the data for category 5.B is embedded in the overall QA/QC-system of the Austrian GHG inventory (see Chapter 7.8).

7.3.7 Recalculations

Some shortcomings in the area data were corrected.

The estimates of the subcategory “cropland remaining cropland” included some double accounting of biomass increment and biomass losses in perennial cropland due to the use of the whole perennial cropland area of Austria for the estimates of biomass changes in this subcategory. As a consequence, these estimates in this subcategory also accounted for losses of perennial cropland to other land uses and gains at areas that changed from other land uses to perennial cropland. In the new estimates these areas were subtracted and the time series of emissions/removals from perennial cropland remaining perennial cropland was revised.

These changes lead to new figures for the estimates of the subcategories ”cropland remaining cropland” and “LUC to cropland”.

7.3.8 Planned improvements

See Chapter 7.9

7.4 Grassland (5.C)

7.4.1 Category description

In this category emissions/removals from grassland management (grassland remaining grassland and land converted to grassland) are considered. In 2008, 1.79 Mio ha of Austria are grassland (STATISTIK AUSTRIA 2009). Total grassland includes one cut meadows; two and more cut meadows, cultivated pastures, litter meadows, rough pastures, alpine meadows and pastures and abandoned grassland.

The annual removals of grassland in Austria amounted to 1 021.6 Gg CO_2 in 1990 and 1 283.8 Gg CO_2 in 2008.

The removals show an increase between 1990 and 2000. The reasons for the rather stable values between 1990 and 2000 and higher fluctuations after 2000 are caused by the area (activity) data for the subcategory for LUCs from cropland to grassland. For the period after 2000 annual activity data are available from the IACS database, whereas the areas for the years before 2000 were estimated with average "land use change factors" based on the annual LUC area data of the period 2000 to 2003. So, the actual land use changes are not as stable as the estimated average LUCs in the years 1990 to 2000. From 2001 the increase of removals continues up to 1 330 Gg CO2 in 2008.

The observed change in emission trends between 1994 and 1995 is caused by the change of the annual LUCs from forest land to grassland according to the results of the two related NFI periods (from 3710 ha until 1994 to 2410 ha from 1995 on) and its impact on the emissions from the biomass pool.

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. Organic soils in Austria occur only in the grassland remaining grassland category and dead wood and litter is assumed not to occur at grassland.

Table 229: 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 230:Activity data of grassland 1990–2008 in ha; other land use changes are not occurring.

	C. Total Grassland	1. Grassland remaining Grassland	2. Land converted to Grassland	2.1 Forest Land converted to Grassland	2.2 Cropland converted to Grassland	2.2.perennial Cropland converted 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	1 817 138	1 267 806	549 332	58 065	488 533	2 734
2008	1 796 168	1 262 689	533 479	56 002	474 798	2 679

Table 231:Emissions from grassland management in Gg CO_2; other land use changes are not occurring.

	5 C Total Grassland	1. Grassland remaining Grassland	2. Land converted to Grassland	2.1 Forest Land converted to Grassland	2.2 Cropland converted to Grassland	2.2.a perenial cropland converted to Grassland
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

	5 C Total Grassland	1. Grassland remaining Grassland	2. Land converted to Grassland	2.1 Forest Land converted to Grassland	2.2 Cropland converted to Grassland	2.2.a perenial cropland converted to Grassland
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	-1 264.41	46.28	-1 310.69	368.68	-1 709.43	30.06
2008	-1 283.77	46.57	-1 330.34	362.22	-1 694.97	2.41

7.4.2 Information on approaches used for representing land areas and on land-use databases used for the inventory preparation

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 – 2009). The surveys are based on the responses to questionnaires sent to all farms and forest enterprises and cover 90 % of Austria. The grassland data are collected in the Austrian farm structure surveys 1993, 1995 (full survey), 1999 (full survey) 2003, 2005 and 2007. For the years between the surveys the data have been interpolated.

Data for land use changes between cropland and grassland were taken from IACS (for a detailed description see chapter 7.3.2).

There is a slight inconsistency of the reported areas of LUCs between cropland and grassland and the year-to-year changes of the reported total cropland and total grassland areas across the time series (see Table 209). The reason lies in the two different statistics for the total cropland and grassland areas (Statistik Austria) and for the LUC areas between cropland and grassland (IACS) which do not exactly fit.

On expert judgement there is also a bias in the land use change data of grassland to cropland in the years from 2005 because of change in the common EU agricultural policy (CAP). The obligations of the EU Cross Compliance Regulations introduce protection of grassland. It is not allowed to change grassland to cropland by more than 10% of grassland. To administrate such prohibition, an earmark system for turned over grassland fields was established. Within five years the former grassland has to be changed to grassland again. Otherwise a real land use change occurs with strong obligation for the farmer involved and the EU-Member State. These leads to a higher fluctuation of grassland change to cropland and backward. So, an assessment of LUC areas via IACS may lead to a repeated accounting of single areas as LUC areas within a period of 20 years leading to a too high amount of land use change areas between cropland and grassland. We are recently trying to model and handle the problems of overestimating these land use change areas and in the same context underestimating cropland remaining cropland and grassland remaining grassland.

The LUC areas from forest land to grassland are based on the NFI data (see chapter 7.2.2).

LUCs from wetland, from settlement and from other land to grassland do not occur in Austria. This assumption is based on the fact that the grassland areas show a steady decrease. In addition, wetland, settlement and other land areas are not suited (anymore) for a land use as grassland: 1) Drainage of wetlands for the purpose of grassland use was carried out at some minor areas in Austria in former decades. For reasons of nature conservation this management praxis stopped many years ago. 2) Settlement areas increased steadily in the last decades mainly by LUC from agricultural areas. 3) Settlement areas and soils – once converted - are usually not more usable for grassland management. 4) There is also a higher economic factor for land dedicated to settlements area than agricultural land which makes a reconversion very unlikely. 5) “Other lands” are the highest located areas of Austria or very steep areas, all in all, areas of very unfavorable ecological conditions that do not allow any agricultural use.

7.4.3 Land-use definitions and the classification systems used and their correspondence to the LULUCF categories

The STATISTIK AUSTRIA classification for grassland was used for land use definitions:

- One cut meadows
- Two and more cut meadows
- Litter meadows
- Cultivated Pastures
- Rough Pastures
- Alpine meadows and pastures
- Abandoned grassland

7.4.4 Methodological Issues

Emissions were estimated by applying country specific methodologies (Tier 2) for both biomass carbon stocks and soil carbon stocks.

7.4.4.1 Grassland remaining Grassland (5.C.1)

The area of grassland remaining grassland in 2008 was 1.26 Mio ha.

The annual emissions from grassland remaining grassland between 1990 and 2008 range from 39.1 Gg CO_2 to 46.6 Gg CO_2 including the emissions from mineral and organic grassland soils.

7.4.4.1.1 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).

7.4.4.1.2 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^{-1} 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 equation 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 232: Weighted mean values of management factors for grassland soils in Austria on basis of the IPCC GPG default values and Austrian agricultural statistics for grassland management.

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. This assumption is supported by the fact that soil inventories were carried out between 1988 and 1996. Furthermore, we assumed that this Austrian specific soil C stock for grassland represents a steady state that already includes the effects of the management factors for the period before 1990 and that grassland management was rather stable in that period. The average grassland management factors of Table 232 were calculated with the soil management factors of the IPCC GPG (table 3.3.4) considering the Austrian grassland management situation in these years. These averages represent the change in the Austrian grassland management between the years 1990 and 2003 and take into account set aside areas for F_{LU} and the increase of organic agriculture area for F_{MG} and F_I. The carbon stock changes of grassland soil (70 t C ha^{-1}) from 1990–2008 were calculated then on basis of the difference of these management factors. The relationship of the management factors from 2003/1990 is above 1 and over a period of 20 years this results in an annual increase of 0.0157 t C ha^{-1}.

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 increases from 70 t C ha^{-1} to 70.315 t C ha^{-1} were estimated.

The equation used for calculating the change in carbon stocks of grassland soils was the same as for cropland (see chapter 7.3.4.1.4).

Annual change in carbon stock of mineral soils in grassland remaining grassland = $\Delta\ SOC_{20}$ ** area of grassland remaining grassland*

$\Delta\ SOC_{20} = (SOC_{1990+20} - SOC_{1990}) / 20 = 0.0157$ t C ha^{-1} a^{-1}

7.4.4.1.3 Liming

The amount of lime applied to grassland was estimated together with cropland in Chapter 7.3.4.1.7. Therefore the CO_2 emissions resulting from liming of grassland are included in category 5 B 1.

7.4.4.1.4 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 the IPCC GPG 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.

7.4.4.2 Land use change to Grassland (5.C.2)

7.4.4.2.1 Forest Land converted to Grassland (5.C.2.1)

The methodology and activity data are described in chapters 7.2.2 and 7.2.4.2. The area in conversion status from Forest Land to Grassland for a time period of 20 year ranges from 56 002 ha to 111 003 ha between the years 1990 and 2008. The main part of conversion takes place from forests to pasture causing annual emission due to the loss of biomass and C stock changes in soil and litter from 362.2 Gg CO_2 to 635.2 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 7.2.4.2).

7.4.4.2.2 Cropland converted to Grassland (5.C.2.2)

The average annual land use change area from cropland to grassland from 1990–2008 is 23 755 ha. The area in conversion status for a time period of 20 years amounts to 496 412 ha in 1990 and 474 798 ha in 2008. Considering the area of the 20 years time period this leads to annual removals from 1 696.4 Gg CO_2 in 1990 and 1 695 Gg CO_2 2008.

The average annual land use change area (1990-2008) from perennial cropland to grassland is 136 ha.

Changes of carbon stock in biomass of annual cropland converted to grassland

For the current submission the carbon stock of living biomass in annual cropland was improved by using country specific data from Statistic Austria (STATISTIK AUSTRIA 2007). The average mean of the above and belowground biomass of the annual crops in cropland was estimated with 6.99 t C ha^{-1} (see chapter 7.3.4.1.2).

A country specific carbon stock in living grassland biomass was estimated. The calculation 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 by 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.

Table 233:Area weighted mean values of grassland biomass.

	area in ha (avg 10 year)	yield in t (avg 10 year)	weighted mean (t ha^{-1})
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^{-1})		6.2
	C t ha^{-1}		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}; average of 5 years). 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.

For the calculation of the annual change in carbon stocks of living biomass of cropland converted to grassland the following equation was applied – IPCC GPG (equation 3.3.8).

*Annual change in biomass =annual area of actually converted land * (L* $_{conversion}$ *+ ΔC* $_{growth}$*)*

$L_{conversion} = C_{after} - C_{before}$

C_{after} *= carbon stock immediately after conversion is 0*

ΔC_{growth} *= country specific value for grassland biomass 3.10 t C ha^{-1}a^{-1}(accounted only for the year of LUC)*

C_{before} *= country specific value of carbon stock of annual crops before conversion is 6.99 t C ha^{-1}a^{-1}(accounted only for the year of LUC)*

Changes of carbon stock in biomass of perennial cropland converted to grassland

The area of annual land use change from perennial cropland converted to grassland in 2008 is 42 ha. The equation is described before (see in chapter "Changes of carbon stock in biomass of annual cropland converted to grassland") and the used default value for perennial cropland is described in chapter 7.3.4.1.1.

C_{before}*= IPCC default value of carbon stock of perennial crops before conversion is 63 t C ha^{-1}a^{-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.

Changes of carbon stock in mineral soil of annual cropland converted to grassland

The area in conversion status from annual cropland converted to grassland for a time period of 20 years amounts to 496 412 ha and 474 798 ha in the years 1990 and 2008.

The IPCC 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_{0-T}
- Step 2: Selecting Austrian specific values for grassland 20 years after conversion → SOC_0
- Step 3: Calculation of average annual carbon stock change for the LUC period of 20 a.
- Step 4: Multiply the annual carbon stock change by the conversion area for a transition period of 20 years.

Average annual carbon stock change $(t\ C\ ha^{-1}\ a^{-1}) = (SOC_0 - SOC_{0-T})/20 = 1.0$

SOC_0…… *carbon stock in soils 20 years after conversion from annual cropland to grassland* →*70 t C* ha^{-1}

SOC_{0-T}….. *carbon stock change in cropland soils before conversion*→ *50 t C* ha^{-1}

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 amounts to 2 097 ha and 2 679 ha in the years 1990 and 2008:

Emissions/removals were calculated by country specific values for carbon stocks in mineral soils of perennial cropland (7.3.4.2).

$\Delta\ SOC = (SOC_0 - SOC_{0-T})/20 = 0.65\ t\ C\ ha^{-1}\ a^{-1}$

annual change in carbon stock of mineral soils converted from grassland to perennial cropland = Δ *SOC * conversion area for a transition period of 20 years*

SOC_0…… *carbon stock in soils 20 years after conversion from perennial cropland to grassland* →*70t C* ha^{-1}

SOC_{0-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.

7.4.5 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 234: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%.

7.4.6 QA/QC and Verification

The calculation of the data for category 5.C is embedded in the overall QA/QC-system of the Austrian GHG inventory (see chapter 7.8).

7.4.7 Recalculations

No recalculations occurred in this category.

7.4.8 Planned improvements

See chapter 7.9

7.5 Wetlands 5.D

7.5.1 Category description

In this category only emissions/removals from the sub-categories "Land converted to wetland" are considered.

Due to the lack of information, it is assumed that the C stock in biomass, dead organic matter and soil of surface waters is 0.

The wetland area ranges from 133 068 ha to 144 265 ha in the years 1990–2008.

The shares of the different previous land use types before conversion to wetland vary between the years and results in the annual variations in the emissions of this subcategory.

Table 235:Activity data of wetland 1990–2008 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
2008	144 265	121 664	22 601	3 170	NO	14 223	NO	5 207

Table 236:Emissions of wetland 1990–2008 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
2008	376.97	NE	376.97	80.91	NO	182.53	NO	113.53

7.5.2 Information on approaches used for representing land areas and on land-use databases used for the inventory preparation

The total wetland area was taken from the regional information derived from the Real Estate Database available since 1995 (BEV 2008). This database covers the whole area of Austria and gathers the land uses of real estate within the municipalities in digital cadastral maps. It is provided by the Austrian Federal Weights and Measures Office and is updated occasionally. 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.

In Austria the increase of wetlands (rivers, standing water bodies) - derived from national statistics (Real Estate Database) - is mainly due to the building of water reservoirs e.g. for water power stations or quarry ponds as well as the reconstruction from natural courses of rivers. The LUC areas from forest land to wetlands are based on the NFI data (see chapter 7.2.2). The remaining year-to-year increase of wetlands is assumed to result from LUC from grassland and other land. This expert judgment is based on the consideration that these activities occur (besides on forest areas) primarily on grassland sites and also on areas that belong to other land (e.g. water reservoirs for snow-making equipment in the alpine region) and do not affect cropland or settlements. Furthermore national statistics show a steady increase of settlement area, thus LUC from settlements to wetlands is considered not to occur in Austria. The land consistency calculation showed that in the years from 1990 to 1995 the LUC areas were derived from grassland and forest land whereas in the following years the areas came also from other land.

The area in conversion status of land converted to wetland for a time period of 20 years ranges from 8 489 ha to 22 601 ha for the period 1990 to 2008.

7.5.3 Land-use definitions and the classification systems used and their correspondence to the LULUCF categories (e.g. land use and land-use change matrix)

The wetland area in correspondence to the LULUCF category comprises the following subcategories of the national Real Estate Database classification system:

- Rivers
- Lakes
- Mires
- Peat areas

7.5.4 Methodological Issues

7.5.4.1 Land use changes to Wetland (5.D.2)

7.5.4.1.1 Forest Land converted to Wetland (5.D.2.1)

The methodology and activity data are described in chapters 7.2.2 and 7.2.4.2. The area in conversion status from forest land to wetland for a time period of 20 years ranges from 3 170 ha to 6 283 ha between the years 1990 and 2008 causing annual emission rates due to the loss of biomass and C stock changes in soil and litter from 80.9 Gg CO_2 to 155.7 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 7.2.4.2).

7.5.4.1.2 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.

7.5.4.1.3 Grassland converted to Wetland (5.D.2.3)

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 equation was applied (equation 3.5.6 GPG)

Annual change in carbon stocks of living biomass in land converted to wetland (tones $C.a^{-1}$):

$$\Delta C_{LW\ flood} = (Sum\ A_i*(B_{after}-B_{before})$$

Ai = annual area of land actually converted 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* $ha.a^{-1}$

B_{after} *= living biomass in land immediately after conversion to wetland (default = 0 t C* $ha.a^{-1}$*)*

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 until 2005 and ranges from 2 699 ha to 14 818 ha between 1990 and 2005.

Since 2005 there is a small decrease in the conversion area from grassland to wetland. In 2008 the area amounted to 14 223 ha.

Calculation:

$$\Delta C_{LW\ flood} = (Sum\ A_i*(B_{after}-B_{before})/20$$

A_i *= area of land converted to flooded land for a transition period of 20 years, ha*

B_{before} *= carbon stock in soil immediately before conversion to wetland = for grassland 70 t C* $ha.a^{-1}$

B_{after} *= carbon stock in soils 20 years after conversion to wetland (default = 0 t C* $ha.a^{-1}$*)*

7.5.4.1.4 Other Land converted to Wetland (5.D.2.5)

In 2008 1 140 ha other land was converted to wetland.

The area in conversion status from other land to wetland for a time period of 20 years ranges from 1 066 ha to 5 207 ha for the period 1990 to 2008.

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 equation according to IPCC GPG was applied (equation 3.5.6 GPG).

Annual change in carbon stocks of living biomass in land converted to wetland (tons $C.a^{-1}$):

$$\Delta C_{LW\ flood} = (Sum\ A_i*(B_{after}-B_{before})$$

A_i *= annual area of land converted actually 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* $ha.a^{-1}$ *see chapter 7.7*

B_{after} *= living biomass in land immediately after conversion to wetland (default = 0 t C* $ha.a^{-1}$*)*

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 to flooded land for a transition period of 20 years, ha*

B_{before} *= carbon stock in soil immediately before conversion to wetland = for other land 71.24 t* $C.ha.a^{-1}$ *see chapter 7.7*

B_{after} *= carbon stock in soils 20 years after conversion to wetland (default=0)*

7.5.5 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.

7.5.6 QA/QC and Verification

The calculation of the data for category 5.D is embedded in the overall QA/QC-system of the Austrian GHG inventory (see chapter 7.8).

7.5.7 Recalculations

No recalculations occurred in this category.

7.5.8 Planned improvements

See chapter 7.9

7.6 Settlements (5.E)

7.6.1 Category description

In this category only emissions/removals from the sub-categories "Land converted to settlement" are considered. Dead organic wood and litter is assumed to occur not at settlement areas. About 0.51 Mio ha of Austria's surface can be allocated to the IPCC land use category "Settlement" (BEV 2009). The area in conversion status from "Land converted to Settlement" for a time period of 20 years ranges from 171 209 ha to 196 647 ha between the years 1990 and 2008 causing annual emission rates due to C stock changes of biomass and soils from 517 Gg CO_2 to 846 Gg CO_2.

Annual LUCs to settlement occur from the sub-categories "Forest Land", "Cropland", "Grassland" and "Other land". The portions of these categories vary between the years and cause variations of CO_2 emissions and IEF for the sum of net C stock changes in living biomass and soils in the category "LUC to settlements". Consequently, the trend of total emissions in this category is partly different to the trend of the total settlement area because:

- the increase of living biomass of perennial species (trees and shrubs) as well as the discounting of soil carbon stocks refer to LUC transition areas for a time period of 20 years, whereas
- the increase of ground vegetation (annual plants) is accounted only at the areas of actual LUC in the categories.
- For some years no annual LUC occur in those sub categories.

Table 237 and Table 238 show the land use changes and removals/emissions from LUC to settlements for the period 1990 to 2008.

Table 237:Derived land use changes for the subcategory 5 E for the period 1990 to 2008 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	38 022	106 084	NO	17 525
1991	391 101	198 497	192 604	29 773	38 022	101 985	NO	22 824
1992	398 137	203 512	194 625	30 594	44 127	97 079	NO	22 824
1993	405 173	208 527	196 647	31 416	45 188	97 218	NO	22 824
1994	412 209	218 162	194 047	29 934	45 188	89 611	NO	29 314
1995	419 245	228 484	190 761	28 085	49 837	83 525	NO	29 314
1996	426 281	238 807	187 475	26 235	50 210	74 368	NO	36 662
1997	433 317	249 129	184 189	24 386	48 007	67 414	NO	44 382
1998	440 353	259 451	180 902	22 536	48 007	64 936	NO	45 423
1999	447 389	267 574	179 815	21 783	43 134	69 476	NO	45 423
2000	454 425	275 697	178 728	21 029	47 409	64 868	NO	45 423
2001	461 461	284 246	177 215	20 276	45 661	65 856	NO	45 423
2002	468 497	292 795	175 702	19 522	45 937	64 820	NO	45 423
2003	475 395	301 344	174 051	18 769	38 725	71 135	NO	45 423
2004	482 293	308 783	173 510	18 185	40 024	75 198	NO	40 103
2005	489 190	316 221	172 969	17 601	40 024	72 979	NO	42 364
2006	494 950	323 660	171 290	17 017	33 486	71 977	NO	48 809
2007	502 903	331 099	171 804	16 433	42 124	66 551	NO	46 695
2008	513 017	338 538	174 479	15 850	52 923	61 126	NO	44 581

Table 238:Emissions/removals from land use changes to settlement for the period 1990 to 2008 in Gg CO_2.

	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.E.2.5 Other Land converted to settlement
1990	759	492	51	185	NO	31
1991	844	504	-81	198	NO	223
1992	763	516	29	178	NO	40
1993	776	527	43	165	NO	40
1994	846	506	-97	161	NO	275
1995	675	451	27	144	NO	52
1996	779	425	-100	136	NO	317
1997	744	399	-103	103	NO	344
1998	588	373	-103	202	NO	116
1999	606	362	26	138	NO	80

	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.E.2.5 Other Land converted to settlement
2000	568	351	-28	165	NO	80
2001	545	341	-99	224	NO	80
2002	531	330	-106	227	NO	80
2003	542	319	-96	239	NO	80
2004	534	311	-72	225	NO	71
2005	665	303	-99	125	NO	336
2006	641	294	-85	123	NO	308
2007	554	286	71	115	NO	82
2008	517	278	71	95	NO	74

7.6.2 Information on approaches used for representing land areas and on land-use databases used for the inventory preparation

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 2009). This database covers the whole area of Austria and gathers the land uses of real estate within the municipalities in digital cadastral maps. It is provided by the Austrian Federal Weights and Measures Office and is updated occasionally. 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 to settlement:

- 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 cropland 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 land use changes to settlement area as shown in Table 237 were derived for the period 1990 to 2008.

7.6.3 Land-use definitions and the classification systems used and their correspondence to the LULUCF categories

The settlement area in correspondence to the LULUCF category comprises the following subcategories of the national classification system:

- building land – sealed, partly sealed and unsealed area
- parks and gardens
- road, railway, track and excavation area
- other, not further differentiated settlement area.

7.6.4 Methodological Issues

7.6.4.1 Land use changes to settlement (5.E.2)

7.6.4.1.1 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 in this study an average biomass per ha settlement area was calculated (see table below). 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

The increase of living biomass of perennial species (trees and shrubs) at LUC areas to settlement is calculated with 0.58 t C ha^{-1}a^{-1}. This value is used for the whole transition period of 20 years. Annual increase of ground vegetation (annual plants) is accounted only at the areas of actual LUC to settlement.

7.6.4.1.2 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}, mineral soil 0 – 50 cm plus the humus layer (litter) above mineral soil) and carbon stocks in mineral soils of settlement land (32 t C ha^{-1} area weighted mean value of input data described in chapter 7.2.4.2.3). These C stocks refer to a mineral soil depth of down to 50 cm. Therefore, these estimates of C stock changes account also for the loss of litter.

Calculations of emissions from soil C stocks changes due to land use changes from other IPCC land use categories refer to a soil depth of 0-30 cm. 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 zero. Based on calculations of the regional information derived from the real estate database 2/3 of the national 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. For 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}

7.6.4.1.3 Forest Land converted to Settlement (5.E.2.1)

The methodology and activity data are described in chapters 7.2.2 and 7.2.4.2. However, the perennial plants in the settlement areas are estimated with a continued annual growth during the whole LUC transition period of 20 years as described in chapter 7.6.4.1.1. The area in conversion status from Forest Land to settlement for a time period of 20 years ranges from 15 850 ha to 31 416 ha between the years 1990 and 2008 causing annual emission rates due to the loss of biomass and C stock changes in soil and litter from 278 Gg CO_2 to 527 Gg CO_2.

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 20 Gg CO_2 in the years 1990 to 2008.

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 soils of forest land (121 t C ha^{-1}, mineral soil 0 – 50 cm plus the humus layer (litter) above mineral soil) and settlement areas (32 t C ha^{-1} area weighted mean value for mineral soil of 0-50 cm according to the input data described in chapter 7.2.4.2.3). Therefore, the estimated changes in soil also account for the loss of litter. The annual emission rates due to C stock changes in soil and litter range from 259 to 513 Gg CO_2 in the years 1990–2008.

7.6.4.1.4 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 33 486 to 52 923 ha in the years 1990–2008.

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 7.3.4.2.2 and 7.4.4.2.2 with the use of country specific biomass data for settlements as described in chapter 7.6.4.1.1. The perennial plants in the settlement areas are estimated with a continued annual growth during the whole LUC transition period of 20 years as described in chapter 7.6.4.1.1.

The annual emission or removal rates due to increase of biomass on settlement area ranges from -106 to 71 Gg CO_2 in the years 1990 to 2008.

Changes in carbon stocks in soil of cropland converted to settlement

The estimates for soil carbon stocks in cropland are as high as in settlement areas (50 t ha^{-1}, see chapter 7.3.4.1.4).

Consequently, no emissions or removals result from carbon stock changes in soils due to land use conversion from cropland to settlement.

7.6.4.1.5 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 61 126 to 106 084 ha in the years 1990–2008 resulting in annual emission rates due to C stock changes of biomass and soils from 95 Gg CO_2 to 239 Gg CO_2.

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 7.3.4.2.2 and 7.4.4.2.2 with the country specific biomass data for settlements as described in chapter 7.6.4.1.1. The perennial plants in the settlement areas are estimated with a continued annual growth during the whole LUC transition period of 20 years as described in chapter 7.6.4.1.1.

The annual removal rates due to increase of biomass on settlement area ranges from 11 to 204 Gg CO_2 in the years 1990–2008.

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 7.3.4.2.2 and 7.4.4.2.2 with a soil C stock for settlements as described in chapter 7.6.4.1.2.

The annual emission rate due to loss of soil carbon in soils ranges from 224 to 389 Gg CO_2 in the years 1990–2007.

7.6.4.1.6 Wetland converted to Settlement (5.E.2.4)

It is assumed by expert judgement that in Austria no conversion from wetland to settlement occurred in the years 1990-2008.

7.6.4.1.7 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 17 525 to 48 809 ha in the years 1990–2008 resulting in annual emissions due to C stock changes of biomass and soils from 31 Gg CO_2 to 344 Gg CO_2.

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 7.3.4.2.2 and 7.4.4.2.2 with country specific biomass data for settlements as given in chapter 7.6.4.1.1 and country specific biomasses for other land as described in chapter 7.7.4.1.1.

The annual removal/emission rates due to increase of biomass on settlement area ranges from 100 to 175 Gg CO_2 in the years 1990–2008.

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 7.3.4.2.2 and 7.4.4.2.2 with a soil C stock for settlements as described in chapter 7.6.4.1.2 and country specific soil C pools for other land as described in chapter 7.7.4.1.2.

The annual emission rates due to loss of soil carbon in soils ranges from 68 and 190 Gg CO_2 in the years 1990–2008.

7.6.5 Uncertainty assessment

According to a first expert guess the uncertainty of this category is ±70%.

7.6.6 QA/QC and Verification

The calculation of the data for category 5.E is embedded in the overall QA/QC-system of the Austrian GHG inventory (see Chapter 7.8).

7.6.7 Recalculations

Some shortcomings throughout the time series of the areas of LUCs to settlements were corrected which leaded to partly new figures for the emissions/removals of the time series of this subcategory.

7.6.8 Planned improvements

See Chapter 7.9

7.7 Other Land 5.F

7.7.1 Category description

Table 239:Derived land use changes for the subcategory 5 F for the period 1990 to 2008 in ha.

	5 F Total Other Land	5.F.1. Other Land remaining Other Land	5.F.2. Land converted to Other Land	5.F.2.1 Forest Land converted to Other Land	5.F.2.2 Cropland converted to Other Land	5.F.2.3 Grassland converted to Other Land	5.F.2.4 Wetland converted to Other Land	5.F.2.4 Settlement converted to Other Land
1990	478 236	431 914	46 322	46 322	NO	NO	NO	NO
1991	446 607	398 970	47 636	47 636	NO	NO	NO	NO
1992	442 817	393 866	48 951	48 951	NO	NO	NO	NO
1993	447 998	397 732	50 266	50 266	NO	NO	NO	NO
1994	433 369	385 474	47 895	47 895	NO	NO	NO	NO
1995	432 459	387 524	44 936	44 936	NO	NO	NO	NO
1996	418 306	376 330	41 976	41 976	NO	NO	NO	NO
1997	413 777	374 760	39 017	39 017	NO	NO	NO	NO
1998	420 063	384 005	36 058	36 058	NO	NO	NO	NO
1999	415 568	380 716	34 852	34 852	NO	NO	NO	NO
2000	418 995	385 348	33 647	33 647	NO	NO	NO	NO
2001	435 695	403 254	32 441	32 441	NO	NO	NO	NO
2002	451 326	420 090	31 236	31 236	NO	NO	NO	NO
2003	465 228	435 197	30 030	30 030	NO	NO	NO	NO
2004	485 444	456 348	29 096	29 096	NO	NO	NO	NO
2005	477 047	448 885	28 162	28 162	NO	NO	NO	NO
2006	473 189	445 961	27 228	27 228	NO	NO	NO	NO
2007	482 440	456 146	26 294	26 294	NO	NO	NO	NO
2008	495 812	470 453	25 359	25 359	NO	NO	NO	NO

Table 240:Emissions/removals from land use changes to Other Land for the period 1990 to 2008 in Gg CO_2.

	5.F.2. Land converted to Other land	5.F.2.1 Forest land converted to Other land	5.F.2.2 Cropland converted to Other land	5.F.2.3 Grassland converted to Other land	5.F.2.4 Wetland converted to Other land	5.F.2.5 Settlement converted to Other land
1990	810	810	NO	NO	NO	NO
1991	829	829	NO	NO	NO	NO
1992	849	849	NO	NO	NO	NO
1993	868	868	NO	NO	NO	NO
1994	833	833	NO	NO	NO	NO
1995	744	744	NO	NO	NO	NO
1996	701	701	NO	NO	NO	NO

	5.F.2. Land converted to Other land	5.F.2.1 Forest land converted to Other land	5.F.2.2 Cropland converted to Other land	5.F.2.3 Grassland converted to Other land	5.F.2.4 Wetland converted to Other land	5.F.2.5 Settlement converted to Other land
1997	657	657	NO	NO	NO	NO
1998	614	614	NO	NO	NO	NO
1999	596	596	NO	NO	NO	NO
2000	578	578	NO	NO	NO	NO
2001	561	561	NO	NO	NO	NO
2002	543	543	NO	NO	NO	NO
2003	525	525	NO	NO	NO	NO
2004	512	512	NO	NO	NO	NO
2005	498	498	NO	NO	NO	NO
2006	484	484	NO	NO	NO	NO
2007	470	470	NO	NO	NO	NO
2008	457	457	NO	NO	NO	NO

Dead wood and litter is assumed not to occur at areas of other land.

7.7.2 Information on approaches used for representing land areas and on land-use databases used for the inventory preparation

The total area of this category is estimated in accordance to the IPCC-GPG. So, other land is understood to be the difference of the area of all other categories and the whole area of Austria in order to avoid double accounting or omission of an area.

The LUC areas from forest land to other land are based on the NFIs. All other LUCs to other land do not occur. This assumption makes sense due to the location of this land in extreme ecological conditions. Any change from other categories to other land would be geographically or from logic reasons non-plausible (e.g. any reconversion of wetlands and settlements to other land is unlikely due to the steady increase of wetlands and settlements and the missing incentives for such conversions).

The digital cadastral data base of Austria (see for instance in chapter 7.6.2) allows an assessment of the area of the category "other land". If the areas for "other land" were taken from this database (instead calculating the "other land" area as the difference between the area sum of all land categories except other land and the area of total Austria) the resulting area sum of all land use categories would be each year 1 to 2 % higher than the real area of total Austria. From that small difference we assume that the used statistics (though different data bases for all land uses) give a rather good picture of the areas of the Austrian land use. The occurring difference may have several reasons. The resulting higher area gives evidence for a double accounting of some areas by two or more statistics. Such double accounting could occur for abandoned remote Alpine pastures that are in the meanwhile stocked by forests (and as such detected by the NFI), but may be still counted as grassland in the agricultural statistics. Another such possibility could be the assessment of "other land" in remote upland areas by the cadastral maps while these areas meet in the real world the forest definition and count as forest land according to Austrian law and the at-site-assessments by the NFI.

7.7.3 Land-use definitions and the classification systems used and their correspondence to the LULUCF categories

The other land area is defined in correspondence to the LULUCF category and contains the following sub-categories of the national classification system:

- Rocks and screes
- glaciers
- unmanaged alpine dwarf shrub heaths

7.7.4 Methodological Issues

7.7.4.1 Land use changes to other land

7.7.4.1.1 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 241: 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
other unmanaged alpine grassland[1]	**243 200**	20.7	119

[1] not forest land and not grassland

According to the share of the different land use areas (glaciers and bolder, types of unproductive areas) in the category other land a weighted mean for living biomass was calculated (10.89 t C per ha).

7.7.4.1.2 Soil

Estimates for the soil carbon stock in other land areas were also based on the results of the study by KÖRNER et al. (1993). According to the share of the different areas (glacier and bolder, types of unproductive areas) in the category other land a weighted mean for the soil carbon stock of 71.24 t C per ha was calculated.

7.7.4.1.3 Forest Land converted to Other Land (5.F.2.1)

The methodology and activity data are described in chapters 7.2.2 and 7.2.4.2. The area in conversion status from forest land to other land for a time period of 20 years ranges from 25 359 ha to 50 266 ha in the years 1990 to 2008 causing annual emission rates due to the loss of biomass and C stock changes in soil and litter from 457 Gg CO_2 to 868 Gg CO_2.

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 the loss of biomass on areas of land use change from forest land to other land range from 85 to 130 Gg CO_2 in the years 1990–2008.

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 soils of forest land (121 t C ha^{-1}, mineral soil 0 – 50 cm plus the humus layer (litter) above mineral soil) and other land (41 t C ha^{-1} area weighted mean value for mineral soil of 0-50 cm according to input data described in chapter 7.2.4.2). Therefore, the estimated changes in soil also account for the loss of litter.

The annual emission rates due to C stock changes in soil and litter range from 327 to 737 Gg CO_2 in the years 1990–2008.

7.7.5 Uncertainty assessment

The uncertainty of this subcategory was not estimated so far.

7.7.6 QA/QC and Verification

The calculation of the data for category 5.E is embedded in the overall QA/QC-system of the Austrian GHG inventory (see chapter 7.8).

7.7.7 Recalculations

No recalculations occurred in this category.

7.7.8 Planned improvements

See chapter 7.9

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 communication with the data providers

1.1.2) Check for plausibility 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 communication 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 consistence 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) Comparison 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 future submissions:

- The used wood density values will be exchanged by those from an Austrian norm including country specific densities for all tree species in the Austrian forests.
- Recalculations of biomass and dead wood data for forest land and LUCs from and to forest land for the years since the last NFI period (2000/02) on basis of the results of the actual NFI (2007/09)
- Improvement of the values for biomass C-stocks in viticulture and horticulture
- Re-evaluation and improvement of the management factors for cropland on basis of the results of Austrian long-time experiments in cropland
- Model based approach for C-stock changes in soil for sector 5A1
- Separate reporting of the C stock changes in the litter pool instead of including it in the figures for the soil C pool
- Improvement of the consistency of the LUC between cropland and grassland based on the IACS data
- Update of the estimates on the uncertainties for the total sector 5 and all its subsectors.

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 2008 amounted to 2 024 Gg CO_2 equivalent (1990: 3 586 Gg CO_2 equivalent). These are about 2.3% of total greenhouse gas emissions in Austria in 2008 and 4.6% in the base year. In 2007, greenhouse gas emissions from the waste sector were 43.6% below the level of the base year.

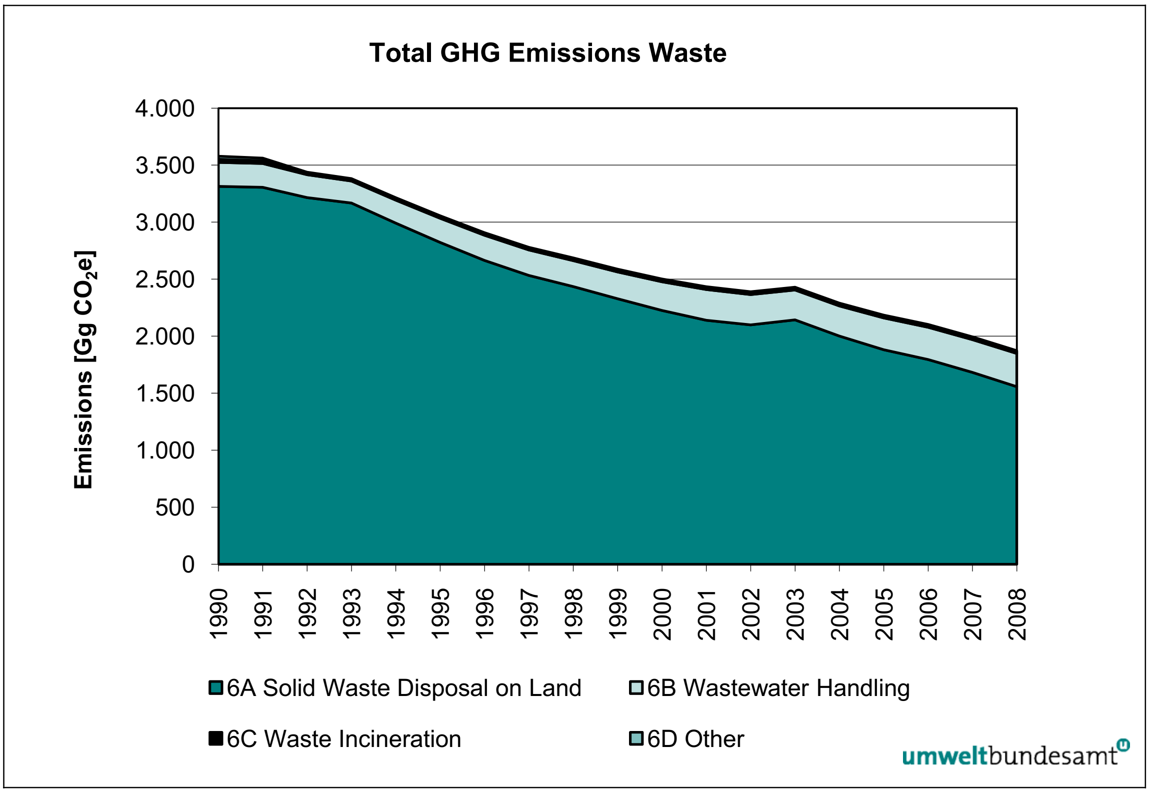

Figure 26: GHG emissions from waste 1990–2008.

Table 242 presents the emission trend by GHG. The major greenhouse gas emissions from this sector are CH_4 emissions, which represent 81.1% of all emissions from this sector in 2008, followed by N_2O (18.3%) 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 (6A).* 94.8% of total CH_4 emissions from this sector are attributable to this subcategory.

CH_4 emissions from the Waste sector amounted to 1 642 Gg CO_2 equivalent in 2008; this was 52.1 % below the level of the base year.

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 increased remarkably over the considered period. In 2008, N_2O emissions from the Waste sector amounted to 370 Gg CO_2 equivalent. This was 179.6% above the level of the base year.

About 70.3 % of N_2O emissions from waste originate from waste water handling and about 29.7% 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. In 2008, 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 242: Emissions of greenhouse gases from waste and trend from 1990–2008.

	CO_2 [Gg]	CH_4 [Gg CO_2 e]	N_2O [Gg CO_2 e]	Total [Gg CO_2 e]
1990	26.89	3 427.11	132.22	3 586.22
1991	23.40	3 419.09	132.44	3 574.92
1992	10.86	3 328.52	131.30	3 470.69
1993	10.60	3 281.33	133.16	3 425.09
1994	10.65	3 104.70	152.00	3 267.35
1995	10.97	2 932.99	168.27	3 112.23
1996	11.30	2 769.21	186.31	2 966.81
1997	11.62	2 630.05	195.37	2 837.04
1998	11.94	2 526.21	208.18	2 746.32
1999	12.26	2 415.29	223.52	2 651.07
2000	12.26	2 308.42	248.03	2 568.72
2001	12.26	2 220.81	278.41	2 511.49
2002	12.26	2 178.75	286.58	2 477.59
2003	12.26	2 221.02	294.30	2 527.58
2004	12.26	2 088.09	315.43	2 415.79
2005	12.26	1 972.04	337.92	2 322.22
2006	12.26	1 878.19	357.05	2 247.51
2007	12.26	1 767.19	364.54	2 143.99
2008	12.26	1 642.41	369.73	2 024.40
Trend 1990–2008	*-54.39%*	*-52.08%*	*179.64%*	*-43.55%*

Emission trends by sub categories

Table 243 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 2008, this category contributed 76.9% to total greenhouse gas emissions of the waste sector.

Table 243: Total greenhouse gas emissions of waste by subcategories and trend from 1990–2008.

CO_2 equivalent [Gg]	6 A	6 B	6 C	6 D	Total
1990	3 314.27	210.28	27.09	34.57	3 586.22
1991	3 305.96	209.14	23.58	36.24	3 574.92
1992	3 215.96	200.88	10.91	42.94	3 470.69
1993	3 168.42	192.82	10.64	53.21	3 425.09
1994	2 992.02	201.51	10.69	63.12	3 267.35
1995	2 822.82	211.73	11.01	66.66	3 112.23
1996	2 665.02	220.53	11.33	69.93	2 966.81
1997	2 533.30	223.29	11.66	68.79	2 837.04
1998	2 435.78	227.30	11.98	71.27	2 746.32
1999	2 329.03	234.78	12.30	74.96	2 651.07
2000	2 226.19	251.40	12.30	78.81	2 568.72
2001	2 140.14	269.70	12.30	89.35	2 511.49
2002	2 099.80	265.68	12.30	99.81	2 477.59
2003	2 143.62	261.92	12.30	109.74	2 527.58
2004	2 001.56	264.17	12.30	137.75	2 415.79
2005	1 881.62	279.00	12.30	149.30	2 322.22
2006	1 795.73	283.05	12.30	156.43	2 247.51
2007	1 682.91	287.19	12.30	161.59	2 143.99
2008	1 557.46	291.45	12.30	163.19	2 024.40
Trend 1990-2008	-53.01%	38.60	-54.57%	372.00%	-43.55%

8.1.2 Key Categories

Methodology and results of the key category analysis is presented in Table 244 summarizes the key categories in the waste sector.

Table 244: 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-LA08; TA
6.B	Wastewater Handling	N_2O	LA08; TA

LA90 = Level Assessment 1990

LA08 = Level Assessment 2008

TA = Trend Assessment BY–2008

In the base year, 4.4% of total greenhouse gas emissions originated from the two key categories of the waste sector compared to 2.1% in 2008. The key categories cover 90% of total GHG emissions from sector waste in 2008.

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 1.3.3, the following source specific quality checks, especially with regard to plausibility of activity data, are performed:

Until the end of 2008 activity data on deposited waste (6.A) was reported annually by landfill operators to the Federal Ministry of Agriculture, Forestry, Environment and Water Management (BMLFUW) resp. to the Umweltbundesamt, who in turn incorporated the reports into the landfill database. In the course of the data collection and administration, a quality control of the incoming data was implemented: data was checked in terms of completeness and of plausibility by comparison with previous reports. To clarify any discrepancies landfill operators were contacted.

However, since the beginning of 2009 landfill operators are obliged[65] to register their data (waste input-output) directly and electronically at the portal of http://edm.gv.at (EDM: **E**lectronic **D**ata **M**anagement). The landfill database is not maintained any more. In various meetings and training courses landfill operators were educated in using this new reporting tool. Responsible institution for administration of the EDM and analysis and control of the data is now the Austrian Federal Ministry of Agriculture, Forestry, Environment and Water Management. As has been done by the Umweltbundesamt, reported data is checked in terms of completeness and plausibility by comparison with previous reports. In case of doubt landfill operators are contacted.

In the course of the emission calculation, activity data – waste volumes deposited (6.A) or composted/treated in mechanical-biological treatment plants (6.D) – also is checked for time series consistency. If dips and jumps exceeding 20% compared to the year before are observed, other experts or data providers are consulted to either provide the explanation or to identify a possible inconsistency or an error. Furthermore data of separately collected bio waste (6.D) – now taken from the Federal Waste Management Plan (BAWP) — is checked against reports published by the Austrian federal provinces.

Finally, after the calculation is finished, waste experts of the Umweltbundesamt not involved in emission calculation of that year are asked to check the applied parameters, the calculation as well as the trend description in the NIR. This also ensures, that new available data/parameters (e.g. concerning landfill gas recovery, denitrification rates, connection rates to wastewater treatment plants) are accounted for in the inventory, to always keep it up-to-date.

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).

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[65] According to §41 (1) Landfill Ordinance

8.1.6 Recalculations

Recalculations have been made for managed waste disposal on land, wastewater handling and 'other waste' (compost). For further information please refer to the respective subchapters.

8.1.7 Completeness

Table 245 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 245: 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*

***) 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 563 landfill sites received waste, 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, and are not relevant for GHG emissions. Data on the number of landfill sites 2008 will become available for next years' submission.

Table 246: Number and type of landfill sites

Landfills for	2002	2003	2004	2005	2006	2007[66]
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 especially 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[67] (1990). Due to this, waste separation and reuse and recycling activities 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 once more in 2003 and then dropped as from the beginning of 2004 only pre-treated waste was allowed to be deposited. This is due to the implementation of the Landfill Ordinance[68], which – apart from some exemptions – prohibits the disposal of untreated waste in Austria and therefore leads to reduced waste volumes as well as decreased carbon content in deposited waste.

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[66] Compared to last years' NIR, the number of landfill sites 2007 increased due to reports from landfill operators received after the due date which were considered for this years' submission; Source: Annual update (2009) of the Federal Waste Management Plan (BUNDESABFALLWIRTSCHAFTSPLAN 2006)

[67] Abfallwirtschaftsgesetz 2002 , BGBl. I Nr. 102/2002

[68] 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)

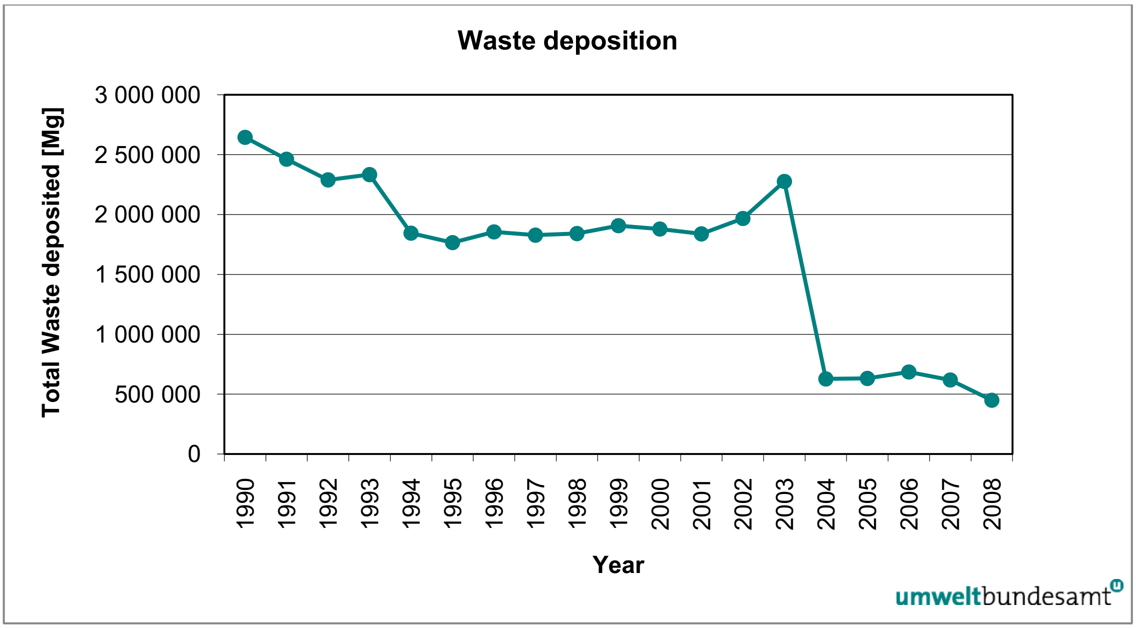

Figure 27: Deposited Waste ('residual waste' and 'non-residual waste'), period 1990–2008.

However, under certain circumstances there were some exceptions to this pre-treatment-obligation granted to some Austrian provinces.[69] In four of the nine Austrian provinces it was still allowed to deposit waste directly without any pre-treatment until the end of 2008.

Table 247 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 1990–2008.

Table 247: Activity data for 'residual waste' and 'non residual waste', greenhouse gas emissions and implied emission factors 1990–2008.

Year	Non Residual Waste [Mg/a]	Residual Waste [Mg/a]	Total Waste [Mg/a]	CH_4 Emissions [Mg]	IEF CH_4 [kg/Mg]
1990	648 702	1 995 747	2 644 448	157 822	59.7
1991	661 676	1 799 718	2 461 394	157 427	64.0
1992	674 909	1 614 157	2 289 067	153 141	66.9
1993	688 407	1 644 718	2 333 126	150 877	64.7
1994	702 175	1 142 067	1 844 242	142 477	77.3
1995	716 219	1 049 709	1 765 928	134 420	76.1
1996	730 543	1 124 169	1 854 713	126 906	68.4
1997	745 154	1 082 634	1 827 788	120 633	66.0
1998	760 057	1 081 114	1 841 171	115 989	63.0
1999	822 179	1 084 625	1 906 804	110 906	58.2
2000	826 874	1 052 061	1 878 935	106 009	56.4
2001	772 786	1 065 592	1 838 378	101 911	55.4
2002	792 753	1 174 543	1 967 296	99 991	50.8

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[69] Regulated in § 76 Abs. 7 AWG 2002

Year	Non Residual Waste [Mg/a]	Residual Waste [Mg/a]	Total Waste [Mg/a]	CH_4 Emissions [Mg]	IEF CH_4 [kg/Mg]
2003	890 640	1 385 944	2 276 584	102 077	44.8
2004	344 747	282 656	627 403	95 313	151.9
2005	389 660	241 733	631 393	89 601	141.9
2006	425 091	260 068	685 159	85 511	124.8
2007	464 109	154 517	618 626	80 138	129.5
2008	319 927	129 324	449 251	74 165	165.1

CH_4 emissions are affected by waste volumes deposited since 1950 (IPCC FOD Method). Single jumps in deposited waste – as from 1993 to 1994 and from 2003 to 2004 – result in declining emissions too. However, CH_4 emissions (in a particular year) do not fall in the same extent than waste volumes decline (in a particular year). This is in general the reason for the partly unstable development of the IEF (as IEF is CH_4 divided by total waste deposited).

The fall in total waste deposited, respectively the increase of IEF 2003-2004 is attributable to the implementation of the Landfill Ordinance.

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 2008 only 3.7% of residual waste was directly deposited. The remaining part was recycled, incinerated or treated mechanical-biologically. According to the Federal Waste Management Plans 2001 and 2006 as well as the recent update in 2009, recycling and treatment of waste from households and similar establishments was performed according to the following procedures:

Table 248: Recycling and treatment of waste from households and similar establishments.

Treatment	**1989 1)**	**1999 2)**	**2004 2)**	**2006 3)**	**2008 4)**
Bio-technical treatment (mechanical-biological treatment)	16.7% 4)	6.3 %	11.2%	17.9 %	8.8 %
thermal treatment (incineration)	5.9%	14.7 %	28.3%	23.7%	34.7 %
treatment in plants for hazardous waste	0.4%	0.8 %	1.2%	1.8%	2.3 %
recycling	12.9%	34.3 %	35.6%	34.8 %	32.3 %
recycling (biogenous waste)	1.0%	15.4 %	16.0%	17.9%	18.2 %
direct deposition at landfills ("residual waste")	63.1%	28.5 %	7.7%	3.8 %	3.7 %

1) *Federal Waste Management Plan (Bundesabfallwirtschaftsplan 2001)*

2) *Federal Waste Management Plan (Bundesabfallwirtschaftsplan 2006)*

3) *Annual update (2008) of the Federal Waste Management Plan (Bundesabfallwirtschaftsplan 2006)*

4) *Annual update (2009) of the Federal Waste Management Plan (Bundesabfallwirtschaftsplan 2006)*

5) *This value also includes plants used in the past to reduce odour emissions.*

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

- Data for 2008 was (for the first time) taken from the EDM (Electronic Data Management), administered by the BMLFUW. This is due to the fact that since the beginning of 2009 landfill operators are obliged to register their data (waste input-output report) directly and electronically (per upload) at the portal of http://edm.gv.at[70]
- From 1998 to 2007 data were taken from the database for solid waste disposals "Deponiedatenbank" ("Austrian landfill database") – a database, administered and maintained by the Umweltbundesamt until the end of 2008.
- From 1950 to 1997 the amounts of deposited residual waste were taken from national studies (Hackl & Mauschitz 1999, Umweltbundesamt 2001c) and the respective Federal Waste Management Plans (Bundesabfallwirtschaftplan 1995, 2001).

In the national study (Hackl & Mauschitz 1999) as well as in the Federal Waste Management Plans the amounts of residual waste from administrative facilities of businesses and industries were not considered and therefore originally not included in the data of the years 1950 to 1999. Waste from these sources is however deposited and hence reported by the operators of landfill sites (therefore included in the Austrian landfill database) and thus considered in the time series from 1998 onwards. To achieve a consistent time series, data of the two overlapping years[71] (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.

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[70] According to §41 (1) Landfill Ordinance, Federal Gazette BGBl. Nr 39/2008

[71] Data available from the Federal Waste Management Plan (Bundesabfallwirtschaftsplan - BAWP) as well as from the Austrian landfill database.

Activity data – Non residual waste

'Non residual waste' is directly deposited waste other than residual waste but with biodegradable lots. Non residual waste comprises for example 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'), the value for 2008 was taken from the EDM (Electronic Data Management). Only the amounts of waste with biodegradable lots were 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 249 presents a summary of all considered waste types and the corresponding identification numbers (List of waste).

Table 249:Considered types of waste (list of waste[72] 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
20303	waste from solvent extraction	200108	biodegradable kitchen and canteen waste
30105	Sawdust, shavings, cuttings, wood, particle board and veneer	200111	textiles
30304	de-inking sludge from paper recycling	200201	Bio-degradable wastes
30307	mechanically separated rejects from pulping of waste paper and cardboard	200302	waste from markets
30310	fibre rejects. fibre-. filler-. and coating sludge from mechanical separation	200307	bulky waste

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

Waste Identification No	Type of Waste	Waste Identification No	Type of Waste
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 non residual waste the waste types are aggregated to the following categories:

- wood
- construction waste
- paper
- green waste
- sludge
- sorting residues, bulky waste, landfill fraction after mechanical-biological treatment,
- textiles
- fats

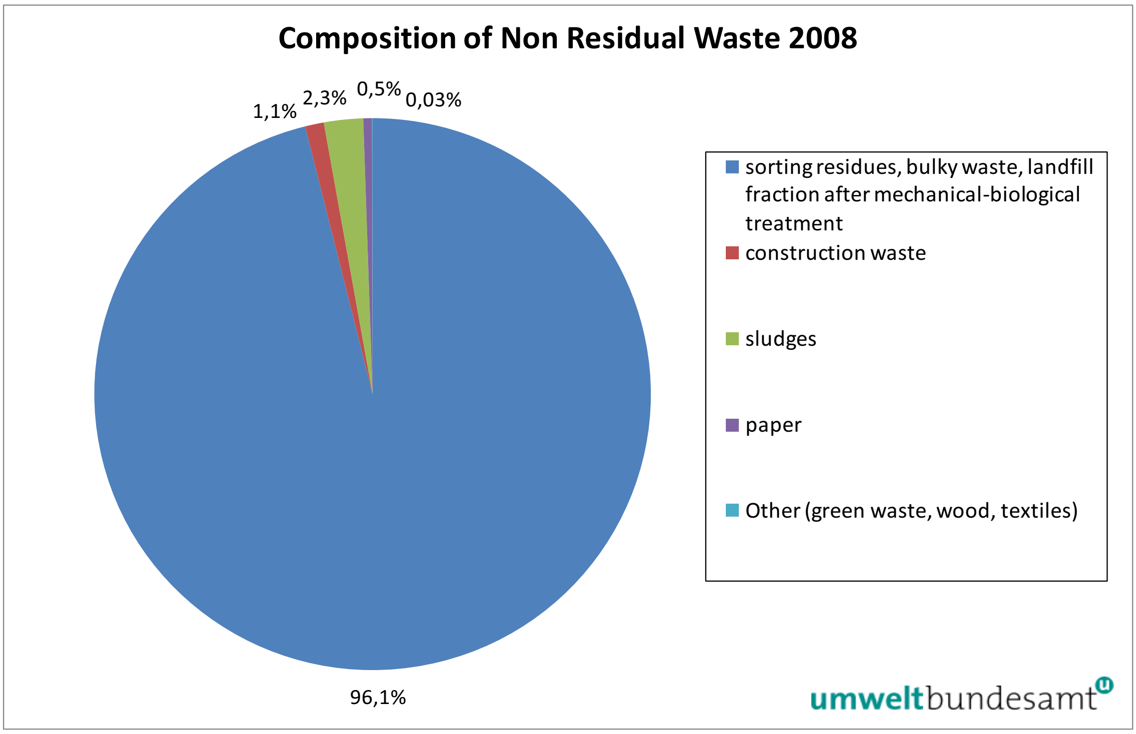

Figure 28: Composition of non residual waste 2008, as considered in the inventory.

Sorting residues remaining after mechanical, biological and mechanical-biological treatment and bulky waste are the main fraction deposited (96% in 2008). 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 Waste Management Law (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. The following table summarises the parameters used plus the corresponding references.

Table 250:Parameters for calculating CH_4 emissions of SWDS.

Waste category/ Parameters	**residual waste**	**wood**	**paper**	**sludges**	**Sorting residues/ output MBT[73]/ bulky waste**	**Bio-waste**	**textiles**	**Construct. waste**	**fats**
Methane correction factor	1								
	IPCC default for managed SWDS								
Fraction of degradable organic carbon dissimilated DOC_F	0.6	0.5	0.55	0.55	0.55	0.55	0.55	0.55	0.77
	The DOC_F for residual waste reflects the recent increase of biogenic components). IPCC default taking into account national waste expertises.								
DOC	See Table 252	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	59 IPCC default including data for 3 to 5 half lives								
Fraction of CH_4 in Landfill Gas	0.55 Mean value cited in the literature, also within the IPCC range.								
Methane Oxidation in the upper layer	10% IPCC default								
Landfill gas recovery	see Figure 30 (Umweltbundesamt 2004e, 2008c)								

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[73] MBT: **M**echanical-**b**iological **t**reatment

Biodegradable organic carbon (DOC) of residual waste

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).

(UMWELTBUNDESAMT 2003) estimated the carbon content in residual waste (DOC) based on the waste composition – i.e. 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).

The DOC value for the year 2004 was updated based on information on the composition of residual waste published in the Federal Waste Management Plan 2006 (BUNDESABFALLWIRTSCHAFTSPLAN 2006) taking into account the different carbon contents of the fractions, published in (UMWELTBUNDESAMT 2003).

For 2005, 2006, 2007 and 2008 the same DOC as for 2004 was used as no new information on the waste composition became available for the calculation since 2004 (BUNDESABFALLWIRTSCHAFTSPLAN 2006).

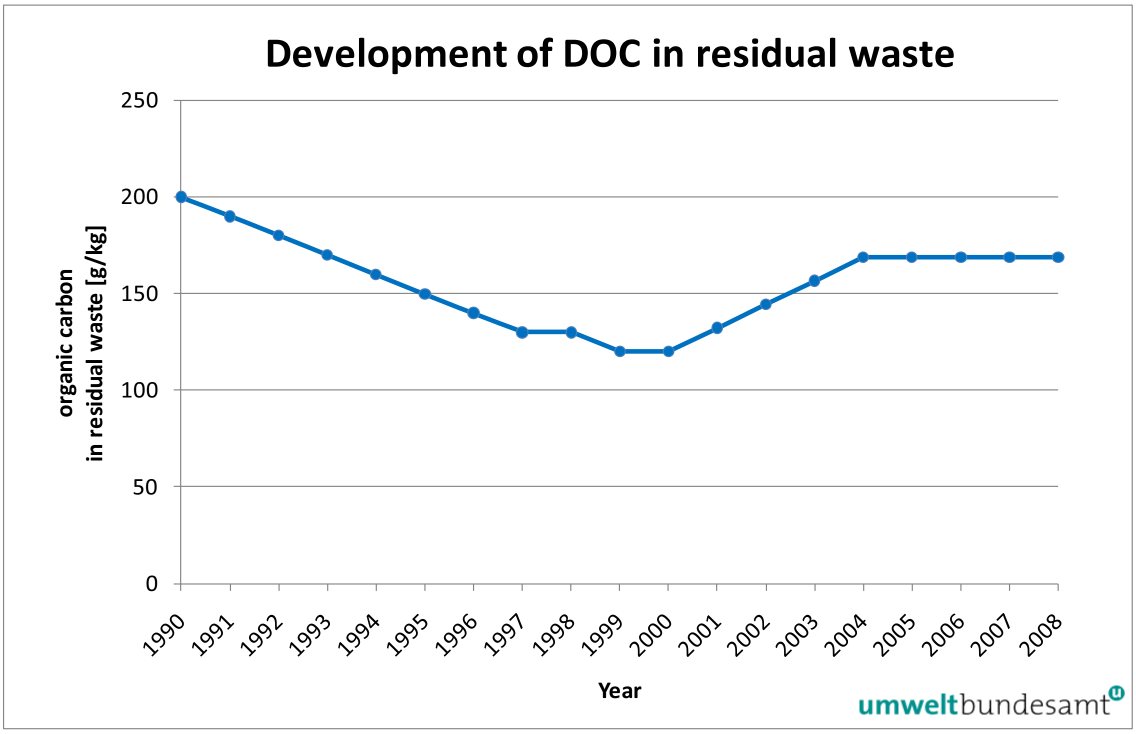

Figure 29: Development of DOC in residual waste.

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. The increase of the DOC of residual waste in 2000 and the following years is due to the increasing share of biogenic components in residual waste.

Table 251: 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
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 252: 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)]	1996	140 [2)]
1960–1969	230 [1)]	1997	130 [2)]
1970–1979	220 [1)]	1998	130 [2)]
1980–1989	210 [1)]	1999	120 [2)]
1990	200 [2)]	2000	120 [2)]
1991	190 [2)]	2001	132 [3)]
1992	180 [2)]	2002	144 [3)]
1993	170 [2)]	2003	157 [3)]
1994	160 [2)]	2004–2008	169 [3)]
1995	150 [2)]		

[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; 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. The value of 2007 was taken as the best proxy for the year 2008 given the small change from 2006 to 2007.

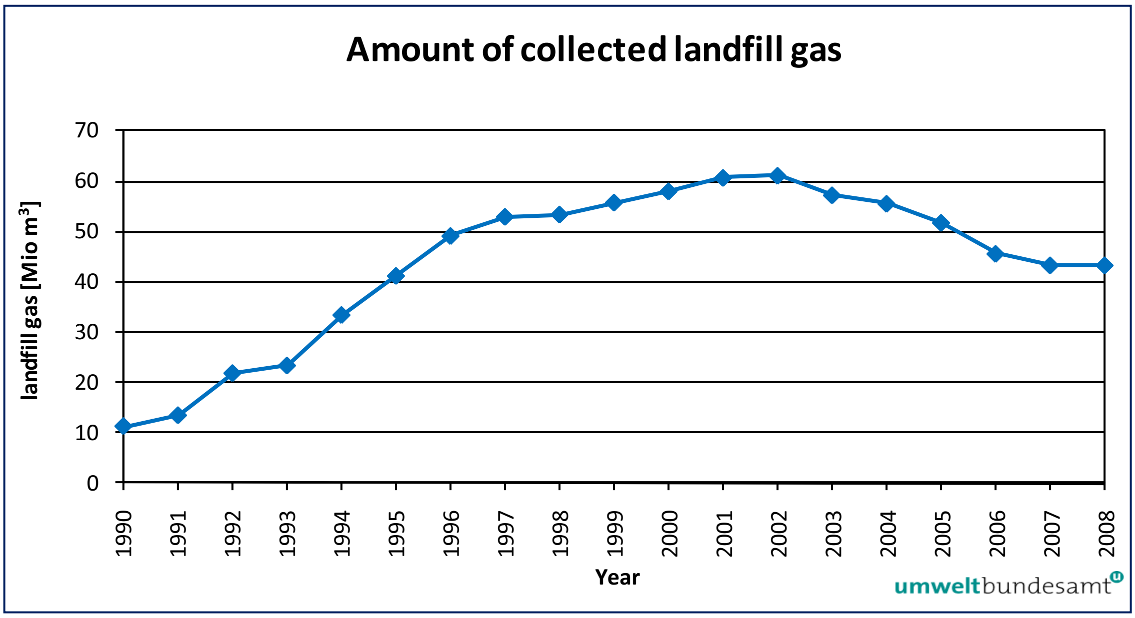

Figure 30: Amount of collected landfill gas 1990 to 2008 (UMWELTBUNDESAMT 2004e, 2008c).

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:

- IPCC Tier 2 method is applied;
- activity data is taken from the Austrian landfill database (for the years 1998-2007) and the EDM (for 2008) respectively, 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 (BUNDESABFALLWIRTSCHAFTSPLAN 2006);
- emission factors, taking into account IPCC default values and national expert know-how on waste and landfills are used.

Table 253: 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 years' submission:

- Activity data was revised for the whole time series, mainly due to the slightly adapted compilation of considered waste types. Some waste types (sand filter contents, waste from chemical recovery in the pulp production) were not considered any more as they contain almost no biodegradable lots. On the other hand, relevant waste types such as expired food or wood wool has been taken into account in this years' submission for the first time.
- A further reason for the revised activity data are delayed reports from operators of landfill sites on the amounts of deposited waste that were now considered, mainly with regard to residual waste, sorting residues, sludges and paper landfilled in 2007.
- Furthermore, as recommended by the Expert Review Team, the DOCf for sludge disposal and bio-waste was adjusted (to 0.55) in this years' submission.

Table 254: Recalculations with respect to previous submission for managed waste disposal on land

Difference	1990	1991	1992	1993	1994	1995	1996	1997	1998
CH_4 [Gg]	-2.97	-3.05	-3.13	-3.21	-3.29	-3.37	-3.45	-3.53	-3.62
[%]	*-1.8%*	*-1.9%*	*-2.0%*	*-2.1%*	*-2.3%*	*-2.4%*	*-2.6%*	*-2.8%*	*-3.0%*

Difference	1999	2000	2001	2002	2003	2004	2005	2006	2007
CH_4 [Gg]	-3.70	-3.67	-3.71	-3.74	-4.09	-3.94	-3.60	-3.29	-2.92
[%]	*-3.2%*	*-3.3%*	*-3.5%*	*-3.6%*	*-3.8%*	*-4.0%*	*-3.9%*	*-3.7%*	*-3.5%*

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 2008, greenhouse gas emissions from wastewater handling contributed 0.3% to total greenhouse gas emissions in Austria.

From 1990 to 2008 greenhouse gas emissions increased by 38.6% due to increasing amounts of wastewater that is treated in treatment plants and increasing amount of denitrification. Emissions from wastewater handling are estimated separately for industrial wastewater and for domestic and commercial wastewater.

Table 255: Greenhouse gas emissions from industrial as well as domestic and commercial wastewater treatment 1990–2008.

	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	209.14
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	0.43	227.30
1999	0.10	2.93	0.46	234.78
2000	0.12	2.68	0.51	251.40
2001	0.14	2.43	0.57	269.70
2002	0.14	2.18	0.57	265.68
2003	0.14	1.95	0.57	261.92
2004	0.15	1.96	0.57	264.17
2005	0.16	1.97	0.61	279.00
2006	0.17	1.48	0.64	283.05
2007	0.17	1.49	0.65	287.19
2008	0.18	1.50	0.66	291.45
Trend 1990–2008	*1 298%*	*-69%*	*96%*	*39%*

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 – the latest year for which data is currently available – 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 routes 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 routes: 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 uses 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.

Table 256:Share of population using septic tanks (1990–2006)

1990	1995	2000	2005	2006
18.0%	15.1%	9.5%	6.8%	5.1%

As there were no updated data available so far, the share of 2006 was used as proxy data for 2007 and 2008.

Sewage sludge treatment

In Austria sewage sludge treatment is carried out by aerobic stabilisation and anaerobic digestion. Under aerobic conditions (stabilisation), only a negligible amount of methane emissions is produced. Methane gas produced in the digestion process is usually used for energy recovery or is flared. As the CH_4 emissions from both processes are therefore 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. As CH_4 gas is usually used for energy recovery or is flared, the amount of CH_4 emissions from industrial wastewater treatment and sewage sludge treatment is negligible. 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 the ***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. The emission factor (0.01) and the fraction of nitrogen in protein (0.16) are IPCC default values.

N_2O emissions arising in waste water treatment plants (i.e. emissions from the ***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 Austrian 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[74] 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 2008 this value has increased to 79%.

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[74] Abwasseremissionsverordnung für kommunales Abwasser (BGBl. 210/1996)

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.

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 the literature was reviewed. It was 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 (connection rate) as well as the denitrification rate increased over the time series. 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. The data for the daily protein intake are taken from FAO statistics[75], the number of inhabitants is provided by STATISTIK AUSTRIA.

Table 257:Parameters used for the calculation of N_2O emissions for 1990–2008

	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

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[75] http://www.fao.org/economic/ess/food-security-statistics/en/

	Connection rate to municipal sewage systems [%]	Denitrification rate [%]	Protein intake (g/day/capita)	Total Inhabitants
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	105	7 976 789
1999	82.6%	**0.51** a)	106	7 992 323
2000	84.3%	0.60	106	8 011 566
2001	**86.0%** b)	**0.68** a)	106	8 042 293
2002	87 5%	0.68	106	8 082 121
2003	**88 9%** b)	0.68	107	8 118 245
2004	88.9%	**0.68** b)	107	8 169 441
2005	88.9%	0.73	107	8 225 278
2006	**91.7%** b)	**0.77** b)	107	8 267 948
2007	91.7%	0.78	107	8 300 954
2008	91.7%	**0.79** b)	107	8 336 549

a) *Source: Austrian reports on water pollution control (GEWÄSSERSCHUTZBERICHT E 1993, 1996, 1999, 2002), values in between are inter- or extrapolated*

b) *Source: Situation reports on the disposal of urban wastewater and sludge (BMLFUW 2006, BMLFUW 2008), Urban Wastewater Treatment Directive (91/271/EEC) – Questionnaire 2009: Status of Implementation in Austria (BMLFUW 2009), values in between are inter- or extrapolated*

8.3.3 Recalculations

The FAO has published new data concerning daily protein intake in Austria – This was taken into account in the calculation and has led to revised emission values for the years 1998 to 2007. Furthermore, a new value for the denitrification rate became available for 2008, changing the value for 2007 too (due to interpolation between 2006 and 2008).

Table 258: Recalculations with respect to previous submission from wastewater handling.

Difference	CH_4 [Gg]	N_2O [Gg]	*CO_2 eq [%]*	Difference	CH_4 [Gg]	N_2O [Gg]	*CO_2 eq [%]*
1998	-0.01	0	*-0.01%*	2004	-0.07	0.00	*-0.08%*
1999	-0.01	0	*-0.02%*	2005	-0.08	0.00	*-0.08%*
2000	-0.02	0	*-0.03%*	2006	-0.09	0.00	*-0.09%*
2001	-0.03	0.00	*-0.04%*	2007	-0.08	0.00	*-0.08%*
2002	-0.03	0.00	*-0.03%*				
2003	-0.03	0.00	*-0.03%*				

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 2008.

In Austria waste oil is incinerated in especially designed so called "USK-facilities" (**U**mwelt**s**chutz**k**omponenten GmbH). 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 259: 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
2008	12	0.000	0.0001	12
Trend 1990–2008	*-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.

8.4.2.1.1 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 260.

Table 260: 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

8.4.2.1.2 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" ("Abfälle aus dem medizinischen Bereich") 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.

Table 261: 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

Year	Municipal Waste [Mg]	Clinical Waste [Mg]	Waste Oil [Mg]
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 2008	0	3 100	3 000

The following table shows activity data of waste incineration with energy recovery.

Table 262: Activity data for waste incineration with energy recovery.

Year	1.A.1.a Public Electricity and Heat1)			1.A.2.f Cement Industry2)		1.A.2 Manuf. Industries3)
	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
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	498 590	70 513	75 117	218 048	26 437	8 278
2002	561 801	70 513	64 225	238 959	30 017	9 385
2003	652 997	70 513	62 970	253 874	30 057	10 898
2004	923 830	90 771	59 460	257 360	28 370	13 952
2005	870 456	103 024	58 979	203 616	26 701	11 986
2006	1 147 980	113 695	60 216	261 474	21 596	12 270
2007	1 080 466	109 724	62 376	300 664	23 808	11 420
2008	890 767	95 548	60 082	297 133	17 692	12 878

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*

8.4.2.1.3 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. 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 263 for the period from 1990 to 2008.

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 263:Greenhouse gas emissions from 'other waste' 1990–2008

	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
1995	1.04	0.14	66.66
1996	1.09	0.15	69.93
1997	1.08	0.15	68.79
1998	1.12	0.15	71.27
1999	1.18	0.16	74.96
2000	1.24	0.17	78.81
2001	1.41	0.19	89.35
2002	1.58	0.22	99.81
2003	1.74	0.24	109.74
2004	2.16	0.30	137.75
2005	2.33	0.32	149.30
2006	2.44	0.34	156.43
2007	2.52	0.35	161.59
2008	2.55	0.35	163.19
Trend 1990-2008	*390%*	*364%*	*372%*

8.5.1 Methodological Issues

Emissions were estimated using a country specific methodology.

Two different fractions were considered:

- residual waste treated in mechanical-biological treatment (MBT) plants
- composted waste: bio-waste collected separately, loppings, home composting

Emissions were calculated by multiplying the quantity of waste by the corresponding emission factor.

8.5.1.1.1 Activity data

Activity data were taken from several publications on national and regional level. For years where no data were available inter- or extrapolation was done. Since 2006, most of data required is available from a national publication referred to as 'Federal Waste Management Plan' (Bundesabfallwirtschaftsplan), which is (in part) updated annually ('Status Reports').

Table 264:Activity data and sources for 'other waste'.

	Total waste	Mechanical-biological waste treatment (MBT)		Bio waste collected separately		Loppings; gardening waste		Home composting	
	[Gg]	**[Mg]**	**source**	**[Mg]**	**source**	**[Mg]**	**source**	**[Mg]**	**source**
1990	763	345 000	(Baumeler et al. 1998)	10 436	Sum of data reported by the Austrian Federal Provinces, (Amlinger 2003)	37 370	Sum of data reported by the Austrian Federal Provinces, (Amlinger 2003)	370 000	(Amlinger 2003)
1991	798	345 000		27 372		50 995		375 000	
1992	942	345 000		88 243		48 464		460 000	
1993	1 161	345 000		156 936		149 470		510 000	
1994	1 373	345 000		246 375		197 130		584 985	
1995	1 446	294 739	(Angerer 1997)	301 809		249 264		600 000	
1996	1 515	281 378	expert judgement	334 371		283 127		616 000	
1997	1 488	243 780	(Lahl 1998)	351 862		229 643		662 571	
1998	1 541	239 671	(Lahl 2000)	362 572		241 835		696 487	
1999	1 621	265 672	(Umweltbundesamt 2001e)	378 796		244 587		732 273	
2000	1 703	253 660	Interpolated	374 271		303 239	Interpolated[76]	771 773	
2001	1 928	241 648		399 090		361 890		944 412	Interpolated
2002	2 150	229 636		422 126		420 542		1 117 051	
2003	2 362	217 625	(Umweltbundesamt 2008d)	433 911		479 194		1 289 691	
2004	2 979	487 623		491 670	BAWP 2006	537 845		1 462 330	Calculated on basis of Status Report* 2008
2005	3 236	623 393		543 420	Interpolated	596 497		1 472 325	
2006	3 391	660 231		595 170	Status Report* 2007	655 148		1 479 963	
2007	3 503	684 322		618 570	Status Report* 2008	713 800	Status Report* 2008	1 485 871	Status Report* 2008
2008	3 537	684 322	extrapolated	650 700	Status Report* 2009	709 600	Status Report* 2009	1 492 242	Calculated on basis of Status Report* 2008[77]

*) *Annual updates (2007, 2008, 2009) of the Federal Waste Management Plan 2006 (BundesAbfallWirtschaftsPlan 2006)*

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[76] Values between 1999 and 2007 were interpolated as originally used data for 2004 became obsolete (see 'Recalculations').

[77] In Status Report 2008 a value of the amount of home composted waste (in kg) per capita is given. This information is used to calculate the emission for the years 2004-2006 and 2008 too.

8.5.1.1.2 Emission factors

Due to different emission factors in different national references an average value was used for both fractions of composted waste.

Table 265: 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) (AMLINGER et al. 2003, 2005) (ANGERER & FRÖHLICH 2002) (DOEDENS et al. 1999)
bio-waste, loppings, home composting	0.75	0.1	(AMLINGER et al. 2003, 2005)

8.5.2 Recalculations

The following improvements have been made compared to last years' submission:

Compost Production

Activity data for organic waste composted have been updated for the years 2004-2007 due to new data and findings published in the Federal Waste Management Plan (BAWP) and its updates (Status Reports), resulting in significant higher emission values (for interpolated values too):

- Activity data for **bio-waste collected separately** has been updated for the years 2004-2007 as more current and accurate data became available on national level (BAWP and its yearly updates).
- **Loppings, gardening waste**: More accurate data became available for 2007 and 2008 and originally published data for 2004 (BAWP 2006) herewith became obsolete (do not represent the current state of knowledge any more, not even for 2004). Consequently, the values 2004-2006 used in previous submissions were now replaced by interpolated values (between 1999 and 2007). Also municipal gardening/park waste has now been taken into account.
- **Home composted** waste amounts of the years 2004-2006 have been revised due to new findings with regard to home composted amounts per capita taken from the annual update ('Status Report') 2008 to the BAWP 2006.

Mechanical-biologically treated waste:

- The minor recalculations of the values 1995-1999 are due to the correction of rounded values.

Table 266: Recalculations with respect to previous submission from 'other waste' 1990–2007

Difference	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007
CH_4 [Gg]	-0,00	0.00	-0.00	-0.00	0.00	0.03	0.17	0.31	0.45	0.64	0.71	0.78	0.85
N_2O [Gg]	-0.00	0.00	-0.00	-0.00	0.00	0.00	0.02	0.04	0.06	0.09	0.09	0.10	0.11
CO_2 eq. [%]	*-0.0%*	*0.0%*	*-0.0%*	*-0.0%*	*0.0%*	*0.0%*	*0.1%*	*0.2%*	*0.3%*	*0.4%*	*0.4%*	*0.5%*	*0.5%*

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 2007. 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.

9.1 Explanations and Justifications for Recalculations, including for KP-LULUCF inventory

9.1.1 GHG inventory

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.

Detailed information on recalculations and their justifications can be found in the following subchapters as well as the corresponding Sector-specific chapters *3 Energy – 8 Waste*, in which all methodological changes and activity data updates that led to recalculations of emissions with respect to the previous submission are listed.

9.1.1.1 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 2004–2008. Major revisions affect the years from 2001 onwards (except for natural gas which has been revised from 1999 onwards). 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 except for gasoil which has been shifted between the years 2003 and 2005–2007.

Natural gas: From 2001 to 2007 up to 5.3 PJ have been shifted between the transformation sectors (public electricity and auto producers; 2007: -0.3 PJ) to *1.A.1.b petroleum refining* (2007: +3.6 PJ) and final consumption of *1.A.2 Industry* (2007: +2 PJ) and *1.A.4 Other* (2007: -5.3 PJ).

Residual fuel oil: Revision of final consumer stock change and final consumption of category *1.A.4 other* for the years 2001 (+3.6 PJ) and 2006 (+1.2 PJ).

Gasoil: Revision of final consumer stock change for the years 2003 and 2005–2007 (up to ±6.3 PJ) to better reflect yearly final consumption instead of fuel sales. This change affects category *1.A.4 Other Sectors* only. The 'net change' for the 4 revised years is +0.4 PJ.

Other solid biomass (such as wood waste, wood chips, pellets): Revision of gross inland consumption from 1999 to 2007 (2007: -6.3 PJ). This affects mainly the categories *1.A.1.a public electricity and heat* (2007: -2.5 PJ), *1.A.4 other* (2007: -2.6 PJ), non metallic mineral products industry (2007: +3 PJ; included in *1.A.2.f*) and wood products industry (2007: -2.6 PJ; included in *1.A.2.f*).

Fuel wood: Revision of gross inland consumption from 2001 (-4.5 PJ) to 2007 (-2.9 PJ). This mainly affects the categories *1.A.4.b Residential* (2007: -1.3 PJ) and wood products industry (2007: -1.7 PJ; included in *1.A.2.f*).

Industrial waste: Revision of gross inland consumption from 2001 (+0.5 PJ) to 2007 (-5.1 PJ), mainly due to chemicals (1.A.2.c), wood product and non metallic mineral products industry (included in 1.A.2.f).

Minor revisions have been carried out for coal and LPG from 2001 to 2007. The changes do not affect gross inland consumption and thus total CO_2 emissions from 1.A fuel combustion activities but emissions were only shifted between sub categories.

Stationary sources

1.A.1.a Public Electricity and Heat

Transformation input of natural gas and biomass has been revised from 2001 to 2007 by the national energy regulator (E-Control). Biomass consumption has been revised according to a new evaluation of boilers < 1 MW (E-Control, Ökostrom-Erhebung).

1.A.1.b Petroleum Refining

Liquid fuel consumption 1999–2001 has been revised following the energy balance. In the previous submission liquid fuel consumption was calculated from other data sources.

Natural gas consumption 2001 (-0.5 PJ) to 2007 (+3.6 PJ) has been revised following the energy balance. This implies e.g. a lower natural gas energy consumption in 2007 for other *1.A Fuel Combustion Activities*.

1.A.4.b Residential

A new household census has been applied from 2004 onwards. This leads to a shift of biomass consumption from stoves to boilers and thus to a reduction of CH_4 emissions. Energy consumption of secondary residences has been estimated for the first time. For the years 2003 to 2007 gasoil stock changes of end consumers have been revised to reflect fuel consumption rather than fuel sales (based on heating degree days).

Mobile sources

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

Activity data for mobile machineries (especially in industry) for the whole time series was updated following the revised national energy balance. Now the activity of mobile machineries in industry is higher.

1.A.3.b Road Transport

An update of statistical energy data, particularly the energy consumption for mobile machineries in 1.A.2.f c shows that more fuel is used by off-road vehicles. As the overall fuel consumption is a fixed value, this increase in fuel consumption had to be counterbalanced by a decrease of fuel tourism on the road.

1.A.3.c Railways

Activity data was updated with updated emission factors.

1.A.4. Other Sectors – mobile sources

Activity data for mobile machineries for the whole time series was updated following the revised national energy balance.

Improvements of methodologies and emission factors

1.A.3.b Road Transport

Adaptation of the specific CO_2 emissions factors of passenger cars according to the national CO_2-monitoring data

1.A.3.c Railways

Activity data was updated with updated emission factors

1.A.3.d Navigation

The splitting of activity data of diesel oil between national and international navigation shows that in 2008 domestic navigation only accounts for 40% of the total diesel oil consumption in Austria. Following, there is a decrease of CO_2 emissions within the Category 1 A 3 d Navigation by around 31.5 Gg.

Improvements of reporting

Transport biofuels: Consumption and CO_2 emissions from pure and blended biofuels are now reported under biomass in categories 1.A.2.f, 1.A.3.b, 1.A.4.b, 1.A.5. Therefore the implied CO_2-emission factors of "diesel oil" and "liquid fuels" reflect pure fossil fuels.

Gasoline IEF: For 1990 to 1991 the net calorific value (NCV) and fuel consumption of gasoline has been revised (increased) by means of the 1992 value. This does not imply changes in emissions but improves time series consistency of the CO_2 implied emission factor which has been flagged as an outlier by the ERT.

Fugitive Emissions (1 B)

Update of activity data

1.B.2.a Refining/Storage

Activity data for 2007 was updated according to data from the national energy balance.

Improvements of methodologies and emission factors

1.B.2.b Transmission and Distribution

Following a recommendation from the in-country review 2007 the method for calculating CH_4 emissions from the key category natural gas distribution has been improved from Tier 1 to Tier 2. For the implementation of the higher tier method country specific emission factors have been developed from national studies. For the sub-category *gas distribution* that contributed more than 70% to CH_4 emissions from 1.B.2.b in the last submission, a Tier 3 approach based on the annual composition of distribution network materials has been developed.

9.1.1.2 Industrial Processes (Sector 2)

Update of activity data

2.C.2. Ferroalloys: Activity data for 2007 was updated.

2.C.4. SF_6 Used in Aluminium and Magnesium Foundries: In the course of industry inquires applications of SF_6 in secondary aluminium smelting works have been identified in recent years. The resulting emissions have been included in the inventory.

Improvements of methodologies and emission factors

2.A.7. Glass Production: CO_2 emissions from limestone, dolomite and soda ash use in the glass production are reported under this category in contrast to previous reports, where these emissions were reported under the categories 2.A.3 Limestone and Dolomite Use and 2.A.4 Soda Ash Use.

2.A.4. Soda Ash Use: Following the recommendation from the in-country review 2007 CO_2 emissions from uses of soda ash other than in glass industry have been reviewed, identified and included in the inventory for the whole time-series.

2.F. Consumption of Halocarbons and SF_6: A new survey was conducted covering consumption and emissions in all sub-categories. Following a recommendation from the in-country review 2007 special focus was given to emissions from manufacturing/installation and disposal. The results of this study were incorporated in the inventory and emissions of all gases and in all sectors have been revised for the whole time-series accordingly.

9.1.1.3 Solvent and other Product Use (Sector 3)

Update of activity data

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

The short term statistics for trade and services and the Austrian foreign trade statistics were updated from 2004 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.

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

9.1.1.4 Agriculture (Sector 4)

Improvements of methodologies and emission factors

As a result of the previous UNFCCC reviews the ERT recommended Austria to update its information on average waste management system (AWMS) distribution (ARR 2006, ARR 2008). Hence, in 2008 the Umweltbundesamt commissioned the University of Natural Resources and Applied Life Sciences with the revision of the national emission model of sector agriculture (AMON & HÖRTENHUBER 2010)[78]. The new input-data on AWMS was taken from the research project "Animal husbandry and manure management systems in Austria" (AMON et al. 2007)[79]. In this project a comprehensive survey on the agricultural practice in Austria had been carried out.

The emission calculations within the revised agriculture GHG inventory follow the methodologies defined in the Revised 1996 IPCC Guidelines and the IPCC Good Practice Guidance 2000.

For the calculation of the losses of gaseous N species the mass-flow procedure pursuant to EMEP/CORINAIR has been used. In 2009 a new revised emission model (AMON, B. & HÖRTENHUBER, S. 2008)[80] has been implemented into the national inventory.

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[78] AMON, B. & HÖRTENHUBER, S. (2010): Revision of Austria's National Greenhouse Gas Inventory, Sector Agriculture. Final Report. Division of Agricultural Engineering (DAE) of the Department for Sustainable Agricultural Systems of the University of Natural Resources and Applied Life Sciences (BOKU), study on behalf of Umweltbundesamt GmbH. Wien (unpublished).

[79] AMON, B , FRÖHLICH, M, WEIẞENSTEINER, R , ZABLATNIK, B & AMON, T (2007): Tierhaltung und Wirtschaftsdüngermanagement in Österreich Endbericht Projekt Nr 1441 Auftraggeber: Bundesministerium für Land und Forstwirtschaft, Umwelt- und Wasserwirtschaft. Wien.

[80] AMON, B. & HÖRTENHUBER, S. (2008): Revision der österreichischen Luftschadstoff-Inventur (OLI) für NH_3, NMVOC und NO_x; Sektor 4, Landwirtschaft. Endbericht. Universität für Bodenkultur, Institut für Landtechnik im Auftrag vom Umweltbundesamt. Wien (unpublished)

4.A.1.a Enteric Fermentation Dairy Cattle: The method of adjusting the GE-intake to the yearly milk yield of dairy cattle has been improved, resulting in yearly slightly differing emissions compared to the previous submission.

4.A.1.b Enteric Fermentation Non-Dairy Cattle (suckling cows): The milk yield of suckling cows has been revised on the basis of the results of a new national study (HÄUSLER, J. 2009)[81]. The new data show an increased GE-intake and thus increased emissions in recent years.

4.B Manure Management: New national data on AWMS distribution have been implemented. A new time series of AWMS has been generated. The new AWMS data show an increasing share of liquid systems and a decreasing share of solid systems and pasture. Following new systems have been taken into account: yard, deep litter, composting, aerobic treatment and anaerobic digester. In the CRF 4.B(a)s2 the new AWMS have been summarised under "Other".

4.B Manure Management – CH_4: In the new inventory for liquid systems new national methane conversion factors (MCF) have been applied. The new factors (cattle: 10,03% swine: 3,42%) have been obtained from a national peer reviewed study (AMON et al. 2006[82], AMON et al. 2007[83]). The factors are based on measurements and considerable lower than the IPCC default value of 39%. For yard (which is not included in the GPG 2000) the MCF of pasture, range and paddock has been taken. For deep litter the MCF of the 2006 IPCC Guidelines (17%) has been taken because the MCF of the GPG 2000 (39%) is not applicable to Austria's cold climate conditions.

4.B Manure Management – N_2O: deep litter: in consistency with the calculations of CH_4, see above, the IPCC 2006 emission factor of 0.01 kg N_2O-N/kg N_2O has been used.

4.B.8 Swine: In the new calculations of emissions from fattening pigs young swine from 20 to 50 kg were considered. In the previous submission these animals were treated like piglets and therefore not accounted (because the emission factor of breeding sows includes piglets). The consideration of pigs 20-50 kg in the fattening pigs category causes higher emissions from swine.

4.D.1 Direct Soil Emissions – Animal Manure Applied to Soils: The revised calculations within category 4.B (see above) as well as the more detailed calculation of NH_3-N and NO_x-N losses within the UN/LRTAP submission resulted in lower amounts of manure N applied to soils.

4.D.1 Direct Soil Emissions – Crop Residue: An error in the calculation of N_2O from certain crop residues was found and corrected, leading to higher N_2O emissions.

4.D.1 Direct Soil Emissions – Other direct emissions: The consideration of NH_3-N and NO_x-N losses led to reduced emissions from sewage sludge spreading.

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[81] JOHANN HÄUSLER (2009): Das Leistungspotenzial von Fleckviehmutterkühen – Versuchsergebnisse des LFZ Raumberg-Gumpenstein. Fachtag „Erfolgreiche Mutterkuhhaltung" Fachschule Warth.

[82] AMON, B.; KRYVORUCHKO, V. & AMON, T. (2006): Influence of different levels of covering on greenhouse gas and ammonia emissions from slurry stores. International Congress Series (ICS) No 1293 "2nd International Conference on Greenhouse Gases and Animal Agriculture

[83] AMON, B., V. KRYVORUCHKO, M. FRÖHLICH, T. AMON, A. PÖLLINGER, I. MÖSENBACHER & ANTON HAUSLEITNER (2007). Ammonia and greenhouse gas emissions from a straw flow system for fattening pigs: Housing and manure storage. Livestock Science 112, 199–207.

4.D.2 Pasture, Range and Paddock Manure: The smaller share of grazed animals led to smaller emissions from grazing.

4.D.3 Indirect Emissions: The comprehensive revision of the agriculture model – including the emission calculation of NH_3 and NO_x – led to higher N_2O emissions from atmospheric deposition and slightly differing emissions from leaching compared to the previous submission.

9.1.1.5 LULUCF (Sector 5)

Revision of the data series for LULUCF are due to the following changes:

5.A Forestland

There was a mistake in the equation used for estimating the emissions from forest fires due to a misunderstanding of the IPCC GPG. The equation was corrected and the time series of the emissions from forest fires was revised.

The new submission includes now information on the area of "protective forests out of yield" (non-productive forest).

5.B Cropland

Some shortcomings in the area data (activity data) were corrected leading to new figures for the estimates of the subcategories "cropland remaining cropland" and "LUC to cropland"

The estimates of the subcategory "cropland remaining cropland" included some double accounting of increment and losses in perennial cropland due to a calculation with the whole perennial cropland area of Austria within this category. These estimates also included losses of perennial cropland to other land uses and areas that changed from other land uses to perennial cropland. In the new estimates these areas were subtracted and the time series of emissions/removals from perennial cropland remaining perennial cropland was revised.

5.E Settlements

Some shortcomings throughout the time series of the areas of LUCs to settlements was corrected which resulted in partly new figures for the emissions/removals of the time series of this subcategory.

5.F Other land

The new submission includes now information on the area of other land remaining other land.

9.1.1.6 Waste (Sector 6)

Update of activity data

6.A.1 Managed waste disposal on land

Activity data was revised for the whole time series, mainly due to the slightly adapted compilation of considered waste types. A further reason for the revised activity data are delayed reports from operators of landfill sites on the amounts of deposited waste that were now considered, mainly with regard to residual waste, sorting residues, sludges and paper landfilled in 2007. Furthermore, as recommended by the Expert Review Team, the DOCf for sludge disposal and bio-waste was adjusted (to 0.55) in this years' submission.

6.B Waste Water Handling

The FAO has published new data concerning daily protein intake in Austria – This was taken into account in the calculation and has led to revised emission values for the years 1998 to 2007. The minor revision of the 1991 value is due to the correction of a rounded value. Furthermore, a new value for the denitrification rate became available for 2008, changing the value for 2007 too (interpolation between 2006 and 2008).

6.D Compost Production

Activity data for composted organic waste have been updated for the years 2004–2007 as new data and findings became available, resulting in significant higher emission values (for interpolated values too).

9.1.2 KP-LULUCF inventory

No recalculations were performed since last submission.

9.2 Implication for Emission Levels, including on KP-LULUCF emission levels

9.2.1 GHG inventory

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 2007 which are submitted this year differ slightly 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 267: Recalculation difference of Austria's greenhouse gas emissions compared to the previous submission

	1990 (Base year)	**2007**
	Recalculation Difference [%]	
TOTAL	-1.10%	-1.14%
CO_2	-0.02%	-0.28%
CH_4	-9.56%	-15.74%
N_2O	+0.49%	+2.31%
HFC, PFC, SF_6	-0.31%	+11.96%

emissions without LULUCF

For the base year recalculated national total emissions excluding LULUCF are 1.10% lower than those reported last year and 1.14% lower than those of the year 2007.

The lower total emissions of the whole time series are mainly attributable to recalculated **CH_4 emissions** in the fugitives and agricultural sector. The main reasons are as follows:

For calculating CH_4 emissions from natural gas distribution a national study became available, replacing estimates based on default values previously used. Now the Tier 2 method was applied and country specific emission factors were used.

In 2008 the Umweltbundesamt commissioned the University of Natural Resources and Applied Life Sciences with the revision of the national emission model of the sector agriculture (AMON & HÖRTENHUBER 2010)[84]. Following a recommendation of the ERT new input-data on animal waste management system (AWMS) distribution were implemented. Data was used from the research project "Animal husbandry and manure management systems in Austria" (AMON et al. 2007)[85]. In this project a comprehensive survey on the agricultural practice in Austria had been carried out.

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[84] AMON, B. & HÖRTENHUBER, S. (2010): Revision der österreichischen Luftschadstoff-Inventur (OLI) für CH_4 und N_2O; Sektor 4, Landwirtschaft. Universität für Bodenkultur, Institut für Landtechnik im Auftrag vom Umweltbundesamt. Wien (unpublished)

[85] AMON, B , FRÖHLICH, M , WEIßENSTEINER, R , ZABLATNIK, B , AMON, T (2007): Tierhaltung und Wirtschaftsdüngermanagement in Österreich Endbericht Projekt Nr. 1441 Auftraggeber: Bundesministerium für Land und Forstwirtschaft, Umwelt- und Wasserwirtschaft. Wien.

The revised calculations within the sector agriculture led to considerable lower CH_4 emissions and higher **N_2O emissions** compared to the previous submission (see Chapter 3.5.4).

A new survey was also conducted covering consumption and emissions of **fluorinated gases** in all sub-categories. The results of this study were incorporated in the inventory and emissions of all gases and in all sectors have been revised for the whole time-series accordingly.

The recalculation of **CO_2 emissions** is mainly based on the revisions of the national energy balance, mainly due to a revised stock change of gasoil (see Chapter 3.5.1).

Table 268 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 268: Recalculation Difference of National Total GHG Emissions.

Year	National Total GHG emissions without LUCF		
	Submission 2009 [Gg CO_2e]	Submission 2010 [Gg CO_2e]	Recalculation Difference [%]
1990*	79 037	78 171	-1.10%
1991	83 121	82 223	-1.08%
1992	76 401	75 521	-1.15%
1993	76 307	75 506	-1.05%
1994	77 210	76 394	-1.06%
1995	80 506	79 822	-0.85%
1996	83 581	82 906	-0.81%
1997	83 133	82 489	-0.77%
1998	82 500	81 877	-0.76%
1999	80 925	80 271	-0.81%
2000	81 078	80 296	-0.96%
2001	85 083	84 533	-0.65%
2002	87 031	86 270	-0.87%
2003	93 112	91 931	-1.27%
2004	91 775	90 926	-0.92%
2005	92 832	92 916	0.09%
2006	91 518	89 688	-2.00%
2007	87 958	86 957	-1.14%

**Base year is 1990 for all gases*

9.2.2 KP-LULUCF inventory

Not applicable as there was no recalculation.

9.3 Implications for Emission Trends, including time series consistency, and also for the KP-LULUCF inventory

9.3.1 GHG inventory

As can be seen in Table 268 and Figure 31, Austria's greenhouse gas emissions as reported in the UNFCCC submission 2010 are slightly different compared to the values reported last year due to recalculations. For the base year recalculated national total emissions excluding LULUCF are 1.1% lower than those reported last year, and 1.14% lower for the year 2007. Thus the trend for 1990 to 2007 reported last year (+11.3%) is still the same with using this years' figures (+11.2%).

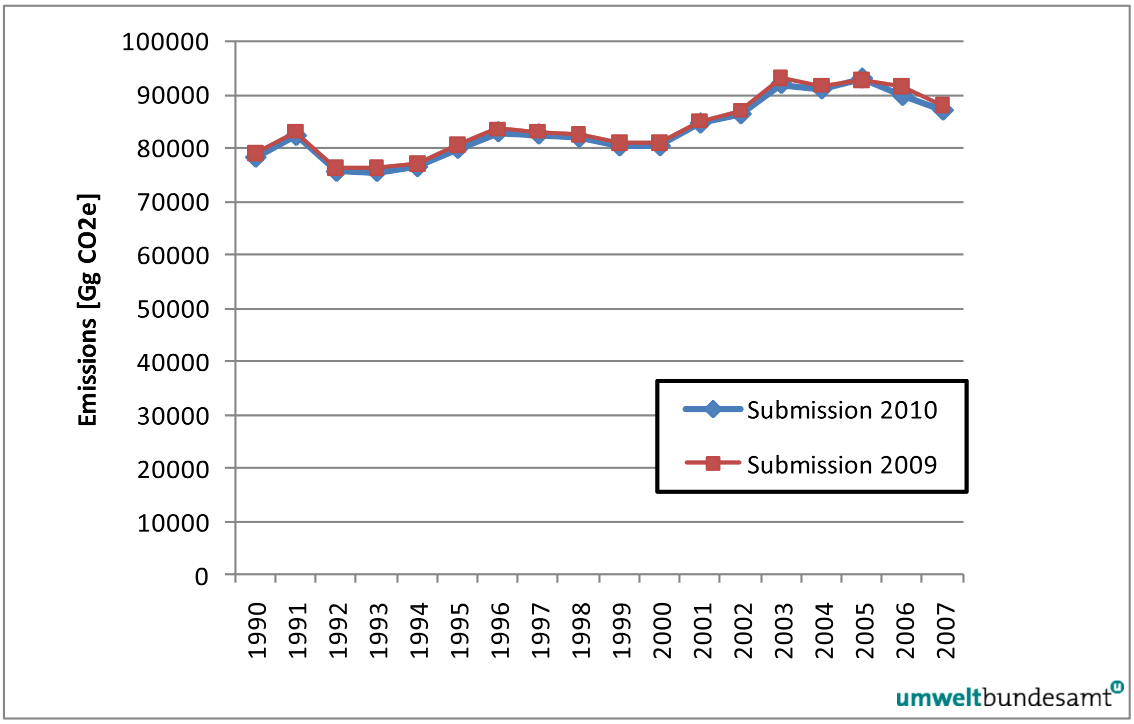


Figure 31: Emission estimates of the submission 2009 and recalculated values of the submission 2010.

9.3.2 KP-LULUCF inventory

Not applicable, because there was no recalculation. Due to the nature and permanence of ARD areas, there is a steady increase in ARD areas from 1990 on (see chapter 10.2.1) and related to that a steady increase of removals and emissions, respectively, at these areas.

9.4 Recalculations, including in response to the review process, and planned improvements to the inventory

9.4.1 GHG inventory

Improvements made in response to the review process

Improvements made in response to the issues raised in the UNFCCC review process are summarized in Table 269.

Table 269: Improvements made in response to the UNFCCC review process.

Finding	Reference	Improvement made
General		
The ERT noted that Austria has to include descriptions of QA/QC procedures for all categories in the NIR	FCCC/ARR/2008/AUT para 17	Sector-specific QA/QC discussions were included in NIR Submission 2009 and Submission 2010 (1.A.2, 1.A.3, 3, 4)
Energy		
Stationary Combustion – other fuels, CO_2: Austria informed the ERT hat it assumes CO_2 emissions from this category to be overestimated for the period 1990–2004. The ERT recommends that Austria correct the emission estimates in its next submission	FCCC/ARR/2008/AUT para 28	Energy statistics has been revised and double counting of industrial waste has been eliminated.
Road transportation – biofuels: There are plans to determine the fossil carbon content of diesel fuel by analysis. The ERT recommends that the Party provides more transparent information on the use of biofuels.	FCCC/ARR/2008/AUT para 31	Consumption and CO_2 emissions from pure and blended biofuels are now reported under biomass in categories 1.A.2.f, 1.A.3.b, 1.A.4.b, 1.A.5. Therefore the implied CO_2-emission factors of "diesel oil" and "liquid fuels" reflect pure fossil fuels.
As regards domestic aviation: For the 2009 submission estimates of emissions for 2000 onwards were updated using detailed information from Statistik Austria applying the CORINAIR tier 3a bottom-up methodology. The ERT recommends that the Party provides explanations on how it has ensured time-series consistencies	FCCC/ARR/2009/AUT para 43	An explanation on how time-series consistency for 1990 to 2008 is given is specified in the respective chapter of the NIR 2010 – taking the year 2000 as an example.
As regards international bunker fuels - waterborne navigation: The ERT encourages Austria to provide information on international navigation on the Danube river in its next submission.	FCCC/ARR/2009/AUT para 44	Information on international navigation is included in NIR 2010 (Table 22). In this submission, international navigation is not included in 1.A.3.d – (domestic) navigation any more.
As regards emissions from the use of other fuels (mainly waste paper) in Category *1.A.2.d Pulp, Paper and Print* CO_2 IEFs reported by Austria are lower than the lower limit of the IPCC default range and – moreover – shows a decreasing trend. The ERT recommends that the Party provides explanations and supportive data on that.	FCCC/ARR/2009/AUT para 47	More information on energy use and CO_2 IEF of 1.A.2.d is provided in NIR 2010.

Finding	Reference	Improvement made
The ERT observed a downward trend since 2005 in the CO_2 IEFs for consumption of other fuels (i.e. combustion of waste) in the chemical industry.	FCCC/ARR/2009/AUT para 48	More information on energy use and CO_2 IEF in NIR 2010 is provided in NIR 2010.
The ERT recommends Austria to provide more transparent information on the use of biofuels, for example by including in its NIR a table on the use and types of biofuel for each year.	FCCC/ARR/2009/AUT para 52	Information on biofuel use and CO_2 emissions substituted is given in NIR 2010 (Table 59).
Biomass - CH_4 residential: The ERT recommends that Austria provides relevant explanations on the decrease of CH_4 IEF in its next NIR.	FCCC/ARR/2009/AUT para 51	Information on number of biomass boiler sales and fuel consumption estimate is given in NIR (Chapter 3.2.7.15)
IP & Fugitive		
Austria uses the IPCC tier 1 method based on default emission factors to estimate CH_4 emissions from natural gas distribution. Since CH_4 emissions from natural gas are a key category, the ERT encourages Austria to use a tier 2 method to estimate CH_4 emissions from natural gas distribution.	FCCC/ARR/2006/AUT para 36	The method for calculating CH_4 emissions from natural gas distribution has been improved from Tier 1 to Tier 2.
Austria provides activity data for fluid filled into new products for various applications of ODS substitutes, for example, foams. Emissions from manufacturing, however, are reported as "not applicable" ("NA"). The ERT encourages Austria to investigate whether emissions occur from foam manufacturing/ installation or other ODS substitute applications to determine whether emissions are currently being underestimated.	FCCC/ARR/2006/AUT para 42	A new survey was conducted covering consumption and emissions in all sub-categories. Special focus was given to emissions from manufacturing/installation and disposal. The results of this study were incorporated in the inventory and emissions of all gases and in all sectors have been revised for the whole time-series accordingly
The ERT encourages Austria to review the additional uses of soda ash (additional to soda ash use in the glass industry) described in the Revised 1996 IPCC Guidelines (e.g. soaps and detergents, pulp and paper production and water treatment).	FCCC/ARR/2006/AUT para 44	CO_2 emissions from uses of soda ash other than in glass industry have been reviewed, identified and included in the inventory for the whole time-series.
The ERT recommends that Austria implements its plan and switch to a higher-tier methodology to estimate emissions from category 1B2b	FCCC/ARR/2009/AUT para 55	Emissions were calculated applying a Tier 3 approach – described in NIR 2010
Cement Production: The ERT encourages Austria to report in its NIR on the $MgCO_3$ content of the raw material in order to explain the large inter-annual variations in the CO_2 IEFs for clincer	FCCC/ARR/2009/AUT para 58	Austria has included explanation for fluctuating IEFs as well as $MgCO_3$ in its submission 2010. Moreover a reference to a study s given to explain the level of the IEF
Agriculture		
Austria is aware that the real shares of the different AWMS have changed over the period and that new treatment systems are currently changing the original pattern. The ERT welcomes Austria's intention to update this information. The ERT also recommends that Austria make efforts to improve its information about "other" treatment of poultry.	FCCC/ARR/2006/AUT para 50	New AWMS data became available, detailed information is provided in the NIR 2010.

Finding	Reference	Improvement made
To improve the transparency of the inventory the ERT recommends that Austria reports emissions from non-dairy mother cows and young cattle separately.	FCCC/ARR/2008/AUT para 47	Austria has provided more detailed information on CH_4 emissions of different non-dairy cattle subcategories in its NIR 2009.
Austria currently applies a single AWMS distribution across the entire time series based on a study carried out in 1995. In previous reviews ERTs have recommended that Austria update its information on AWMS distribution as it has probably changed over the time period. Austria is currently carrying out a study to update its AWMS distribution information and will incorporate the new data into the inventory in coming years. The ERT welcomes this development and recommends that Austria report on the results in its next NIR.	FCCC/ARR/2008/AUT para 48	A new study was commissioned, detailed information is provided in the NIR 2010.
The ERT noted that the QC activities performed by the Party included only routine control procedures, and that no source category-specific QC procedures have been designated to the key categories in the agriculture sector.	FCCC/ARR/2009/AUT para 63	Source category-specific QC procedures are provided in the NIR 2010.
Enteric Fermentation: In NIR 2009 Austria has reported that a tier 2 approach (with Swiss EF) was used to estimate emissions from poultry. As Austria herewith uses Swiss EF as default values a tier method is applied. The ERT suggests that Austria rectify the reporting.	FCCC/ARR/2009/AUT para 64	This has been done in NIR 2010
The ERT encourages Austria to update the data on its AWMS distribution in its next annual inventory submissions.	FCCC/ARR/2009/AUT para 67	The inventory has been revised. A detailed description of the inventory update is provided in the NIR 2010, Chapter 6.3.2.
LULUCF		
The ERT raised the question, whether there were any shortcomings in the used formulas concerning cropland remaining cropland – perennial crops.	2nd Centralized review 2009	Equations were checked and revised adequately by subtracting those areas of perennial cropland before 30 (or 10 or 6, respectively) years that were matter of land use change.
The ERT recommends that Austria reports a consistent and complete set of annual land use and land-use change matrices (see as example table 2A.1.2 of the IPCC good practice guidance for LULUCF) established in accordance with the IPCC good practice guidance for LULUCF, in order to have unbiased activity data.	Voluntary KP LULUCF review by UNFCCC	Austria reported the following two land-use areas in the CRF tables that were not reported previously: 1) the areas of the subcategory "other land remaining other land" and 2) the area of the "forest remaining forest", subcategory "protective forest out of yield (non-productive forest)". With these areas the land use statistic is complete and consistent.

Finding	Reference	Improvement made
Austria reported altogether lands deforested from 1990 to 2007 and similarly land afforested from 1990 to 2007. To increase transparency it is a good practice to stratify according to the year of the onset of the activity; that requirement is also fundamental for identification and then tracking of those lands.	2nd Centralized review 2009	Information on the ARD-areas emissions/removals were stratified in more detail.
Disaggregation of ARD areas within the country, e.g. by ecological or administrative units, is needed	Voluntary KP LULUCF review by JRC	See answer to related question above
The reported IEF values are, most probably and correctly, for all D areas since 1990. However, these IEF values are not informative as to the mean loss of carbon of the area deforested in the inventory year. A separate and explicit reporting of the mean loss applied to the D areas of the reporting year is suggested for enhanced transparency.	Voluntary KP LULUCF review by JRC	See answer to related question above
Waste		
The ERT encourages Austria to include information on assumptions behind the derivation of the 'residual waste' DOC and the percentage composition of 'non-residual waste' in future submissions	FCCC/ARR/2008/AUT, para 74	The NIR 2009 includes this additional information.
It is recommended that Austria adopts the DOCf value for sludge disposal and bio-waste as lignin is contained.	FCCC/ARR/2008/AUT, para 75	As recommended, the DOCf for sludge disposal and bio-waste was adjusted (to 0.55) in submission 2010

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.

9.4.2 KP-LULUCF inventory

Not applicable, because there was no recalculation.

PART 2:
SUPPLEMENTARY INFORMATION REQUIRED UNDER ARTICLE 7, PARAGRAPH 1

10 KP-LULUCF

10.1 General information

10.1.1 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 270.

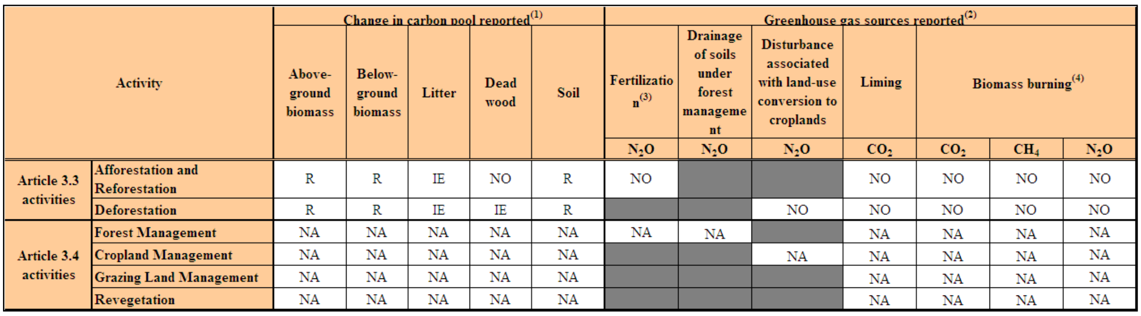
Table 270: Selected parameters defining forest in Austria for the reporting which are the same as according to the NFI of Austria (FBVA, 2001).

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
Average width		> 10 m

Permanently unstocked basal areas that are directly connected with forest in terms of space and forestry enterprise and contribute directly to its management (such as forestal hauling systems, wood storage places, forest glades, forest roads) also represent forests. Areas which are used in short rotation with a rotation period of up to thirty years as well as forest arboretums, forest seed orchards, Christmas tree plantations and plantations of woody plants for the purpose of obtaining fruits such as walnut or sweet chestnut do not account as forests but represent cropland. Rows of trees and areas with woody plants in a park structure are not forest land.

10.1.2 Elected activities under Article 3.4

As reported in the Initial Report[86] Austria has decided not to elect any of the activities under Article 3.4 of the Kyoto Protocol.



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

Figure 32: Activity coverage relating to activities under Art. 3.3 and 3.4 (CRF NIR 1 –Table).

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[86] http://unfccc.int/files/national_reports/initial_reports_under_the_kyoto_protocol/application/pdf/at-initial-report-200611-corr.pdf

10.1.3 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 has the same basis as the area reported for Land use changes from and to forests in the UNFCCC greenhouse gas inventory taking the different time frame (ARD areas starting with 1990) as well as the permanence of ARD areas into account. All LUC from and to forests are considered to be direct human induced ARD. AR activities are reported together. A justification for that is given in chapter 10.4.1.

The information about ARD areas is based on the NFI (see chapter 10.2.1). 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. Definitions and the methods of assessment were stable in the period since 1990. This guarantees consistency in the statistical approach and in the assessment over time. The most recent NFI period was 2007-09.

10.2 Land-related information

10.2.1 Spatial assessment unit used for determining the area of the units of land under Article 3.3

The information on ARD areas is based on the assessments of 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. So far, the NFI periods 1986/90, 1992/96 and 2000/02 are the relevant ones for the Kyoto-Protocol-reporting-period. Recently, the NFI assessment period 2007/09 was finalised.

A statistical approach is used to estimate the total area of ARD units following Reporting Method 1 of the IPCC GPG LULUCF (2003).

The NFI uses a permanently below ground marked 4 x 4 km grid across all of Austria (Figure 33) with four permanent sample plots of 300 m^2 size at each grid point (Figure 34). Details are described in SCHADAUER et al. (2007). The NFI provides representative and systematically measured data for the total Austrian forest area and for all Austrian areas of LUCs from and to forests. The NFI grid covers the whole area of Austria and provides measured data on the total Austrian forest area with a statistical error of ±1.2%. Each grid point shown in Figure 33 is terrestrially inspected during each NFI assessment for a potential af-/reforestation except grid points that are not suited to cover forests (e.g. grid points at glaciers or at permanent surface water bodies). Therefore, the spatial assessment unit for the submission of the Kyoto Protocol LULUCF tables covers the entire territory of Austria.

ARD activities are accounted in direct connection with the forest definition (see chapters 10.1.1 and 10.4.2). At permanent sample plots with ARDs adjacent to existing forests any ARD area is accounted, even at ARD areas smaller than 0.05 ha but larger than the minimum assessment size (see below). At each permanent sample plot the ARD area is assessed. The minimum size of the sub-area with a different land use within one permanent sample plot needs to be larger than 1/10 of the total sample plot area to be assessed (> 30 m^2). If this pre-condition is met the polygon that divides the different areas of land uses within the sub-plot is measured using polar-coordinates (see examples in Figure 35). This does not mean that the sample plot is further subdivided into parcels of 30 m^2, but the 30 m^2 only represent the minimum area threshold for the measurement of a plot division in two different land uses. At site, sketches are drawn and the polygon data are entered into the geographic information system of the portable NFI input devices. 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.

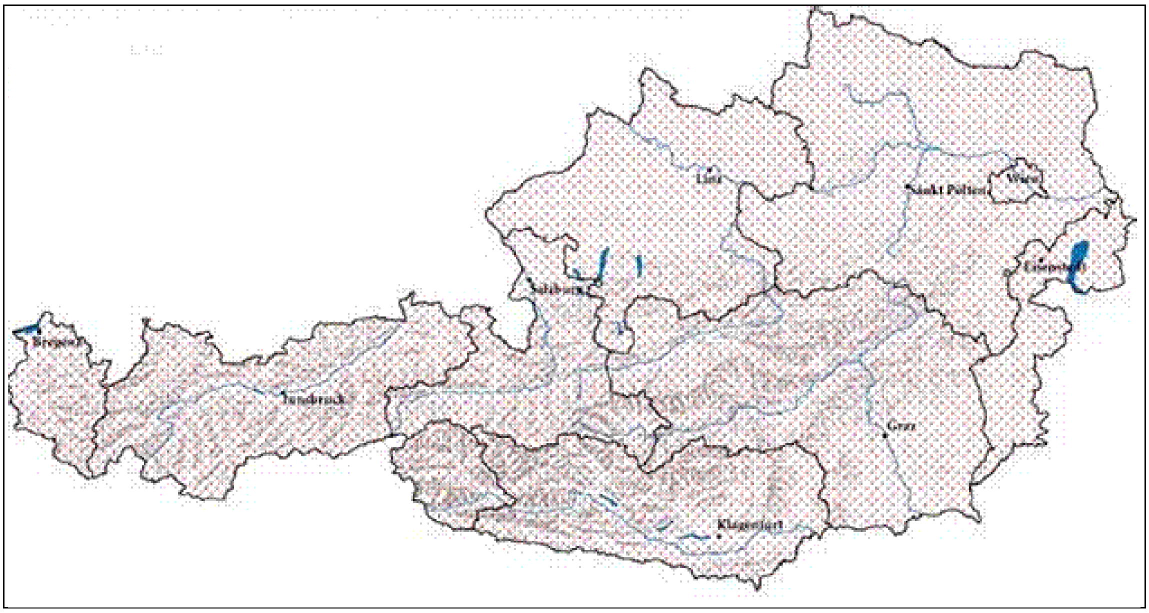


Figure 33: Systematic sample grid of the Austrian NFI (Federal Research and Training Centre for Forests, Natural Hazards and Landscape, 2005).

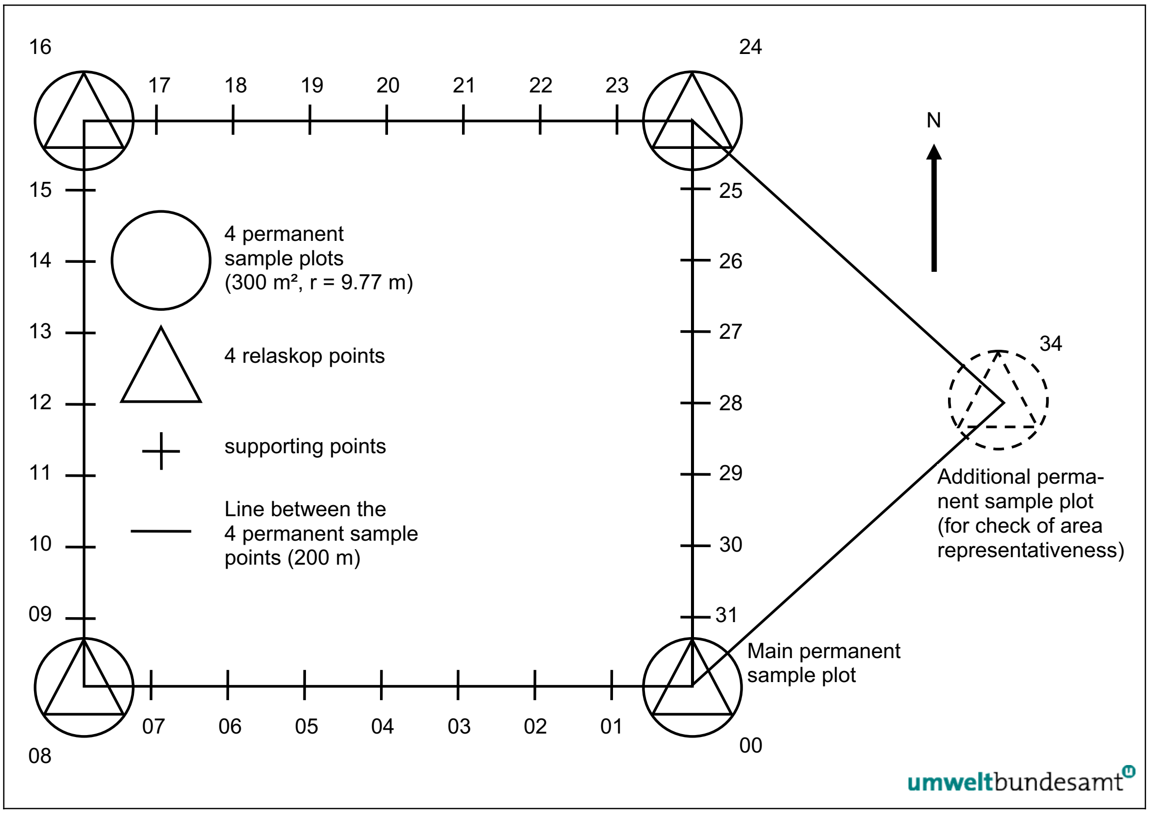


Figure 34: Scheme of permanent sample plots at each NFI grid point (nach SCHADAUER et al. 2007).

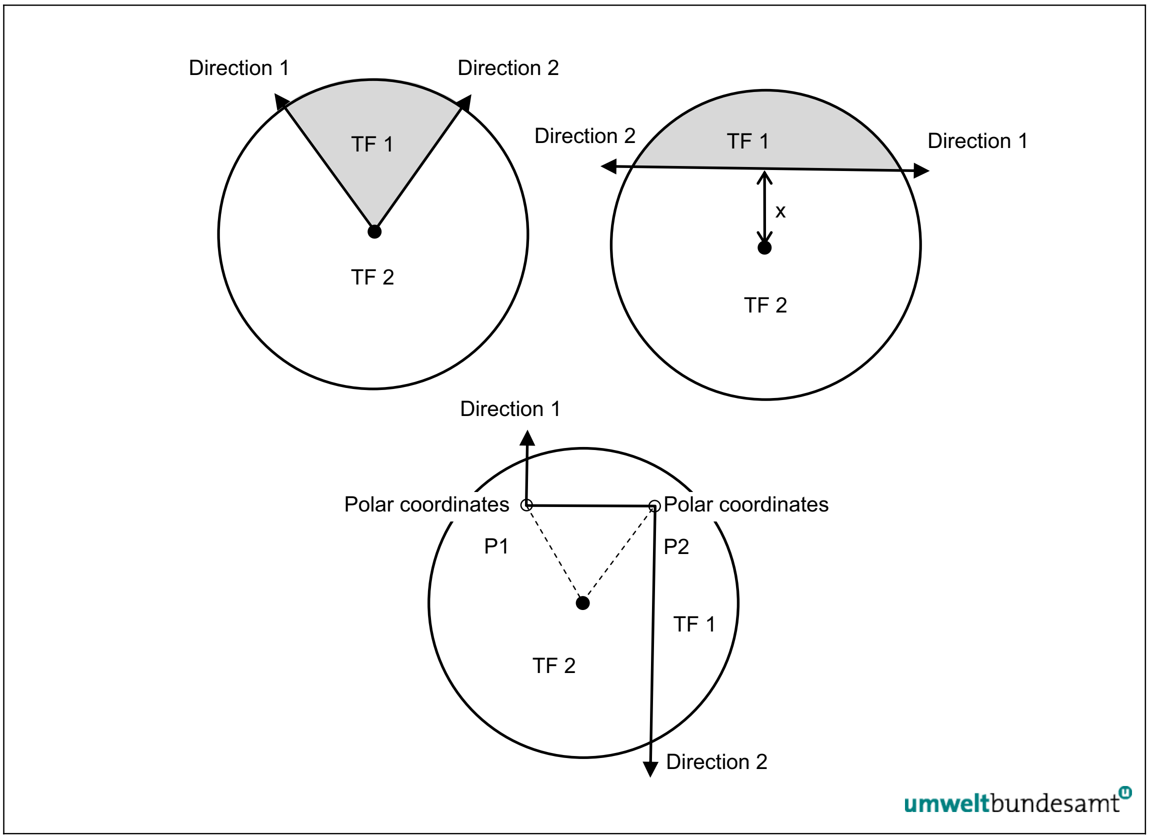


Figure 35: Examples for the measurement of polygones dividing permanent NFI sample plots according to different land uses (TF1, TF2), (nach SCHADAUER et al. 2007).

Due to its representativeness and coverage the NFI data allow an unbiased reporting of the complete Austrian forest area and its change by LUCs from and to forests. This is of relevance for the reporting of the Austrian Art. 3.3 areas which are based on the NFI data only.

In case a land use change has been observed at a sample plot of the NFI the type of the neighbouring non-forest land was recorded (see chapter 10.2.2 for the assessed land use types). This specification of different land use types is however only available since the NFI 2000/02. The evaluation of 2/3 of such forest boundary points led to the land use statistic shown in Table 271 and Table 272. It is assumed, that the other third follows the same distribution.

The total AR area between the NFI periods 1992/96 and 2000/02 was 68 000 ha. The total D area for the same period was about 32 000 ha.

Table 271:AR areas observed between the NFI periods 1992/96 and 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 272:D areas observed between the NFI periods 1992/96 and 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 271 and Table 272 ARDs mainly occur from or to grassland sites (59% or 53%, respectively). The land use changes from or to other categories are far below this value.

For the years before 1997 it was assumed that the measured land use change areas between two observation periods show the same relative ratio of LUC distribution as in the latest inventory because only the total area of AR-lands and D-lands are available for previous NFI periods.

Figure 36 gives an overview of the ARD areas. The NFI is designed to provide representative information for Austria in a randomized way. For reasons of accuracy and uncertainty Austria reports separately for different types of ARD activities but does not differentiate according to geographical units. If the figures would be further divided according to e.g. the nine Federal provinces, the estimates and resulting figures for these provinces would become very uncertain.

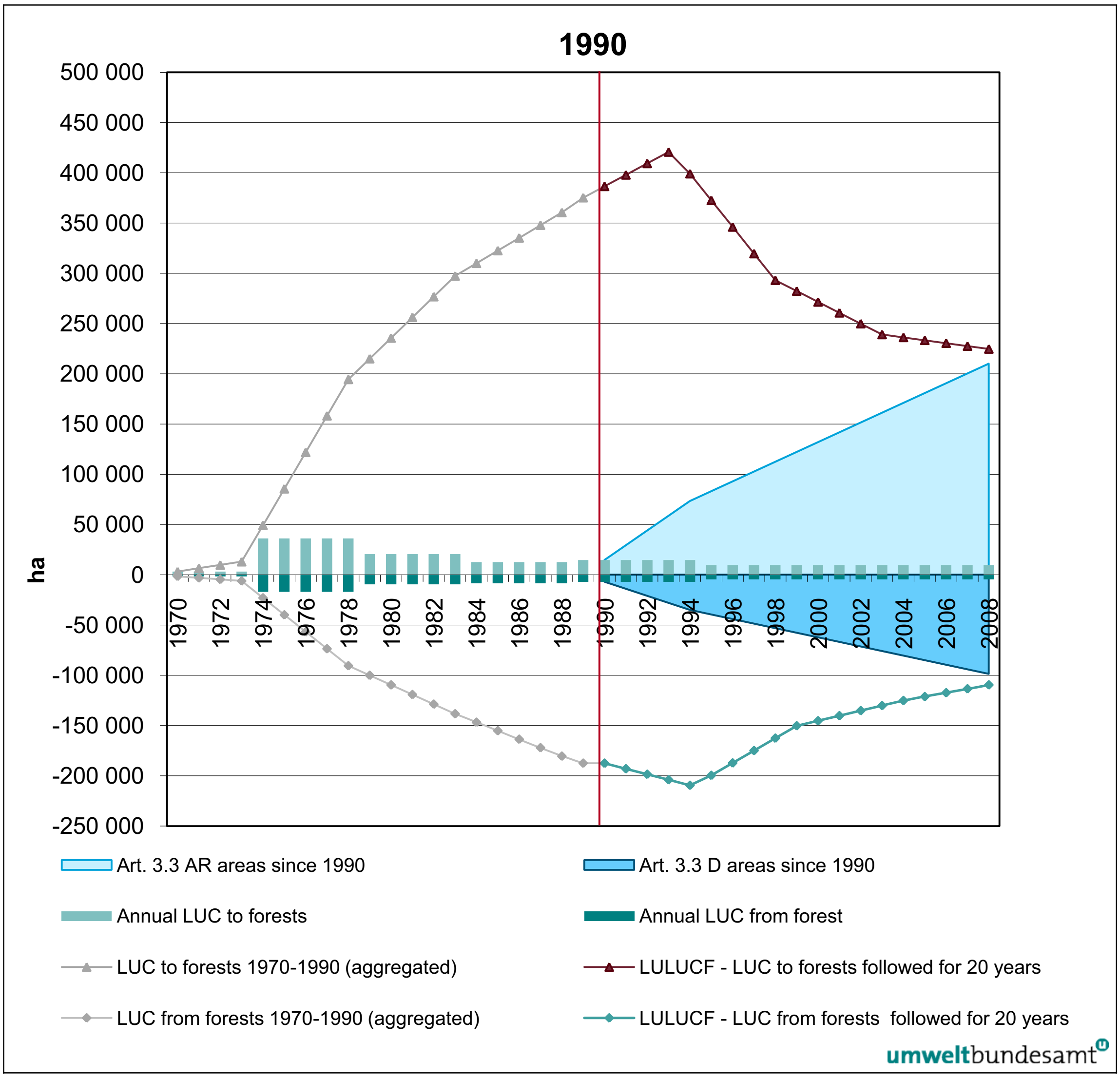


Figure 36: Areas of LUC from and to forests and ARD areas since 1970 and 1990, respectively.

10.2.2 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 NFIs of the periods 1986/90, 1992/96 and 2000/02. The assessment methods at the NFI grid points are described in chapter 10.2.2. The land uses at the sub-areas of the permanent sample plots are assessed according to the following sub-categories (forests with its sub-specifications; cropland: cropland, fallow, orchards and vineyards, energy plantations, 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 change areas 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. The figures for the years 1995 to 2001 were used for the years after that period - new figures for these years will be available with the recently finalised NFI 2007/09. Table 273 shows the current land use transition matrix for the years 1990 to 2008.

Table 273: Land transition matrix. Area change between the current and the previous year (CRF NIR-2 table)

FROM... \ TO...		Article 3.3 activities		Article 3.4 activities				Other	Total
		Afforestation and reforestation	Deforestation	Forest Management (if elected)	Cropland Management (if elected)	Grazing Land Management (if elected)	Revegetation (if elected)		
		(kha)							
Article 3.3 activities	Afforestation and Reforestation	200.25	NO						200.25
	Deforestation		94.12						94.12
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		9.76	4.55	NA	NA	NA	NA	NA	14.31
Total area		210.02	98.66	0.00	0.00	0.00	0.00	0.00	308.68

10.2.3 Maps and/or database to identify the geographical locations, and the system of identification codes for the geographical locations

The database and system to identify the geographical locations of the ARD areas represents the NFI assessment system with its systematic statistical grid across the whole area of Austria (see chapters 10.2.1 and 10.2.2). This system allows identifying the geographical location of ARD activities in a randomised way. The geographical result of ARD activities between the NFI periods 1991/96 and 2000/02 is given in Figure 37. As can be seen, ARD areas are spread across the whole country. Areas with fewer symbols are not necessarily areas of less ARD activity, but more frequently regions with less forest cover.

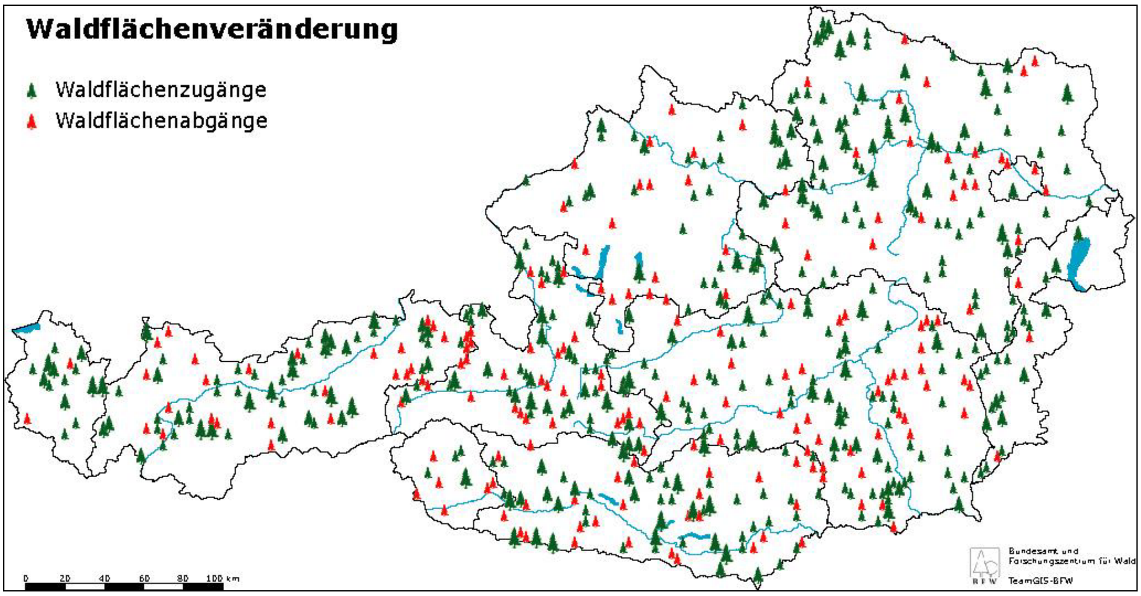


Figure 37: LUCs from and to forests between the NFI periods 1992/96 and 2000/02. The green tree symbols indicate AR areas, the red tree symbols D areas. The size of the symbol is related to the local size of these ARD areas (Russ 2004).

10.3 Activity-specific information

10.3.1 Methods for carbon stock changes and GHG emission and removal estimates

10.3.1.1 Description of the methodologies and the underlying assumptions used

The methodologies and assumptions used for the reporting under the Kyoto Protocol Art. 3.3. follow completely those for the areas of LUCs from and to forests (see Chapter 7.2.2 Land Use Changes to Forest Land - 5 A 2).

The methods to derive the activity data were described before in chapter 10.2.

The emission factors were estimated in the following manner:

Biomass

On basis of results from the NFIs the experts of the Federal Research and Training Centre for Forests, Natural Hazards and Landscape provided the following values for increment and drain at areas of LUC to and from forests (Schadauer, pers. comm.):

The annual increment of stemwood over bark (o.b.) on LUC areas to forests was estimated with 3 m^3 ha^{-1}. This value is used for the AR areas from all previous land use types.

The annual average loss of stemwood o.b. on D areas was estimated with 60 m^3 ha^{-1} on average for deciduous and coniferous trees. This value is used for the LUCs from forests to all other land use types.

Both of these values, increment and drain at ARD areas, are below the Austrian average and indicate the specific situation of these ARD areas. Due to the use of natural regeneration as well as due to the ecological conditions there is a slow increment at these AR areas. Also the D areas comprise to a large extent forests or parts of forests (e.g. the edges) that are not fully stocked but have a tree stock that lies clearly below the average of the Austrian forests. The recent NFI 2007/09 carried out a very detailed measurement of the biomass gains and losses at the ARD areas so that a more accurate reassessment of these estimated biomass gains and losses at the ARD areas will be possible.

Conversion factors (BEF)

In Table 274 the applied conversion factors for the gains and losses of the total living tree biomass (above and belowground biomass with no further division into coniferous and deciduous) at ARD areas are given. These factors are used to convert the increment and loss values in m^3 stemwood (as described in the paragraphs before) at the ARD areas to the t C of total tree biomass. They were derived from age specific BEFs for the main tree species in Austria (Weiss et al. 2000). A reassessment of these factors will be done with the available biomass functions for Austria that are already used to estimate the tree biomass changes for sector 5.A.

Table 274: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)	
increment	0.8
harvest	0.72
t dm whole tree → t C whole tree	0.49

For AR areas the calculation leads then to the following result of annual stock change in living biomass per ha:

$3*0.8*0.49=1.176$ t C ha^{-1} a^{-1}

This constant value is used for all AR areas and multiplied with the total AR areas.

For D areas the calculation leads to the following result of stock change in living biomass per ha in the year of D:

$60*0.72*0.49=21.168$ t C ha^{-1}

This value is then multiplied with the D area in the year of the D activity.

It should be noted that the previous biomass at AR areas before LUC and the following biomass at D areas after LUC is not accounted for. The rationale is that the estimated tree biomasses at ARD areas do not include the leaf biomass of the deciduous trees and the ground vegetation. The total AR areas since 1990 are much higher than the areas converted in the Kyoto-period (2008-2012) and the tree leaf biomass grows at all AR areas since 1990. This is different to the lost biomasses of the previous land uses that are only accounted at the AR areas in the period 2008-12. At D areas, the biomass gains of the new land uses after conversion is in almost all cases higher than the lost deciduous leaf biomass of the deforested trees. Therefore, this approach leads to an underestimate of the net biomass gains at AR areas and to an overestimate of the net losses of biomass at the D areas.

Dead wood

The assessment of stemwood stocks of the NFI also accounts for standing dead trees. Therefore, the estimated stemwood losses at areas of LUC from forests to other land uses also account for the loss of standing dead wood.

Due to the young age of the forests at AR areas and the assumed lack of dead wood at areas of all other land uses it is assumed that a stock change of dead wood does not occur at AR areas.

An accurate assessment of deadwood at ARD areas will be available with the NFI 2007/09. The new NFI assessment system of all biomass gains and losses at ARD areas detects any dead wood changes at ARD areas in the commitment period.

Soil

The estimates of the soil C stock changes at ARD areas include also changes in the litter and follow the equation below. The resulting stock changes are estimated to happen annually within the first 20 years after the ARD activity.

$$\Delta\ SOC = (SOC_0 - SOC_{0\text{-}T})/20$$

Δ SOC = average annual carbon stock change in soils and litter (t C ha^{-1} a^{-1}) over 20 years after the ARD activity

SOC_0 = carbon stock in soils and litter 20 years after conversion (e.g forest land→121 t C ha^{-1}, see Table 275)

$SOC_{0\text{-}T}$ = carbon stock in soils and litter before conversion (e.g. area weighted mean value of soil C stocks from grassland converted to forest land: 102 t C ha^{-1}, see Table 275)

The annual change in carbon stock of soils and litter at ARD areas equals Δ SOC * specific ARD area of the last 20 years. These estimates are carried out separately for all types of land use changes at ARD areas and their average soil C stock.

The input data for forest soil C stocks (121 t C ha^{-1}) represent 0–50 cm soil depth plus the complete humus layer (litter in sense of IPCC GPG) above the mineral soil. Therefore, the C stock changes described under soil C stock changes also account for the changes in litter at lands converted to or from forests (litter exists only in forest land).

The following soil C stocks for a depth of 0–50 cm have been used to calculate emissions/removals in soil due to ARD activities:

- Forests: 121 t C ha^{-1}, represents 0–50 cm depth of mineral soil plus the complete humus layer (litter in sense of IPCC GPG) above the mineral soil (UMWELTBUNDESAMT 2000)
- Cropland: 60 t C ha^{-1}, (GERZABEK et al. 2005)
- Vineyards: 58 t C ha^{-1}, (GERZABEK et al. 2005)
- Orchards/garden: land 78 t C ha^{-1}, (GERZABEK et al. 2005)
- Grassland (intensive use): 81 t C ha^{-1}, (GERZABEK et al. 2005)
- Grassland (extensive use) 119 t C ha^{-1} (GERZABEK et al. 2005).
- Bogs: 150 t C ha^{-1} (expert judgement)
- Surface waters and reed beds: 0 t C ha^{-1} (expert judgement)
- Settlements and traffic area: 60 t C ha^{-1} (expert judgement)
- Industrial and mining areas, dumps: 0 t C ha^{-1} (expert judgement)
- Alpine shrub lands: 119 t C ha^{-1} (KÖRNER et al. 1993)
- Rocks and stone slopes: 0 t C ha^{-1} (expert judgement)
- Other land uses: 30 t C ha^{-1} (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, which specifies the types of land use changes from and to forest land in a more detailed way than the existing six major land use categories (according to the list of the soil C stocks above), an area weighted mean value of soil C stock was calculated for each land use change category of the IPCC GPG (Table 275).

Table 275: Area weighted mean values for carbon stocks in soils (down to a depth of the mineral soil of 50 cm)[1] used for the ARD estimates and for the individual land use classes

Land use categories (IPCC – GPG)	**C-stocks (t ha^{-1}) in soils[1]**	
	AR estimates	**D estimates**
Forest land[1]	121	121
Cropland	61	62
Grassland	102	104
Wetland	30	0
Settlements	43	32
Other land	30	41

[1] The value for forest land represents 0–50 cm depth of mineral soil plus the complete humus layer (litter in sense of IPCC GPG) above the mineral soil

Planned improvements

By means of the recently carried out NFI (2007-2009) additional and specified data (e.g. for dead wood, detailed biomass assessments at ARD sites) were recorded to better meet the reporting requirements for Art. 3.3. This information will be available for the NIR 2011. These NFI results will also allow a revision of the activity data for the years since the previous NFI period (2000/02).

Changes in the litter stock will be reported no more included in the soil C pool but under the litter pool.

N_2O emissions at LUC areas from forests to cropland will be provided with the next submission.

A modelling study on the change of soil C stocks will be finalised in summer 2010 and will allow refinements of the estimates of the soil C stock changes at ARD areas.

10.3.1.2 Justification when omitting any carbon pool or GHG emissions/removals from activities under Article 3.3

No carbon pool is omitted.

Net carbon stock changes in litter are not reported separately. The used forest soil C stock includes the total humus layer (with the litter layer). So the estimates of the soil C stock changes account for the changes in the litter. Any further estimates for the litter layer would therefore lead to a double accounting of this carbon pool.

Deadwood is assumed not to occur on AR areas. Due to the young age of the forests at AR areas (since 1990) and the assumed lack of dead wood at areas of all other land uses it is assumed that a stock change of dead wood does not occur at AR areas. If there was any in the young forests of AR areas it would represent a C stock increase due to the lack of dead wood in the previous land uses. So, this assumption is conservative.

The assessment of stemwood stocks of the NFI also accounts for standing dead trees. Therefore, the estimated stemwood losses at D areas also account for the loss of standing dead wood.

More specific data on the occurrence of deadwood at AR-areas will be available with the NFI 2007/09. The new NFI assessment system of all biomass gains and losses at the ARD areas will detect any dead wood changes at ARD areas in the commitment period.

There is no practice of biomass burning at ARD areas in Austria. Furthermore, forests are not fertilised in Austria. So, fertilisation at AR areas and liming at ARD areas do not occur.

10.3.1.3 Information on whether or not indirect and natural GHG emissions and removals have been factored out

Due to a lack of available methods in the IPCC GPG and elsewhere, indirect and natural GHG emissions/removals have not been factored out.

10.3.1.4 Changes in data and methods since the previous submission (recalculations)

No recalculations were performed since the last submission.

10.3.1.5 Uncertainty estimates

A model based approach to assess the uncertainties of emissions/removals of the ARD units is planned for 2011.

10.3.1.6 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.

10.3.1.7 The year of the onset of an activity, if after 2008.

In 2008 the following ARD activities were presumed: AR at 9 700 ha, D at 4 500 ha.

10.4 Article 3.3

10.4.1 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.

10.4.1.1 Legal framework on forests and af-/reforestation – overview

The main legal basis around forest topics and forest assessment is the Austrian Forest Act. The Austrian Forest Act is valid for all forests in Austria. There exist forest implementation laws in most of the Federal Provinces of Austria, but they are containing only few provisions to specify some regulations of the Forest Act and do not change anything on the issue of forest, forest management and af-/reforestation as laid down by the Austrian Forest Act. Furthermore, there does not exist any EU legislation on forests, hence definitions and legal understanding of forest, af/reforestation, deforestation as well as forest management differs from member state to member state.

The Austrian Forest Act §1a (BGBl. Nr 440/1975 and amendments) defines forest as follows:

§ 1a

(1) Forest within the meaning of this Federal Act consists of basal areas stocked with woody plants of the categories listed in the Appendix (forestal plant cover), where the growing stock reaches an area of at least 1,000 m^2 and an average width of 10 m.

(2) Forest within the meaning of Subsection 1 also consists of basal areas of which the forestal plant cover has been temporarily reduced or removed as a result of being used for other reasons.

(3) Notwithstanding its particular use, forest within the meaning of Subsection 1 also consists of permanently unstocked basal areas where they are directly connected with forest in terms of space and forestry enterprise and contribute directly to its management (such as forestal hauling systems, wood storage places, forest glades).

(4) The following are not deemed to be forest within the meaning of Subsection 1

a) *notwithstanding other provisions of this Federal Act, basal areas which serve other purposes than that of forestry and where the plant cover of an age of at least 60 years has not reached a canopy cover of three tenths,*

b) *stocked areas which, because the structure of their plant cover is that of parks, predominantly serve purposes other than that of forestry,*

c) *shrub areas not used for forestry purposes with the exception of those which have been managed as coppice or which have been classified as protection forest (§ 23) or which have been declared protective forests (§ 30),*

d) *rows of trees where they are not shelter belts (§ 2 Subsection 3),*

e) *stocked areas which serve the immediate operation of a railway that is in existence at the time at which this Federal Act comes into force,*

f) *border areas within the meaning of § 1 paragraph 2 of the National Border Act, BGBl. No. 9/1974, insofar as they are to be kept free of plant cover based on national treaties regulating the surveying and demarcation of the national borders.*

The provisions of §§ 43 to 46 shall apply.

(5) Areas which are used in short rotation with a rotation period of up to thirty years as well as forest arboretums, forest seed orchards, Christmas tree plantations and plantations of woody plants for the purpose of obtaining fruits such as walnut or sweet chestnut, where they are not planted on forest soil and their owners have reported the intended operational use to the authority within ten years of carrying out the afforestation or establishing these facilities, shall not be deemed to be forest within the meaning of Subsection 1. Should no such report be made, § 4 shall apply.

(6) The provisions of §§ 43 to 45 shall apply to the sites listed in Subsection 5, first sentence, to forest arboretums and forest seed orchards additionally those of the Forestry Propagation Act.

(7) Forest, where the plant cover has a canopy of less than three-tenths, is referred to as a sparse stand, and forest soil with no plant cover is referred to as a clear felled area.

For the assessment of an area as forest only the definition of forest according to the Austrian Forest Act is legally binding. The Austrian forest law experts comment on basis of legal decisions the meaning of the Austrian Forest Act with respect to the land use classification in more detail: The legal consequence of the Austrian Forest Act is that any area that meets this definition becomes a forest independent from an allocation of that area to a different land use category within the property tax land register, within the borders land register or within the owners land register. In addition, any priority rights from property, ownership or servitude rights cannot change the forest status of an area that has become a forest according to the Austrian Forest Act (Jäger, 2003). The relevance of this legal binding frame for management operations is the following: Any change of land use management in a way that the resulting land cover meets the forest definition represents a legally binding land use change to forest.

The Austrian Forest Act also lays down the “public interest in the sustaining of forests”, which is expressed by the fundamental ban of deforestation in §17 (1). The consequence is the following: Once an area has become a forest (see above), a following land-use change would be deforestation (and the ending of an area as “forest”) in the sense of the law. However, this would be only possible under certain very limited circumstances (e.g. public interest in deforestation) and has to follow several administrative steps before being legally allowed. Therefore, the landowners have a legal need for activities to prevent an undesired re-growth of an area to a “forest” (“forest force”). As a consequence, the re-growth of an area as “forest” takes only place where desired and represents therefore a “direct human induced activity”.

With respect to the technique of af-/reforestation the following points are relevant: It is a frequent and often desirable forest management strategy in Austria to use the potential of natural re-growth caused, for instance, by the seed of adjacent forests (in line with the third technique of af-/reforestation listed in the Marrakesh-Accords). Reasons for that are i.a. lower economic costs and a better adaptation of the naturally re-grown trees to the local ecological conditions. Also here, the Austrian Forest Act qualifies such an activity as an appropriate management activity to reforest cleared areas (and, therefore, as a "direct human induced activity") and prioritizes it in comparison to other re-afforestation techniques:

The Austrian Forest Act §13 (BGBl. Nr 440/1975 and amendments):

§ 13. (3) Re-afforestation shall take place by means of natural regeneration, if there is a natural regeneration by seed, stool shoot or root sucker within a period of ten years, which gives rise to the expectation that the re-afforestation area will be fully stocked.

According to a decision by the "Administrative Court of Austria" (June 24th, 1996, Nr. 91/10/0168) it counts as "forest use" or "forest management" if an owner or a forest manager let an area to be re-afforested by natural regeneration.

In this context it is important to recognize, that in Austria areas are also subject to the provisions of the Forest Act in the case of natural regeneration. An area afforested by means of natural regeneration is also qualified as forest to be managed under the forest law according to Z 2 of § 4 Abs. 1 of the Forest Act:

New Afforestation

§ 4. (1) Basal areas which were not previously forest are subject to the provisions of this Federal Act in the case of:

1. afforestation (seed or planting) ten years after it has been carried out,
2. natural regeneration after reaching a canopy cover of five tenths of its area with a plant cover having a height of at least 3 meters.

The provisions of Section IV should nevertheless be applied as soon as plant cover exists.

(1a) The Federal Minister for Agriculture, Forestry, Environment and Water Management can determine, according to technical requirements in forestry, a plant cover height deviating from the provisions of Subsection 1 fig. 2

In the regulation of the Federal Minister for Agriculture, Forestry, Environment and Water Management, BGBl. II Nr. 25/2003, according to § 4 Abs. *1a of the Forest Act, for species (Alnus viridis, Pinus cembra, Pinus mugo), which are growing in high altitudes, the plant cover height is laid down with 1 meter.*

These forestry legal circumstances in Austria and the legal overruling capacity of the Austrian Forest Act with respect to the assessment of the property of an area as forest, is the reason and the legal frame work that – according to Austrian law – also qualify a stop of land management and the following re-growth of a forest as a "direct human induced activity" for the conversion of an area to a forest. The nature of a "decision" towards forest by the land owner is best expressed by the re-growth of forests. This regeneration would not be possible without a stop of the previous land management, so it must be desired by the land owner having in mind the automatic "forest force" due to Austrian law (besides, the land owner looses premium payments for grassland or cropland management).

10.4.1.2 Forest – definition

For its reporting under the Kyoto-Protocol Austria uses almost the same forest definition as laid down by the Austrian Forest Act (see chapter 10.4.1.1). The basis for the Austrian estimates of af-/reforestation are the results of the Austrian NFI. The NFI assesses at the plot level and within the Austrian wide grid if the forest definition according to the Austrian Forest Act § 1a is met. The assessment of all grid points of this Austrian wide grid within each NFI period secures that all forests in Austria (including all ARD activities) are identified in a randomized way. For the NFIs, a written technical instruction is available where all the assessed parameters are defined, including also the forest and non-forest definition (Schadauer et al. 2007, Schieler and Hauk 2001, **http://bfw.ac.at/700/pdf/da_ges_neu.pdf**). If this forest definition is met, any such area which was not forest before (in the previous NFI period) is detected as Af-/Reforestation area. There is only a slight difference in the definitions according to NFI: The minimum area for forest according to NFI is 500 m^2, while the Forest Act defines 1000 m^2. Theoretically this may result in a minor over-estimation of the af-/reforestation and deforestation area compared to the legal basis of the Forest Act. According to the statistical nature of the assessment the minor over-estimation from af-/reforestation is likely to be of the same magnitude than the over-estimation for deforestation.

10.4.1.3 Forest management – definition

According to the legal framework in Austria any forest area and, as a consequence, all AR areas represent areas under forest management and are as such reported (see chapter 10.4.1.4). The reason is that all Austrian forests are under the Austrian Forest Act which implies rights and obligations with regard to forest management for the land owners. This includes for instance: The need for reforestation of forests that lost their crown cover (§ 13 of the Forest Act), the necessity for forest pest control measures (§§ 43 to 45 of the Forest Act), needs for management measures that sustain the forests (§ 22 of the Forest Act), measures that prevent visitors from accidents along public paths (§ 176 (4) of the Forest Act).

In Austria also the forests in nature protected areas are qualified as forests according to the Forest Act and therefore all the above mentioned management-obligations have also to be fulfilled in these areas, if no exceptions are permitted by the forest-public authority (§ 32a of the Forest Act). There are only few such permissions, regarding negligible areas (less than 1 % of the Austrian forests), where partly exceptions have been permitted. Mostly, the provisions to af-/reafforestation and forest protection measures are only reduced but not cancelled. All forests in nature protected areas are managed to fulfill ecological and social functions and are subject to forest management.

The management of all the Austrian forests has to be consistent with the principles as defined in § 1 of the Austrian Forest Act.

§ 1 (2) of the Austrian Forest Act defines as aim of this law to secure the "sustainable forest management". The definition of forest management in Austria follows completely the decisions of the PAN European Process of the Forest Ministers that broadly define:

"Sustainable forest management comprises the tending and use of forests in a way and at a rate, that maintains their biodiversity, productivity, regeneration capacity, their vitality and their potential to fulfill, now and in the future relevant ecological, economic and social functions at local, national, and global levels, and that does not cause damage to other ecosystems. Notably precautions have to be taken with respect to the use of forests in view of the long production period and potential planning in order to ensure that the use of forest resources will also be preserved for future generations."

This broad definition of "forest management" is also in line with the related definitions in the IPCC GPG.

10.4.1.4 Reporting on forests in Austria

The forest area according to NFI is the basis for all international reporting of forest area in Austria. The figures may differ from report to report, but only due to different time periods under consideration and/or different definitions of forest that underlie the different reporting obligations.

As described in chapter 10.4.1.3 above, 100 % of the Austrian forests are under forest management. This is also reported internationally, for instance in the reports "State of Europe's Forest 2003" and "State of Europe's Forest 2007" under the "Ministerial Conference on The Protection of Forests in Europe" (MCPFE Liasion Unit and UNECE/FAO, 2003, 2007 http://www.foresteurope.org/filestore/mcpfe/Publications/pdf/state_of_europes_forests_2007.pdf).

Also for the actual FRA2010 of the FAO, 100 % of the Austrian forested area has been reported as under sustainable forest management (FRA 2010, Country Report Austria). Furthermore, Austria reported the same figures for the increase in forested area under FRA2010 as compared to the af-/reforestation areas under Article 3.3 of the Kyoto-Protocol (taking the different definitions into account).

10.4.1.5 Justification for Austria's accounting under Article 3 paragraph 3

The following elements are intended to document Austria's justification for accounting all forest area increases as "direct human induced" af-/reforestation:

a) The issue of forest land under management

According to chapters 10.4.1.3 and 10.4.1.4 all forest area in Austria is under forest management. Following the IPCC GPG (chapter 4.2.1, Table 4.2.1) a change to managed forest land always represents "direct human induced" af-/reforestation. Otherwise, unmanaged forest land would be "produced" while – in fact - unmanaged forests don't exist in Austria per definition. For the same reasons and symmetry, Austria reports every loss of forest land as deforestation under Article 3.3 of the Kyoto-Protocol (a conversion of managed forest land to a different land use must be "direct human induced").

b) Further considerations on "direct human induced"

Besides the fundamentals as described in chapter 10.4.1.2 above, the following arguments also support our view:

Our reading of the IPCC GPG on LULUCF suggests that the use of a broad definition of "direct human induced " Af-/Reforestation is valid. The statement that probably best expresses this is the 2nd but last paragraph (Chapter 4, p. 4.52) in the IPCC GPG on LULUCF:

"It is good practice to provide documentation that all afforestation and reforestation activities included in the identified units of land are direct human-induced. Relevant documentation includes forest management records or other documentation that demonstrates that a decision had been taken to replant or to allow forest regeneration by other means."

The second sentence of this paragraph is also in line with our reported AR areas and documentation. A discontinuation of any management of land not being a forest that leads to a forest is in our view evidence "that a decision had been taken to replant or to allow forest regeneration by other means" as there exists a legal basis which accounts this land use change also in an administrative sense and provides obligations for its forest management (that the af-/reforestated forests are under forest management).

The question on the af-/reforestation technique is in our understanding not the relevant one: The expression *"…to replant or to allow forest regeneration by other means"* is in our view a broad definition that includes also natural regeneration as an af-/reforestation technique (as does the definition of af-/reforestion in the Marrakech Accords). More relevant, however, may be the documentation around the issue (…*other documentation that demonstrates that a decision had been taken to replant or to allow…).*

c) Documentation material that supports Austria's approach

The following key documents were cited for Austria's justification:

The Austrian Forest Act with its definitions and implied understanding of "forest", "forest management" (broad definition) including afforestation/reforestation.

The cited parts of the Austrian Forest Act show that an area which meets the forest definition becomes a forest by law (independent from different assignments under other regulations). This "Forest-Force" overrules all other regulations and protects the af-/reforested areas from deforestation. Chapter 10.4.1.3 shows that all forests in Austria are forests under the Austrian Forest Act with related rights and obligations for the land owners (including an obligation for forest management). All land in Austria has some owner. These national circumstances result in that all Austrian forests are reported to be under forest management. Chapter 10.4.1.2 informs that natural regeneration is by law an accepted and frequently desired management technique to af-/reforest land.

The results of the NFI with regard to the increase in the forested area are the basis for the reported af-/reforestation area. The NFI covers the whole territory of Austria, and identifies in a randomized way all forested land and all changes in forested land. The instruction handbook of the NFI defines all assessed parameters (see Schadauer et al. 2007, Schieler and Hauk 2001, http://bfw.ac.at/700/pdf/da_ges_neu.pdf) and the procedure (including training of staff) guarantees that only areas, that meet the definition of forest are recognized as forested area.

Summary

Austria believes that there is well established documentation explaining that all LUC areas to forests are "direct human induced" AR lands in Austria. This is because all forests in Austria are managed ones according to the Forest Act and therefore in Austria there are no unmanaged forests even in the case of natural regeneration and independent of the land use before and because the NFI only identifies an area as a forested area if it meets the criteria of forests according to the Forest Act.

10.4.2 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 the results of forest management operations and Land Use Changes.

Af-/reforestated areas

fulfill 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:

1. The forest definition of Austrian NFI has ceased to apply.

And:

2. There are ***significant visible changes in soil structure or ground vegetation*** which do not go with the natural succession of a forest (e.g. 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).

Exceptions 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). Particularly, if point 2 is not clearly fulfilled an unstocked area remains 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 land owners into guaranteeing the regeneration of the forests (according to the criteria of the forest definition) on forest areas without sufficient crown cover within a defined time span. This legal framework represents the main reason why unstocked forest areas that do not clearly fulfil point 2 above are still assessed as forests by the NFI.

10.4.3 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

Austria reports no occurrence of harvesting on AR areas since 1990. Primarily due to the young 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 (2007/09) of the biomass and biomass losses at the ARD areas will detect any harvest at AR areas in the commitment period.

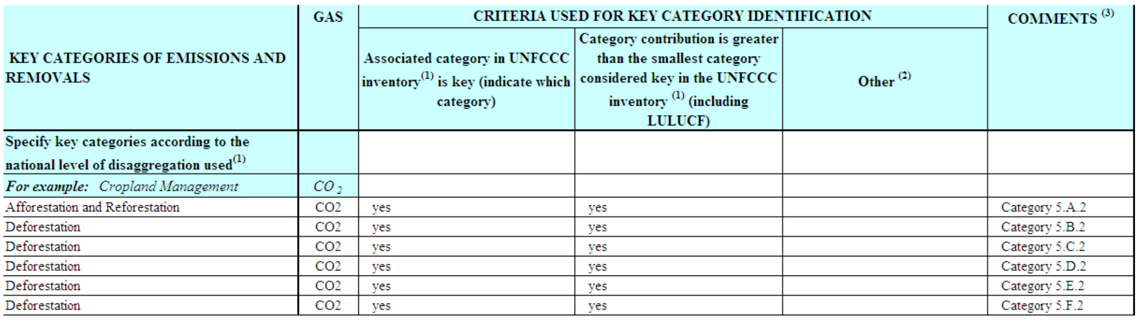
10.4.4 Information on the size and geographical location of forest areas that have lost forest cover but which are not yet classified as deforested

During the NFI assessments areas are immediately classified as being deforested or not using the criteria described in chapter 10.4.2. For the arguments given in this chapter, there exists no transition period. If a LUC is visible it is accounted, but the assessment of a LUC needs more criteria than just the loss of forest cover (see above).

10.5 Other information

10.5.1 Key category analysis for Article 3.3 activities and any elected activities under Article 3.4

Figure 38 shows that all land use changes from and to forests are considered as key categories.



KEY CATEGORIES OF EMISSIONS AND REMOVALS	GAS	CRITERIA USED FOR KEY CATEGORY IDENTIFICATION			COMMENTS [3]
		Associated category in UNFCCC inventory[1] is key (indicate which category)	Category contribution is greater than the smallest category considered key in the UNFCCC inventory [1] (including LULUCF)	Other [2]	
Specify key categories according to the national level of disaggregation used[1]					
For example: *Cropland Management*	*CO_2*				
Afforestation and Reforestation	CO2	yes	yes		Category 5.A.2
Deforestation	CO2	yes	yes		Category 5.B.2
Deforestation	CO2	yes	yes		Category 5.C.2
Deforestation	CO2	yes	yes		Category 5.D.2
Deforestation	CO2	yes	yes		Category 5.E.2
Deforestation	CO2	yes	yes		Category 5.F.2

Figure 38: Summary overview of key categories for LULUCF activities under the Kyoto Protocol (CRF – NIR 3 table).

10.6 Information related to Article 6

There are no Article 6 activities concerning the LULUCF sector in Austria.

11 INFORMATION ON ACCOUNTING OF KYOTO PROTOCOL UNITS

11.1 Background information

Annex I Parties are required to report from its national registry holding of and transaction of Kyoto units and inform about related issues. The following chapters serve this purpose.

11.2 Summary of information reported in the SEF tables

The standard electronic format (SEF) for providing information on ERUs, CERs, tCERs, lCERs, AAUs and RMUs for the year 2009 is submitted together with this report (SEF_AT_2010_2_9-56-8 5-3-2010.xls).

11.3 Discrepancies and notifications

Further information on KP units referring to the respective paragraphs of decision 15/CMP.1 is reported in the following list:

Paragraph 12: The discrepancies identified by the transaction log are listed in the document ‘SIAR reports 2009-AT v1.0’ in the report R-2 (see Annex 6).
Paragraph 13: No CDM notifications occurred in 2009. See report R-3 of the document ‘SIAR reports 2009-AT v1.0’ (see Annex 6).
Paragraph 14: No CDM notifications occurred in 2009. See report R-3 of the document ‘SIAR reports 2009-AT v1.0’ (see Annex 6).
Paragraph 15: No non-replacements occurred in 2009. See report R-4 of the document ‘SIAR reports 2009-AT v1.0’ (see Annex 6).
Paragraph 16: No invalid units exist as at 31 December 2009. See report R-5 of the document ‘SIAR reports 2009-AT v1.0’ (see Annex 6).
Paragraph 17: Actions necessary to correct any problem causing a discrepancy

In release 1.1.13.0, which went into production on 21 January 2010, the problem that the registry would propose units that were already proposed in another internal transaction was corrected. Concerning external transactions Austria participated in a developer’s working group aiming at changing the DES transaction message flow so that transactions are already finalized when they are completed in the ITL eliminating the final message from the transferring registry to the ITL. The implementation of this change will reduce the occurrence of the response codes 4003 and 4010.

11.4 Publicly accessible information

Section E of the annex to decision 15/CMP.1 outlines provisions for the national registry to support, via a user-interface, non-confidential information being made available to the public. Austria has made this information available on the website of the Austrian emissions trading registry: www.emissionshandelsregister.at

The following 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" provided that this information is non-confidential. Austria considers all information to be confidential that is determined to be confidential according to the EU Registry Regulation No 916/2007/EC.

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.

11.5 Calculation of the commitment period reserve (CPR)

According to paragraph 6 of the annex of decision 11/CMP.1 each Party included in Annex I shall maintain, in its national registry, a commitment period reserve which should not drop below 90 per cent of the Party's assigned amount calculated pursuant to Article 3, paragraphs 7 and 8, of the Kyoto Protocol, or 100 per cent of five times its most recently reviewed inventory, whichever is lowest.

Austria's assigned amount was fixed at 343 866 009 tonnes CO_2 equivalent in its initial review report[87]. 90% of this assigned amount is 309 479 408 tonnes CO_2 equivalent. 100 per cent of five times Austria's most recent inventory (2008) would result in 433 206 045 tonnes CO_2 equivalent (86 641 209 x 5), which is higher than 309 479 408 tonnes CO_2 equivalent. Therefore Austria's commitment period reserve is **309 479 408 tonnes CO_2 equivalent**.

11.6 KP-LULUCF accounting

Austria selected accounting of the KP-LULUCF activities at the end of the commitment period.

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[87] http://unfccc.int/resource/docs/2007/irr/aut.pdf

12 CHANGES IN THE NATIONAL SYSTEM

The national system is unchanged compared to the description given in the Austrian Initial Report under the Kyoto Protocol[88].

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[88] http://unfccc.int/files/national_reports/initial_reports_under_the_kyoto_protocol/application/pdf/at-initial-report-200611-corr.pdf

13 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 description of the changes in the Austrian National Registry since the previous submission in April 2009.

a) Registry Administrator

The name and contact information of the registry administrator designated by the Party to maintain the national registry

No change in the name or contact information of the registry administrator occurred during the reported period.

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

No change of cooperation arrangement occurred during the reported period.

c) Database structure and capacity

A description of the database structure of the national registry

No changes to the database or the capacity of the national registry occurred during the reported period.

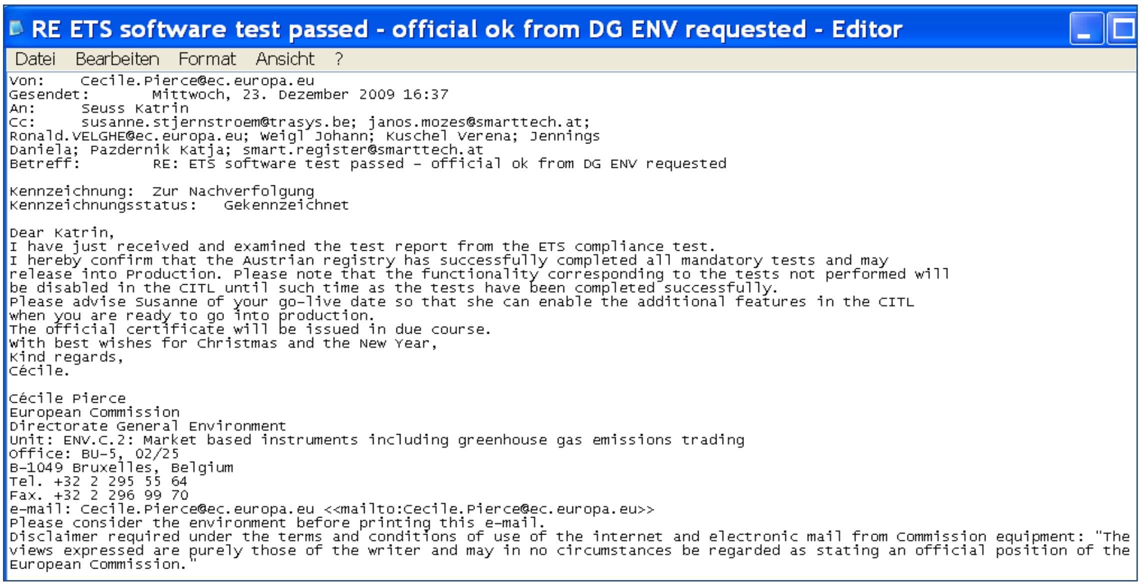
d) Conformity with Data Exchange Standards

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 the 1st Amendment of the Registry Regulation 917/2007/EC

In 2007 the EU Registry Regulation 2216/2004/EC was amended for the first time by Regulation 917/2007/EC. The changes to be implemented referred to the EU Emissions Trading Scheme, e.g. changes of the National Allocation Plan Table and additional information to be made available to the public.

The changes were implemented and tested in the Austrian registry in the course of 2009. Austria passed the official test with the European Commission on 23 December 2009 (ETS Testing Plan – see Annex 6). The EU Commission and the UNFCCC Secretariat had agreed that passing the EU tests will at the same time serve as authorization towards the UNFCCC Secretariat and the ITL to go live. The new software version 1.1.13.0 of the Austrian registry software was rolled out into production on 21 January 2010. The e-mail by the European Commission confirming the successful completion of the EU Tests and the authorization to go live is depicted in figure A 3. Austria has requested the official test certificate but not yet received it.



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Von:     Cecile.Pierce@ec.europa.eu
Gesendet:        Mittwoch, 23. Dezember 2009 16:37
An:      Seuss Katrin
Cc:      susanne.stjernstroem@trasys.be; janos.mozes@smarttech.at;
Ronald.VELGHE@ec.europa.eu; Weigl Johann; Kuschel Verena; Jennings
Daniela; Pazdernik Katja; smart.register@smarttech.at
Betreff:         RE: ETS software test passed - official ok from DG ENV requested

Kennzeichnung:  Zur Nachverfolgung
Kennzeichnungsstatus:   Gekennzeichnet

Dear Katrin,
I have just received and examined the test report from the ETS compliance test.
I hereby confirm that the Austrian registry has successfully completed all mandatory tests and may
release into Production. Please note that the functionality corresponding to the tests not performed will
be disabled in the CITL until such time as the tests have been completed successfully.
Please advise Susanne of your go-live date so that she can enable the additional features in the CITL
when you are ready to go into production.
The official certificate will be issued in due course.
With best wishes for Christmas and the New Year,
Kind regards,
Cécile.

Cécile Pierce
European Commission
Directorate General Environment
Unit: ENV.C.2: Market based instruments including greenhouse gas emissions trading
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European Commission."
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Figure 39: E-mail from Commission confirming the successful completion of the EU tests and authorization to go live with the new software version 1.1.13.0.

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

No changes of discrepancies procedures occurred during the reported period.

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.

No change of security measures occurred during the reporting period.

g) Publicly accessible information

A list of the information publicly accessible by means of the user interface to the national registry

Regulation 917/2007/EC amending the EU Registry Regulation 2216/2004/EC included additional and altered requirements of publicly accessible information including the following requirements that Austria has implemented in software version 1.1.13.0, which was put into production on 21 January 2010. The new reporting requirements are additional to the requirements in the annex to decision 13/CMP.1, heading E "Publicly accessible information", which are fulfilled by the Austrian registry and are not interfered with by additional reporting requirements under Regulation 917/2007/EC.

Annex XVI of Regulation 917/2007/EC:

Paragraph 3 (e): The date of the greenhouse gas permit's entry into force and the date of the opening of the account has to be displayed in the registry.

Paragraph 4 (a): Corrections of verified emissions in accordance with Article 51 for the installation related to the operator holding account for year X shall be displayed from 15 May onwards of year (X+1) in addition to verified emissions.

Paragraph 4 (c): a symbol identifying whether the installation related to the operator holding account did or did not surrender the necessary number of allowances for year X by 30 April of year (X+1) in accordance with point (e) of Article 6(2) of Directive 2003/87/EC and any subsequent changes to that status pursuant to corrections to verified emissions in accordance with Article 51 (4) of this Regulation shall be displayed from 15 May onwards of year (X+1). Depending on the installation's compliance status figure and the registry's operational status, the following symbols shall be displayed together with the following statements:

A "A number of allowances and Kyoto units greater than or equal to verified emissions were surrendered by 30 April"

B "A number of allowances and Kyoto units lower than verified emissions were surrendered by 30 April"

C "Verified emissions were not entered until 30 April"

D "Verified emissions were corrected by competent authority after 30 April of year X. The competent authority of the Member State decided that the installation is not in compliance for year X."

E "Verified emissions were corrected by competent authority after 30 April of year X. The competent authority of the Member State decided that the installation is in compliance for year X."

X "Entering verified emissions and/or surrendering was impossible until 30 April due to the allowance surrender process and/or verified emissions update process being suspended for the Member State's registry in accordance with Article 6(3)" '

Paragraph 4 (d): a symbol indicating if the installation's account is blocked in accordance with Article 27(1) shall be displayed from 31 March onwards of year (X+1).

Paragraph 4 (a):The national allocation plan table of each Member State, indicating the allocations to installations and the quantity of allowances reserved for later allocation or sale shall be displayed and updated whenever there is a correction to the national allocation plan table, clearly indicating where corrections were made.

h) The Internet address of the interface to its national registry

No change of the registry Internet address occurred during the reporting period.

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

No change of data integrity measures occurred during the reporting period.

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

As described under point d) Austria tested the software version 1.1.13.0 in the second half of 2009. Austria passed the official test with the European Commission on 23 December 2009. See Figure 39 for the e-mail confirming the successful completion of the tests and the authorization to go live with software version 1.1.13.0.

The EU Commission and the UNFCCC Secretariat had agreed that passing the EU tests will at the same time serve as authorization towards the UNFCCC Secretariat and the ITL to go live. The new software version 1.1.13.0 of the Austrian registry software was rolled out into production on 21 January 2010.

The official test plan for the EU test 'ETS Testing Plan 2009 (3).doc' is submitted together with this report (in Annex 6).

14 INFORMATION ON MINIMIZATION OF ADVERSE IMPACTS IN ACCORDANCE WITH ARTICLE 3, PARAGRAPH 14

23. Each Party in Annex I shall provide information relating to how it is striving, under Article 3, paragraph 14, of the Kyoto Protocol, to implement its commitments mentioned in Article 3, paragraph 1 of the Kyoto Protocol in such a way as to minimize adverse social, environmental and economic impacts on developing country Parties, particularly those identified in Article 4, paragraphs 8 and 9, of the Convention.

The Kyoto Protocol is, in principle and in general, designed to minimize adverse effects on specific sectors, specific industries or specific trade partners of a Party, including the adverse effects of climate change, on international trade, and social, environmental and economic impacts on other parties. This is due to the fact that it does not limit action to a single gas or sector, that the use of it's flexible mechanisms guarantees that possible impacts are distributed on various fields of action, that the Clean Development Mechanism aims at both promoting sustainable development in countries with continuing development needs and at reducing greenhouse gas emissions, and that it requests action to support the least developed countries. By striving to implement all the features that the Protocol has integrated Austria is naturally working to minimize not only adverse effects of climate change but also any adverse effects due to the reduction of greenhouse gases.

Austria is strongly promoting long term sustainable development and will hence have scarcely direct or indirect negative effects. In cases where adverse effects could occur, the following measures are/were undertaken:

- Adverse effects of climate change

Emission Trading could lead to carbon leakage and higher emissions in countries which do not have comparable environmental standards. To minimise that risk, according to EU Directive 2003/87/EG emission allowances are granted for free to companies with specific characteristics. (http://www.eu-emissionshandel.at)

- Social, environmental and economic impacts on developing countries

JI/CDM projects may in principle have negative side effects in the host countries. For example, projects for the production of biofuels might add to deforestation of forests and/or result in higher prices for food. The Austrian JI CDM Programme therefore has demanding social and environmental criteria to be eligible as an Austrian JI CDM project. The favoured project categories reflect the high priority that is given to technology transfer projects. http://www.public-consulting.at/de/portal/sterreichischesjicdmprogramm/)

Ensuring that any consequences of economic affairs are addressed Austria is improving its policies to eliminate potential negative impacts.

24. Parties included in Annex II, and other Parties included in Annex I that are in the position to do so, shall incorporate information on how they give priority, in implementing their commitments under Article 3, paragraph 14, to the following actions, based on relevant methodologies referred to in paragraph 11 of decision 31/CMP.1

(a) The progressive reduction or phasing out of market imperfections, fiscal incentives, tax and duty exemptions and subsidies in all greenhouse-gas-emitting sectors, taking into account the need for energy price reforms to reflect market prices and externalities.

Austria strives to phase out market imperfections that run counter to the objective of the Convention.

Market imperfections

Austria has reformed to a large extent its energy markets. Several Directives and Regulations reflect the continuous EU effort to reduce market imperfections

- Directive 2003/54/EC of the European Parliament and of the Council of 26 June 2003 concerning common rules for the internal market in electricity and repealing Directive 96/92EC
- Directive 2003/55/EC of the European Parliament and of the Council of 26 June 2003 concerning common rules for the internal market in natural gas and repealing Directive 98/30EC
- Council Directive 90/377/EEC of the 29 June 1990 concerning a Community procedure to improve the transparency of gas and electricity prices charged to industrial end-users
- Regulation (EC) No 1228/2003 of the European Parliament and of the Council of 26 June 2003 on conditions of access to the network for cross-border exchanges in electricity
- Directive 2004/17/EC of the European Parliament and of the Council of 31 March 2004 coordinating the procurement procedures of entities operating in the water, energy, transport and postal services sectors

On the other hand Austria uses fiscal incentives etc. as important instrument to advance the objectives of the Convention.

Fiscal incentives

Energy prices for road transport do not yet sufficiently reflect externalities. In the course of the Ökologisierungsgesetz 2007 (ÖkoG 2007) the Mineral Oil Tax Act 2005 (Mineralölsteuergesetz 2005) and the Normverbrauchsabgabegesetz (NoVA) were changed.

- Mineral Oil Tax

In July 2007 tax per liter diesel was raised at 5 Cent and is now 34.7 Cent per liter. Fuel was raised at 3 Cent and is now 44.2 Cent per liter.

- NoVA (from 1. July 2008, NoVA Ökologisierungsgesetz: BGBl. I Nr. 46/2008)

(1) newly authorized automobiles with a CO_2-emission of at most 120 g/km get a bonus of 300 Euro, (2) alternativly operated vehicles – Hybrid, E 85 , Methan in form of natural gas, hydrogen or liquefied gas – get a general bonus of 500 Euro and (3) newly authorized automobiles with a CO_2-emission of more than 160 g/km will have to pay 25 Euro for each gram over the threshold (until december 2009 the threshold was 180 g/km).

Consequences of the ecologisation of the NoVA for newly authorized automobiles are easily observable: (1) The shares of all alternativly operated vehicles have increased significantly, (2) From January 2008 until November 2009 the shares of small vehicles with emissions of less than 120 g/km have increased from 5% to 20% and (3) From January 2008 until November 2009 the shares of big vehicles with emissions over 180 g/km decreased from 21% to 11%.

Subventions Agriculture

ÖPUL 2007 (Österreichisches Programm für umweltgerechte Landwirtschaft)

Austria provides subsidies for farmes according to the programme for the promotion of agriculture that is extensive, appropriate to the environment, and protective of nature. The subsidised measures also lead to decreasing greenhouse gas emissions.

http://land.lebensministerium.at/article/articleview/62457/1/21409/

(b) Removing subsidies associated with the use of environmentally unsound and unsafe technologies

No subsidies for environmentally unsound technologies have been identified.

(c) Cooperating in the technological development of non-energy uses of fossil fuels, and supporting developing country Parties to this end

This technological field is not a high priority in the Austrian research policy.

(d) Cooperating in the development, diffusion and transfer of less-greenhouse-gas-emitting advanced fossil-fuel technologies, and/or technologies, relating to fossil fuels, that capture and store greenhouse gases, and encouraging their wider use; and facilitating the participation of the least developed countries and other non-Annex I Parties in this effort

The Austrian CDM Purchase Programme is an ambitious player in the global carbon market – ambitious not only in economic terms, but also in a political sense: more than 50 CDM projects were already put in place all over the world. But also the promotion of sustainable development through CDM through an equitable distribution of CDM projects is one of our key policy goals.

In this light we recently launched a "CDM in Africa" initiative, with a view to boosting the CDM in Ethiopia, Ghana and Uganda.

What makes the Austrian approach different from others is that it is holistic in scope. Austria addresses all issues – capacity, awareness, technical, methodological and financial restrictions – that are currently impeding the growth of the CDM in Sub Sahara Africa. http://www.ji-cdm-austria.at/de/portal/aboutus/currentissues/workshopsinafrica/

(e) Strengthening the capacity of developing country Parties identified in Article 4, paragraphs 8 and 9, of the Convention for improving efficiency in upstream and downstream activities relating to fossil fuels, taking into consideration the need to improve the environmental efficiency of these activities

Action has been taken in this regard via the Austrian initiative "CDM in Africa". A new renewable energy and energy efficiency programme for Africa has been launched recently. As a part of this project, Austria will (1) finance the calculation of country emissions factors in the three host countries of the Austrian initiative; (2) hold project design workshops with a focus on the application of these emissions factors; (3) support the development of new methodologies for the energy sector; and (4) address financial issues impeding the realisation of concrete projects.

(f) Assisting developing county Parties which are highly dependent on the export and consumption of fossil fuels in diversifying their economies.

Austria is a member of institutions and initiatives that have the exchange of research results and transfer of technology as a main target, e. g. the International Energy Agency and the Climate Technology Initiative. Bilateral assistance projects are another important means for transfer of technology which helps countries reducing their dependence on the consumption of fossil fuels.

- International Energy Agency (IEA)

Austria is a founding member of the International Energy Agency (IEA), which was founded in 1974. A lot of climate change issues are processed in so-called joint Implementation Agreements, where international partners collaborate on different research topics.

- Climate Technology Initiative

Austria is member of the Climate Technology, which was established in 1995 at the Conference of Parties to the UNFCCC and has a new status as an IEA Implementing Agreement since 2003. Its mission is to promote the objectives of the UNFCCC by fostering international cooperation for accelerated development and diffusion of climate friendly technologies and practises for all activities and greenhouse gases. The main principles of CTI are close collaboration with developing countries and economies in transition and partnership with stakeholders, including the private sector, non-government organisations (NGOs), and other international organisations. CTI performs a. o. capacity building and technical assistance for technology needs assessments as well as technology implementation activities and organizes seminars, symposia and training courses. **http://www.climatetech.net**

The long-standing relationship with Bhutan must be particularly highlighted, too. Austria is collaborating with the Department of Energy in Bhutan since several years in the field of hydropower infrastructure, maintenance and management training, rural electrification and efficient use of biomass. Information on Austria's support for Bhutan and several other countries with respect to sustainable energy supply can be found in Austria's National Communications under the Convention.

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 of 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" (not occurring)	for activities or processes in a particular source or sink category that do not occur within a country;
"NE" (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" (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" (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. 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" (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}

REFERENCES

ABFALLWIRTSCHAFT (2003): E.H. Reil, Fernwärme Wien: Situation der Monoverbrenner. In: Abfallwirtschaft und Klimaschutz. Umweltbundesamt, Oktober 2003, Wien.

AMLINGER, F.; PEYR, S.; HILDEBRANDT, U.; MÜSKEN, J.; CUHLS, C. & CLEMENS, J. (2005): Stand der Technik der Kompostierung. Grundlagenstudie. Bundesministerium für Land- und Forstwirtschaft, Umwelt und Wasserwirtschaft, Wien. http://www.umweltnet.at/article/articleview/30919/1/6954.

AMON B.; HOPFNER-SIXT K. & AMON T. (2002): Emission Inventory for the Agricultural Sector in Austria – Manure Management, Institute of Agricultural, Environmental and Energy Engineering (BOKU – University of Agriculture, Vienna), July 2002.

AMON, B.; MOITZI, G., SCHIMPL, M., KRYVORUCHKO, V. & WAGNER-ALT, C. (2002a): Methane, Nitrous Oxide and Ammonia Emissions from Management of Liquid Manures. Final Report November 2002. Research project no. 1107, BMLF GZ 24.002/24-IIA1a/98 and extension GZ 24.002/33-IIA1a/00. On behalf of Federal Ministry of Agriculture, Forestry, Environment and Water Management, and Federal Ministry for Education, Science and Culture. Vienna.

AMON, B.; KRYVORUCHKO, V. & AMON, T. (2006): Influence of different levels of covering on greenhouse gas and ammonia emissions from slurry stores. International Congress Series (ICS) No 1293 "2nd International Conference on Greenhouse Gases and Animal Agriculture.

AMON, B.; FRÖHLICH, M.; WEIßENSTEINER, R; ZABLATNIK, B. & AMON, T. (2007): Tierhaltung und Wirtschaftsdüngermanagement in Österreich. Endbericht Projekt Nr. 1 441. Auftraggeber: Bundesministerium für Land- und Forstwirtschaft, Umwelt- und Wasserwirtschaft, Wien.

AMON, B.; KRYVORUCHKO, V.; FRÖHLICH, M.; AMON, T.; PÖLLINGER, A.; MÖSENBACHER, I.; HAUSLEITNER, A. (2007a). Ammonia and greenhouse gas emissions from a straw flow system for fattening pigs: Housing and manure storage. Livestock Science 112, 199–207.

AMON, B. & HÖRTENHUBER, S. (2008): Revision der österreichischen Luftschadstoff-Inventur (OLI) für NH_3, NMVOC und NO_x; Sektor 4, Landwirtschaft. Endbericht. Universität für Bodenkultur, Institut für Landtechnik im Auftrag vom Umweltbundesamt. Wien (unpublished)

AMON, B. & HÖRTENHUBER, S. (2010): Revision of Austria's National Greenhouse Gas Inventory, Sector Agriculture. Final Report. Division of Agricultural Engineering (DAE) of the Department for Sustainable Agricultural Systems of the University of Natural Resources and Applied Life Sciences (BOKU), study on behalf of Umweltbundesamt GmbH. Wien (unpublished)

AMON, B (2010): expert judgement, personal communication. Vienna.

AMT DER BURGENLÄNDISCHEN LANDESREGIERUNG (1996): Bodenzustandsinventur Burgenland. Amt der Burgenländischen Landesregierung, Eisenstadt.

AMT DER KÄRNTNER LANDESREGIERUNG (1999): Kärntner Bodenzustandsinventur. Amt der Kärntner Landesregierung, Klagenfurt.

AMT DER NIEDERÖSTERREICHISCHEN LANDESREGIERUNG (1994): Bodenzustandsinventur Niederösterreich. Amt der Niederösterreichischen Landesregierung, St. Pölten.

AMT DER OBERÖSTERREICHISCHEN LANDESREGIERUNG (1993): Oberösterreichischer Bodenkataster – Bodenzustandsinventur 1993. Amt der Oberösterreichischen Landesregierung, Linz.

AMT DER SALZBURGER LANDESREGIERUNG (1993): Salzburger Bodenzustandsinventur. Amt der Salzburger Landesregierung, Salzburg.

AMT DER STEIERMÄRKISCHEN LANDESREGIERUNG (1988–1996): Steiermärkische Bodenschutzberichte 1988–1996. Amt der Steiermärkischen Landesregierung, Graz.

AMT DER TIROLER LANDESREGIERUNG (1988): Bericht über den Zustand der Tiroler Böden. Amt der Tiroler Landesregierung, Innsbruck.

ANGERER, T. (1997): Stand der Mechanisch-Biologischen Restabfallbehandlung vor der Deponierung (MBRVD) in Österreich. November 1997, MUL Leoben.

ANGERER, T. & FRÖHLICH, M. (2002): Thermisch Regenerative Oxidation als Verfahren der Abluftreinigung bei mechanisch-biologischen Anlagen zur Behandlung von Abfällen. Schriftenreihe des BMLFUW. Study is not published but can be made available to the ERT upon request.

BARBER, M.A.: (1996): (Alcan International Limited) Alcans's P-FKW Emission Reduction Program. A Case Study, Lecture at the U.S. EPA Workshop on P-FKW's. Washington DC, May 8th–9th 1996.

BARNERT (1998): Österreichisches Lackinstitut: Möglichkeiten und Grenzen umweltverträglicher Beschichtung (Lacke, Klebstoffe, Bautenschutzmittel, Holzschutzmittel). Wien.

BAUMELER, BRUNNER, FEHRINGER; KISLIAKOVA & SCHACHERMAYER (1998): Reduktion von Treibhausgasen durch Optimierung der Abfallwirtschaft. Schriftenreihe der Energieforschungsgemeinschaft im Verband der E-Werke Österreichs. Wien.

BELLAMY, P.H.; LOVELAND, P.J.; BRADLEY R.I.; LARK R.M.; KIRK, G.J.D. (2005): Carbon losses from all soils across England and Wales 1978–2003. Nature 437: 245–248.

BEV – Austrian Federal Office of Metrology and Surveying (2008): Regional Information derived from the Austrian real estate database (BEV – Austrian Federal Office of Metrology and Surveying, as of 1.1. of the respective year 2007).

BFW – Federal Research and Training Centre for Forests, Natural Hazards and Landscape (1992): Österreichische Waldbodenzustandsinventur. Mitteilungen der Forstlichen Bundesversuchsanstalt Wien, Vol. 168/I, Vol. 168/II, Federal Office and Research Centre for Forests, Wien.

BFW – Federal Research and Training Centre for Forests, Natural Hazards and Landscape (2004a): Österreichische Waldinventur 2000/02. CD-Rom, Federal Office and Research Centre for Forests, Wien.

BFW – Federal Research and Training Centre for Forests, Natural Hazards and Landscape (2004b): Österreichische Waldinventur 2000/02 – Hauptergebnisse. Praxis Information Nr. 3, Federal Office and Research Centre for Forests, Wien.

BFW – Federal Research and Training Centre for Forests, Natural Hazards and Landscape (2005): Annual growth indices. Personal communication, Federal Office and Research Centre for Forests, Wien.

BFW – Federal Research and Training Centre for Forests, Natural Hazards and Landscape (2006): Figures on needle, branch and root biomasses for the Austrian forests for the individual NFI periods. Personal communication, Federal Office and Research Centre for Forests, Wien.

BGBL. NR. 440/1975: Forest Act of the Republic of Austria. Federal Ministry of Agriculture, Forestry, Environment and Water Management – Vienna/Austria.

BITTERMANN, W. & GERHOLD, S. (1995): Wirtschaftliche Aspekte und Holzbilanz. In: Ökobilanz Wald. Östereichisches Statistisches Zentralamt, Forstliche Bundesversuchsanstalt (eds.), Statistik Austria, Wien, 99–110.

BMLFUW – Federal Ministry of Agriculture, Forestry, Environment and Water Management (1964–2003): Österreichische Waldberichte; Jahresberichte über die Forstwirtschaft. Edited annually by the Federal Ministry for Agriculture, Forestry, Environment and Water Management, Wien.

BMLFUW – Federal Ministry of Agriculture, Forestry, Environment and Water Management (1985, 1990, 1995, 2003): Grüner Bericht 1985,1990,1995, 2003. Bericht über die Lage der österreichischen Land- und Forstwirtschaft. Wien.

BMLFUW – Federal Ministry of Agriculture, Forestry, Environment and Water Management (2000–2008): Grüner Bericht 1999, 2000, 2002, 2005, 2006, 2007, 2008. Bericht über die Lage der österreichischen Landwirtschaft (Grüner Bericht gemäß § 9 des Landwirtschaftsgesetzes BGBl. Nr. 375/1992) Bundesministerium für Land- und Forstwirtschaft, Umwelt und Wasserwirtschaft, Wien. www.gruenerbericht.at.

BMLFUW (2000–2009): Grüner Bericht 1999, 2000, 2002, 2005, 2006, 2007, 2008, 2009. Bericht über die Situation der österreichischen Land- und Forstwirtschaft. Grüner Bericht gemäß § 9 des Landwirtschaftsgesetzes BGBl. Nr. 375/1992. Bundesministerium für Land- und Forstwirtschaft, Umwelt und Wasserwirtschaft, Wien. www.gruenerbericht.at.

BMLFUW – Federal Ministry of Agriculture, Forestry, Environment and Water Management (2004b): Abschätzung der Auswirkungen des Tanktourismus auf den Treibstoffverbrauch und die Entwicklung der CO_2-Emissionen in Österreich. November 2004, Wien.

BMLFUW – Federal Ministry of Agriculture, Forestry, Environment and Water Management (2006b): Kommunale Abwasserrichtlinie der EU – 91/271 EWG, Österreichischer Bericht 2006. Wien.

BMLFUW – Federal Ministry of Agriculture, Forestry, Environment and Water Management (2007): Sonderrichtlinie des Bundesministers für Land- und Forstwirtschaft, Umwelt und Wasserwirtschaft (BMLFUW) für das Österreichische Programm zur Förderung einer umweltgerechten, extensiven und den natürlichen Lebensraum schützenden Landwirtschaft. Anlage I, Anhänge zum Agrarumweltprogramm und zur Tierschutzmaßnahme (ÖPUL 2007).

BMLFUW – Federal Ministry of Agriculture, Forestry, Environment and Water Management (2008b): Kommunale Abwasserrichtlinie der EU – 91/271/EWG. Österreichischer Bericht 2008. Wien.

BMLFUW – Federal Ministry of Agriculture, Forestry, Environment and Water Management (2009): Kommunale Abwasserrichtlinie der EU – 91/271/EWG. Fragebogen 2009 der Europäischen Kommission – Überprüfung des Umsetzungsstandes in Österreich. Wien.

BMUJF – Bundesministerium für Umwelt, Jugend und Familie (1994a): CH_4-Emissionen in Österreich, Reihe Dokumentation, Band 6. Bundesministerium für Umwelt, Jugend und Familie, Wien.

BMUJF – Bundesministerium für Umwelt, Jugend und Familie (1994b): N_2O-Emissionen in Österreich. Endbericht zum Forschungsauftrag des BMUJF GZ 01 2943/2-I/7/94 vom 18. Mai 1994. Bundesministerium für Umwelt, Jugend und Familie, Wien.

BMWA–EB (1990): Energiebericht der Österreichischen Bundesregierung. Bundesministerium für wirtschaftliche Angelegenheiten, Wien.

BMWA–EB (1996): Energiebericht der Österreichischen Bundesregierung. Bundesministerium für wirtschaftliche Angelegenheiten, Wien.

BMWA–EB (2003): Energiebericht der Österreichischen Bundesregierung 2003. Bundesministerium für wirtschaftliche Angelegenheiten, Wien.

BORIS – Bodeninformationssystem des Umweltbundesamt. http://www.borisdaten.com.

BRITISH GEOLOGICAL SURVEY (2001): World Mineral Statistics 1995–1999. Keyworth, Nottingham: British Geological Survey.

BRITISH GEOLOGICAL SURVEY (2005): World mineral production 1999–2003. Keyworth, Nottingham: British Geological Survey.

BRITISH GEOLOGICAL SURVEY (2006): World mineral production 2000–2004. Keyworth, Nottingham: British Geological Survey.

BRITISH GEOLOGICAL SURVEY (2007): World mineral production 2001–2005. Keyworth, Nottingham: British Geological Survey.

BRITISH GEOLOGICAL SURVEY (2008): World mineral production 2002–2006. Keyworth, Nottingham: British Geological Survey.

BUNDESABFALLWIRTSCHAFTSPLAN (BAWP): Bundesabfallbericht 1995. Bundesministerium für Umwelt, Jugend und Familie, Wien.

BUNDESABFALLWIRTSCHAFTSPLAN (BAWP): Bundesabfallbericht 2001, Bundesministerium für Land- und Forstwirtschaft, Umwelt und Wasserwirtschaft, Wien.

BUNDESABFALLWIRTSCHAFTSPLAN (BAWP): Bundesabfallbericht 2006, Bundesministerium für Land- und Forstwirtschaft, Umwelt und Wasserwirtschaft, Wien 2006. Latest (2008) of the annual updates of specific chapters: Statusbericht 2008. http://www.bundesabfallwirtschaftsplan.at/filemanager/download/34724.

BUNDESANSTALT FÜR AGRARWIRTSCHAFT (2009): Federal Institute of Agricultural Economics. Download from data pool http://www.awi.bmlfuw.gv.at/framesets/datapoolframeset.html.

BUWAL – Bundesamt für Umwelt, Wald und Landschaft (1995): Emissionsfaktoren für stationäre Quellen. Bundesamt für Umwelt, Wald und Landschaft, Bern.

CHARLES, D.; JONES, B.M.R.; SALWAY, A.G.; EGGLESTON, H.S. & MILNE, R. (1998): Treatment of Uncertainties for National Estimates of Greenhouse Gas Emissions, AEA Technology: Culham, UK.; AEAT-2688-1.

DETZEL, A; VOGT, R & FEHRENBACH, H. et al. (2003): Anpassung der deutschen Methodik zur rechnerischen Emissionsermittlung an internationalen Richtlinien. Institut für angewandte Ökologie (IFEU). Institute for Applied Ecology.

DOEDENS, H.; CUHLS, C.; MÖNKEBERG, F.; LEVSEN, K.; KRUPPA, J.; SÄNGER, U. & KOCK, H. (1999): Bilanzierung von Umweltchemikalien bei der biologischen Vorbehandlung von Restabfällen, Phase 2: Emissionen, Schadstoffbilanzen und Abluftbehandlung. BMB+F Verbundvorhaben: Mechanisch-biologische Vorbehandlung von zu deponierenden Abfällen.

DÖHLER, H., DÄMMGEN, U., BERG, W., BERGSCHMIDT, A., BRUNSCH, R., EURICH-MENDEN, B., LÜTTICH, M. & OSTERBURG, B. (2001): Anpassung der deutschen Methodik zur rechnerischen Emissionsermittlung an internationale Richtlinien und Prognose der Ammoniak-Emissionen der deutschen Landwirtschaft und Szenarien zu deren Minderung bis zum Jahre 2010. Final Report for Bundesministerium für Verbraucherschutz, Ernährung und Landwirtschaft and Umweltbundesamt.

DÖRFLINGER, A.; HIETZ, P.; MAIER, R.; PUNZ, W. & FUSSENEGGER, K. (1995): Ökosystem Großstadt Wien – Quantifizierung ökologischer Parameter unter besonderer Berücksichtigung der Vegetation; Bundesministerium für Wissenschaft und Forschung und MA 22.

ECKMÜLLNER O. (2006): Allometric relations to estimate needle and branch mass of Norway spruce and Scots pine in Austria. Austrian Journal on Forest Science, Special Issue on Austrian biomassfunctions. 123. Jg., Heft 1/2, 7-16.

E-CONTROL (2009): Ökostrombericht 2009. Bericht der Energie-Control GmbH gemäß § 25 Abs 1 Ökostromgesetz. Juli 2009. Wien.

EEA – European Environment Agency (1999): EMEP/CORINAIR Emission Inventory Guidebook – Second Edition, Prepared by the EMEP Task Force on Emission Inventories, Edited by Stephen Richardson Task Force Secretary. Technical Report No. 30. Copenhagen 1999.

EEA – European Environment Agency (2007): EMEP/CORINAIR Emission Inventory Guidebook – 2007, Technical report No 16/2007. Copenhagen.

EEA – European Environment Agency (2009): EMEP/EEA air pollutant emission inventory guidebook — 2009. Technical report No 6/2009. Copenhagen.

EIDGENÖSSISCHE FORSCHUNGSANSTALT FÜR AGRARÖKOLOGIE UND LANDBAU ZÜRICH-RECKENHOLZ, Institut Für Umweltschutz und Landwirtschaft Liebefeld (eds.) (1997): Ammoniak-Emissionen in der Schweiz: Ausmass und technische Beurteilung des Reduktionspotentials. Schriftenreihe FAL 26. Eidgenössische Forschungsanstalt für Agrarökologie und Landbau, Zürich.

EUROSTAT (2008): Structural business statistics (NACE Rev.1.1) – online statistics. Luxembourg. http://epp.eurostat.ec.europa.eu.

FAO AGR. STATISTICAL SYSTEM (2001): FAO Agricultural Statistical System. http://apps.fao.org/page/-collections?-subset-=agriculture.

FAOSTAT (2005): Online statistics of the FAO. http://faostat.fao.org/faostat/form?collection=Trade.CropsLivestockProducts&Domain=Trade&servlet=1&hasbulk=&version=ext&language=EN.

FAO: Country Report Austria. Rome. in print

FRA (2010): Country Report Austria: Global Forest Resources Assessment 2010

FRANKHAUSER JOHANNES (2007): Personal Communication, Austrian Chamber of Agriculture, May. Vienna.

FREIBAUER, A. & KALTSCHMITT, M. (2001): Biogenic greenhouse gas emissions from agriculture in Europe. European Summary Report (Project Report Task 3) of the EU-Concerted Action FAIR3-CT96-1877 "Biogenic Emissions of Greenhouse Gases Caused by Arable and Animal Agriculture".

GEBETSROITHER E.; STREBL F. & ORTHOFER R. (2002): Greenhouse Gas Emissions from Enteric Fermentation in Austria; Report ARC-S-0175. ARC Seibersdorf research, July 2002.

GERZABEK, M. H.; STREBL, F.; TULIPAN, M. & SCHWARZ S. (2003): Quantification of carbon pools in agriculturally used soils of Austria by use of a soil information system as basis for the Austrian carbon balance model. OECD Expert Meeting: Soil Organic Carbon and Agriculture: Developing Indicators for Policy Analyses, C. A. S. Smith (ed., 14–18 October 2002, Ottawa, Canada), Agriculture and Agri-Food Canada, Ottawa, CA & Organisation of Economic Co-operation and Development, Paris, FR.

GERZABEK, M. H., STREBL F., TULIPAN M. & SCHWARZ S. (2005): Quantification of organic carbon pools for Austria's agricultural soils using a soil information system. Can. J. Soil Sci. 85, 491–498.

GEWÄSSERSCHUTZBERICHT (1993, 1996, 1999, 2002): Gewässerschutzbericht gemäß § 33e Wasserrechtsgesetz BGBl. Nr. 215/1959 i.d.F. BGBl. I Nr. 156/2002. Bundesministerium für Land- und Forstwirtschaft, Umwelt und Wasserwirtschaft, Wien.

GIBBS, M. (ICF Inc.) & JACOBS, C. (US EPA); (1996) Reducing P-FKW Emissions from Primary Aluminium Production in the USA, from: Light Metal Age, February 1996.

GILBERG et al. (2005): Waste management in Europe and the Landfill Directive, Background paper from the ETC/RWM to the ETC/ACC workshop „Inventories and Projections of Greenhouse Gas Emissions from Waste". European Environment Agency.

Good Practice Guidance for CLRTAP Emission Inventories – Draft chapter for the UNECE Corinair Guidebook on Emissions inventories, Tino Pulles, Jon van Aardenne, European Topic centre on air and climate change (ETC/ACC), November 2001.

GRABNER, R.; KLATZER, R.; MEIER, W.; STEINWIDDER, A.; STÖGER, E. & TOIFL, G. (2004): Mutterkuh- und Ochsenhaltung 2003. Ergebnisse und Konsequenzen der Betriebszweigauswertung aus den Arbeitskreisen Mutterkuh und Ochsenhaltung [Husbandry of mother cows and bullocks 2003]. Bundesministerium für Land- und Forstwirtschaft, Umwelt und Wasserwirtschaft, Wien.

GRUBER & STEINWIDDER (1996): Einfluß der Fütterung auf die Stickstoff- und Phosphorausscheidung landwirtschaftlicher Nutztiere – Modellkalkulationen auf Basis einer Literaturübersicht. In: Die Bodenkultur – Austrian Journal of Agricultural Research, 47. Band/Heft 4/Dezember 1996/ISBN 0006-5471, WUV-Universitätsverlag, Wien.

GRUBER, L. & PÖTSCH, E. M. (2006): Calculation of nitrogen excretion of dairy cows in Austria. Die Bodenkultur, 2006, Vol. 57, Heft 1–4, Vienna.

GSCHWANTNER TH. & SCHADAUER K. (2006): Branch biomass functions for broadleaved tree species in Austria. Austrian Journal on Forest Science, Special Issue on Austrian biomassfunctions. 123. Jg., Heft 1/2, 17-34.

HACKL, A. & MAUSCHITZ, G. (1996): Methangas und Kohlendioxid aus der Bereitstellung in Österreich genutzter Energieträger. TU-Wien, Wien, 1996.

HACKL, A. & MAUSCHITZ, G. (1995, 1997, 2001, 2003, 2007): Emissionen aus Anlagen der österreichischen Zementindustrie.

HACKL, A. & MAUSCHITZ, G. (1999): Beiträge zum Klimaschutz durch nachhaltige Restmüllbehandlung. Studie im Auftrag des Bundesministeriums für Umwelt, Jugend und Familie, Weitra.

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.

HANDLER, F. (2003): Abschätzung des Dieselverbrauchs in der österreichischen Landwirtschaft; Bundesanstalt für Landtechnik; BLT-Wieselburg.

HARNISCH, J. & SCHWARZ, W. (2003): Final Report on the Costs and the impact on emissions of potential regulatory framework for reducing emissions of hydrofluorocarbons, perfluorocarbons and sulphur hexafluoride. European Commission (DG ENV).

HARRISON, K.G. (1996): Using bulk soil radiocarbon measurements to estimate soil organic matter turnover times: Implications for atmospheric CO_2 levels. Radiocarbon 38 (2): 181–190.

HARRISON, K.G.; BROECKER, W. & BONANI, G. (1993a): A strategy for estimating the impact of CO_2 fertilization on soil carbon storage. Global Biogeochem. Cycles 7 (1), 69–80.

HARRISON, K.G.; BROECKER, W. & BONANI, G.; (1993b) The effect of changing land use on soil radiocarbon. Science 262, 725–726.

HARRISON, K.G.; POST, W.M. & RICHTER, D.D. (1995) Soil carbon turnover in a recovering temperate forest. Global Biogeochem. Cycles 9 (4), 449–454.

HASENAUER, H.; NEMANI, R.R.; SCHADAUER, K. & RUNNING, S.W. (1999a): Forest growth response to changing climate between 1961 and 1990. Forest Ecology and Management 122: 209–219.

HASENAUER, H.; NEMANI, R.R.; SCHADAUER, K. & RUNNING, S.W. (1999b): Climate variations and tree growth between 1961 and 1995 in Austria. In: Karjalainen, T.; Spiecker, H. & Laroussini, O. (eds.): Causes and consequences of accelerating tree growth in Europe. European Forest Institute Joensuu, Proceedings No. 27: 75–86.

HAUSBERGER, S. (1998): GLOBEMI – Globale Modellbildung für Emissions- und Verbrauchsszenarien im Verkehrssektor; Institute for Internal Combustion and Thermodynamics. University of Technology Graz; Volume 71; Graz.

HAUSBERGER, S. (2004): Straßenverkehrsemissionen und Emissionen sonstiger mobiler Quellen Österreichs – gemäß CORINAIR-Methodik – für die Jahre 1990 bis 2002. FVT – Forschungsgesellschaft für Verbrennungskraftmaschinen und Thermodynamik mbH. Erstellt im Auftrag des Umweltbundesamt, Graz.

HÄUSLER, J. (2009): Das Leistungspotenzial von Fleckviehmutterkühen – Versuchsergebnisse des LFZ Raumberg-Gumpenstein. Fachtag „Erfolgreiche Mutterkuhhaltung“ Fachschule Warth.

UMWELTBUNDESAMT (2001c): Häusler, G.: Emissionen aus Abfalldeponien 1980–1998, Interner Bericht, Bd. IB-623. Umweltbundesamt, Wien.

HEIM, P. (2005): Fütterung von Kuh und Kalb. [Feeding of mother cow and calve]. Article in UFA-Revue 3/05, an agricultural journal of Switzerland.

HIEBLER, GAMSJÄGER & GOD: Vergleich von metallurgisch und thermisch bedingten CO_2 Emissionen. Montanuniversität Leoben.

HOCHBICHLER E., BELLOS P. & LICK E. (2006): Biomass functions and expansion factors for spruce, pine, beech and oak in Austria. Austrian Journal on Forest Science, Special Issue on Austrian biomass-functions. 123. Jg., Heft 1/2, 35-46.

http://www.ama.at/Portal.Node/ama/public?gentics.rm=PCP&gentics.pm=gti_full&p.contentid=10008.47092&SRL_O4_20071126.pdf

IEA JQ (2007): IEA/EUROSTAT Joint Questionnaire Submission 2007. Statistik Austria, Vienna.

IPCC (2006): 2006 IPCC Guidelines for National Greenhouse Gas Inventories, Prepared by the National Greenhouse Gas Inventories Programme, Eggleston H.S., Buenida L., Miwa K., Ngara T., and Tanabe K. (eds.), IGES, Hayama.

IPCC (1997): Revised 1996 IPCC Guidelines for National Greenhouse Gas Inventories, Vol. 1: Reporting Instructions, Vol. 2: Workbook, Vol. 3: Reference Manual. Intergovernmental Panel on Climate Change, Edited by J.T. Houghton, L.G. Meira Filho, B. Lim, K. Tréanton, I. Mamaty, Y. Bonduki, D.J. Griggs and B.A. Callander, Genf.

IPCC (2000): Report on Good Practice Guidance and Uncertainty Management in National Greenhouse Gas Inventories (IPCC Good Practice Report). Edited by J. Penman, D. Kruger, I. Galbally, T. Hiraishi, B. Nyenzi, S. Emmanuel, L. Buendia, R. Hoppaus, T. Martinsen, J. Meijer, K. Miwa and K. Tanabe, Japan.

IPCC (2003): Good Practice Guidance for Land Use, Land-Use Change and Forestry. Edited by J. Penman, M. Gytarsky, T. Hiraishi, T. Krug, D. Kruger, R. Pipatti, L. Buendia, K. Miwa, T. Ngara, K. Tanabe and F. Wagner.

JÄGER, T. (2003): Forstrecht. 3rd Edition, Verlag Österreich, Wien.

KALIVODA, M. et al (2002): Air Traffic Emission Calculation for Austria 1990–2000, study commissioned by Umweltbundesamt, Wien. Study has not been published, but can be made available upon request.

KAUSEL, A. (1998): Ein halbes Jahrhundert des Erfolges, Der ökonomische Aufstieg Österreichs im OECD-Raum seit 1950. Österreichische Nationalbank, Wien.

KIRNER, SCHNEEBERGER (1999): Strukturanalyse der Betriebe mit der ÖPUL-Maßnahme "Verzicht auf bestimmte ertragssteigernde Betriebsmittel (Betrieb)". Der Förderungsdienst 47(6).

KOLLMANN F. (1982): Technologie des Holzes und der Holzwerkstoffe. 1. Band, 2. Aufl., Springer-Verlag, Berlin, Heidelberg, New York.

KONRAD, S. (1995): Die Rinder-, Schweine- und Legehennenhaltung in Österreich aus ethologischer Sicht, WUV Universitätsverlag, Wien.

KÖRNER, C.; SCHILCHER, B. & PELAEZ-RIEDL, S. (1993): Bestandsaufsaufnahme anthropogene Klimaänderungen: Mögliche Auswirkungen auf Österreich – Mögliche Maßnahmen. Dokumentation, Kapitel 6.1. Österreichische Akademie der Wissenschaften. Wien.

Lahl U., Zeschmar-Lahl B. & Scheidl K. (1998): Abluftemissionen aus der mechanisch-biologischen Abfallbehandlung in Österreich. Klagenfurt.

Lahl U., Zeschmar-Lahl B. & Angerer T. (2000): Entwicklungspotentiale der mechanisch-biologischen Abfallbehandlung. Eine ökologische Analyse. Wien.

Ledermann T. & Neumann M. (2006): Biomass equations from data of old long-term experimental plots. Austrian Journal on Forest Science, Special Issue on Austrian biomassfunctions. 123. Jg., Heft 1/2, 47-64.

Leisewitz, A.; Schwarz, W. (2010): Service contract on the estimation of consumption and emissions of fluorinated gases in Austria. Prepared for Umweltbundesamt Wien. Final Report (in preparation).

Lohmann, U. (1987): Holzhandbuch. 3. Aufl., DRW-Verlag, Leinfelden-Echterdingen.

Löhr, L. (1990): Faustzahlen für den Landwirt.

Mauschitz, G. (2004): Emissionen aus Anlagen der österreichischen Zementindustrie. TU Wien.

Menzi, H , Ruettimann, L , Reidy, B (2003): DYNAMO: A new calculation model for dynamic emission inventories for ammonia. Proc. International Symposium 'Gaseous and odour emissions from animal production facilities', Horsens, Denmark, June 1-4.

MCPFE Liaison Unit and UNECE/FAO (2003): "State of Europe's Forest 2003". Ministerial Conference on the Protection of Forests in Europe, Liaison Unit Vienna, ISBN 3-902073-09-8.

MCPFE Liaison Unit and UNECE/FAO (2007): "State of Europe's Forest 2007". Ministerial Conference on the Protection of Forests in Europe, Liaison Unit Warsaw, ISBN 10-83-922396-8-7.

MEET (1999): MEET – Methodology for calculating transport emissions and energy consumption. European Commission, DG VII, Belgium.

Monni, S. & Syri S. (2003): Uncertainties in the Finnish 2001 Greenhouse Gas Emission Inventory. VTT RESEARCH NOTES 2209, Espoo.

Nestroy, O., Danneberg, O. H. & Englisch, M. (2000): Systematische Gliederung der Böden Österreichs (Österreichische Bodensystematik 2000). Mitt. d. Österr. Bodenkundl. Ges., H. 60, Wien.

Obernosterer, R.; Smutny, R. & Jäger, E. (2004): HFKW Gase in Dämmschäumen des Bauwesens. Internal Report. Umweltbundesamt, Wien. Study has not been published, but can be made available upon request.

Offenthaler I. & Hochbichler E. (2006): Estimation of root biomass for Austrian forest tree species. Austrian Journal on Forest Science, Special Issue on Austrian biomassfunctions. 123. Jg., Heft 1/2, 65-86.

ÖIGV – Österreichischer Industriegaseverband (2007): N_2O use in medical and industrial field (personal communication), Schwechat.

Ökoinstitut (2002): Öko Institut e.V., Institut für angewandte Ökologie, April 2002, Freiburg, Darmstadt, Berlin.

Orthofer R., Knoflacher M. & Züger J. (1995): N_2O-Emissionen in Österreich. Seibersdorf Research, Seibersdorf.

Orthofer, R., Knoflacher, M. & Züger,J. (1994): N_2O-Emissionen in Österreich. Seibersdorf Research Report OEFZS-A–3256, Seibersdorf.

Philippitsch, R., Grath, J., Schimon, W. Gmeiner, C. Deutsch, K. Gruber, D. Tomek, H. Bonani, M. & Lassnig M. (2001): Wassergüte in Österreich. Jahresbericht 2000 ("Austrian water protection report"). Erhebung der Wassergüte gemäß Hydrographiegesetz (BGBl. Nr. 252/90, i.d.g.F.). Bundesministerium für Land- und Forstwirtschaft, Umwelt und Wasserwirtschaft in Zusammenarbeit mit dem Umweltbundesamt, Wien.

PISCHINGER, R. (2000): Emissionen des Off-Road-Verkehrs im Bundesgebiet Österreich für die Bezugsjahre 1990 bis 1999. Institut für Verbrennungskraftmaschinen und Thermodynamik TU Graz, Graz.

PÖLLINGER, A. (2008): national expert at the Agricultural Research and Education Centre Raumberg-Gumpenstein. Expert judgement to AWMS distribution 1990-2008 carried out in June 2008. Vienna.

PÖTSCH, E.M.; GRUBER, L. & STEINWIDDER, A. (2005): Answers and comments on the additional questions, following the meeting in Bruxelles. Internal statement, HBLFA Raumberg-Gumpenstein.

RAMIREZ, A.; DE KEIZER, C.; & VAN DER SLUIJS, J. P. (2006): Monte Carlo Analysis of Uncertainties in the Netherlands Greenhouse Gas Emission Inventory for 1990–2004. Report NWS-E-2006-58, Copernicus Institute for Sustainable Development and Innovation, Utrecht.

REIDY, B , MENZI, H (2005): Ammoniakemissionen in der Schweiz: Neues Emissionsinventar 1990 bis 2000 mit Hochrechungen bis 2003 Technischer Schlussbericht Schweizerische Hochschule für Zollikofen.

REIDY, B , RIHM, B , MENZI, H (2007): A new Swiss inventory of ammonia emissions from agriculture based on a survey on farm and manure management and farm-specific model calculations, Reference: AEA7495, IN Journal: Atmospheric Environment.

Reidy, B.; Dämmgen, U.; Döhler, H.; Eurich-Menden, B.; Evert, F. K. van; Hutchings, N. J.; Luesink, H. H.; Menzi, H.; Misselbrook, T. H.; Monteny, G.J.; Webb, J. (2008): Comparison of models used for national agricultural ammonia emission inventories in Europe : liquid manure systems. Atmospheric environment, Band 42, Heft 14, Seite 3452-3464, englisch. ISSN: 0004-6981.

Reidy, B.; Webb, J.; Misselbrook, T.H.; Menzi, H.; Luesink, H.H.; Hutchings, N.J.; Eurich-Menden, B.; Döhler, H.; Dämmgen, U. (2009): Comparison of models used for national agricultural ammonia emission inventories in Europe: Litter-based manure systems. Atmospheric environment, Band 43, Heft 9, Seite 1632-1640, englisch. ISSN: 0004-6981

RUBATSCHER D., MUNK K., STÖHR D., BAHN M., MADER-OBERHAMMER M. & CERNUSCA A. (2006): Biomass expansion functions for Larix decidua: a contribution to the estimation of forest carbon stocks. Austrian Journal on Forest Science, Special Issue on Austrian biomassfunctions. 123. Jg., Heft 1/2, 86-101.

RUSS W. (2004): Mehr Wald – ein positiver Trend? BFW Praxis Information 3/2004, pp. 4-7, Federal Research and Training Centre for Forests, Natural Hazards and Landscape, Vienna, download at: http://bfw.ac.at/700/pdf/BFW_praxis2004_kl.pdf

RWA (2008): Expert judgement based on annual sales data of urea. Personal communication, Raiffeisen Ware Austria AG, Wien.

RWA (2009): Expert judgement based on annual sales data of urea. Personal communication, Raiffeisen Ware Austria AG, Wien.

RYPDAL, K. (1999): Evaluation of uncertainty in the Norwegian emission inventory, Norwegian Pollution Control Authority, Oslo, Norway, Report 99:01.

SAEFL – Swiss Agency for the Environment, Forests and Landscape (2004): National Inventory Report 2004. Submission to the UNFCCC. Swiss Agency for the Environment, Forests and Landscape.

SBV – Swiss Farmers Union (2007): Statistische Erhebungen und Schätzungen über Landwirtschaft und Ernährung 2006. Swiss Farmers Union, Brugg.

SCHADAUER K., HAUK E., NIESE G., MEHRANI-MYLANY H., GABLER K., PRSKAWETZ M., MATZIK H., SCHILD A., REGNER B. (2007): Instruktionen für die Feldarbeit der Österreichischen Waldinventur 2007 – 2009. Bundesamt und Forschungszentrum für Wald, Wien.

SCHÄFER, R. (2002): Neues Konzept zum Düngemitteleinsatz. In: VKS News 65. Ausgabe 08/2002.

SCHECHTNER (1991): Wirtschaftsdünger – Richtige Gewinnung und Anwendung, Sonderausgabe des Förderungsdienst 1991, BMLF, Wien.

SCHIELER, K.; BÜCHSENMEISTER, R. & SCHADAUER, K. (1995): Österreichische Forstinventur – Ergebnisse 1986/90. Bericht 92, Federal Office and Research Centre for Forests, Wien.

SCHIELER, K. & HAUK, E. (2001): Instruktion für die Feldarbeit der Österreichischen Waldinventur 2000-2002, Fassung 2001. Federal Office and Research Centre for Forests, Wien **http://bfw.ac.at/700/pdf/da_ges_neu.pdf**

SCHMIDT A., VITOVEC W., PUXBAUM H. & KNIERIDER R. (1998): TU Wien, Gesellschaft Österreichischer Chemiker: Die ökologischen Auswirkungen der Lösungsmittelverordnung 1991 und 1995. September 1998, Wien.

SCHWARZ, W.; GSCHREY, B. (2009): Service contract to assess the feasibility of options to reduce emissions of SF6 from the EU non-ferrous metal industry and analyse their potential impacts. Prepared for European Commission, DG Environment. Final Report, p. 15ff, Frankfurt/M., October 2009

SJARDIN M. (2003): CO_2 emission factors for non-energy use in the non-ferrous metal, ferroalloys and inorganics industry. Copernicus Institute, Department of Science, Technology and Society, University of Utrecht.

STANZEL, G., JUNGMEIER, J. & SPITZER, J. (1995): Emissionsfaktoren und Energetische Parameter für die Erstellung von Energie- und Emissionsbilanzen im Bereich Raumwärmeversorgung, Joanneum Research Graz.

STATISTIK AUSTRIA (1960–2007): Statistik der Landwirtschaft. Statistik Austria, Wien.

STATISTIK AUSTRIA (2006): Allgemeine Viehzählung am 1. Dezember 2006. National livestock counting December 2006, published in (BMLFUW 2007a).

STATISTIK AUSTRIA (2007): Allgemeine Viehzählung am 1. Dezember 2007. National livestock counting December 2006, published in (BMLFUW 2008).

STATISTIK AUSTRIA (2008): Allgemeine Viehzählung am 1. Dezember 2008. National livestock counting December 2006. Wien.

STATISTIK AUSTRIA[89]: Statistisches Jahrbuch Österreich 1992–2008;
- Industrie und Gewerbestatistik (1. Teil) 1990–1995;
- Konjunkturerhebung im Produzierenden Bereich (Band 2 bzw. 3) 1997–2007;
- Der Außenhandel Österreichs 1. bis 4. Vierteljahr 1980 – 2007, Spezialhandel nach Waren und Ländern. Statistik Austria, Wien.

STEINER, G., M. & REITER, K. (1992): Österreichischer Moorschutzkatalog-Datenbank. Styria Medien Service. Wien.

STEINLECHNER, E.; BERGHOLD, H.; CATE, F.M.; JUNGMEIER, G.; SPITZER, J. & WUTZL, C. (1994): Möglichkeiten zur Vermeidung und Nutzung anthropogener Methanemissionen. Report des Joanneum Research: Institut für Umweltgeologie und Ökosystemforschung.

STEINWENDER, R & GOLD, H. (1989): Produktionstechnik und Gebrauchskreuzungen in der Mutterkuhhaltung. Versuchsbericht. Agricultural Research Center for Alpine Regions, Gumpenstein.

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[89] STATISTIK AUSTRIA (or Statistics Austria): collects national information on the demographic, social and economical structure and development of Austria and provides information and expert services, in particular statistical analyses, as well as statistical data partly free-of-charge (e.g. published in the "The Statistical Yearbook" = a comprehensive reference book on official statistics or in separate technical papers.) Homepage: **http://www.statistik.at/**

STEINWIDDER, A. & GUGGENBERGER, T. (2003): Erhebungen zur Futteraufnahme und Nährstoffversorgung von Milchkühen sowie Nährstoffbilanzierung auf Grünlandbetrieben in Österreich. Die Bodenkultur 54 (1): 49–66.

STEINWIDDER, A; HÄUSLER, J.; SCHAUER, A.; MAIERHOFER, G.; GRUBER, L.; GASTEINER, J. & PODSTATZKY, L. (2006): Einfluss des Absetztermins auf die Milchleistung und Körpermasse von Mutterkühen sowie die Zuwachsleistung von Mutterkuh-Jungrindern. Versuchsbericht. Extensively managed beef cows – Effects on animal health, reproductive success, performance of calves and economics. Experiment 2004 to 2008. Interim report. Agricultural Research and Education Centre, HBLFA Raumberg-Gumpenstein.

STREBL F.; GEBETSROITHER E. & ORTHOFER R. (2002): Greenhouse Gas Emissions from Agricultural Soils in Austria. ARC Seibersdorf research, revised version, Nov. 2002.

STREBL, F.; GEBETSROITHER, E. & ORTHOFER R. (2003): Greenhouse Gas Emissions from Cropland & Grassland Management in Austria. Report ARC-S-0221. Austrian Research Centre, Seibersdorf.

TABERAUX, A.; (1996): Relationship between Operating Parameters and Emissions, Lecture at the U.S. EPA Workshop on P-FKW's, Washington DC, May 8th–9th 1996.

TRUMBORE, S.E.; CHADWICK, O.A. & AMUNDSON, R. (1996): Rapid exchange between soil carbon and atmospheric carbon dioxide driven by temperature change. Science 272: 393–396.

U.S. EPA (2007): Inventory of U.S. Greenhouse Gas Emissions and Sinks: 1990–2005. Draft for Public Review. Washington, available at http://www.epa.gov/globalwarming/publications/emissions.

UBA BERLIN (1999): MBA Bericht: Ökologische Vertretbarkeit mechanisch-biologischer Vorbehandlung von Restabfällen.

UMWELTBUNDESAMT (1995): Boos, R., Neubacher, F.; Reiter, B.; Schindlbauer, H. & Twrdik, F.: Zusammensetzung und Behandlung von Altölen in Österreich. Monographien, Bd. M-054. Umweltbundesamt, Wien.

UMWELTBUNDESAMT (1997): Scharf S., Schneider M. & Zethner G.: Zur Situation der Verwertung und Entsorgung des kommunalen Klärschlamms in Österreich. Monographien, Bd. M-095. Umweltbundesamt, Wien.

UMWELTBUNDESAMT (1998a): Götz, B.: Stickstoffbilanz der österreichischen Landwirtschaft nach den Vorgaben der OECD. Aktualisierte und erweiterte Fassung. Berichte, Bd. BE-087a, Umweltbundesamt, Wien, July 1998.

UMWELTBUNDESAMT (1998b): Scharf S., Schneider M. & Zethner G.: Zur Situation der Verwertung und Entsorgung des kommunalen Klärschlammes in Österreich. Monographien, Bd. M-095. Umweltbundesamt, Wien.

UMWELTBUNDESAMT (2000): Weiss, P.; Schieler, K.; Schadauer, K.; Radunsky, K. & Englisch, M.: Die Kohlenstoffbilanz des Österreichischen Waldes und Betrachtungen zum Kyoto-Protokoll. Monographien, Bd. M-106, Umweltbundesamt, Wien.

UMWELTBUNDESAMT (2001b): Bichler, B.; Werenskiold, W. & Unterberger S.: Abschätzung der tatsächlichen und potentiellen treibhauswirksamen Emissionen von H-FKW, P-FKW und SF_6 für Österreich. Internal Report. Umweltbundesamt, Wien. Study has not been published, but can be made available upon request.

UMWELTBUNDESAMT (2001): Emissionsfaktoren als Grundlage für die Österreichische Luftschadstoff-Inventur Stand 1999. Interner Bericht, Bd. IB-614. Umweltbundesamt, Wien.

UMWELTBUNDESAMT (2001e): Grech H. & Rolland C.: Stand der Abfallbehandlung in Österreich im Hinblick auf das Jahr 2004. Berichte, Bd. BE-182. Umweltbundesamt, Wien.

UMWELTBUNDESAMT (2001d): Perz, K.: Materialien zum Bundesabfallwirtschaftsplan 2001, Monographien, Bd. M-138, Umweltbundesamt, Klagenfurt.

UMWELTBUNDESAMT (2001c): Häusler, G.: Emissionen aus Abfalldeponien 1980–1998, Interner Bericht, Bd. IB-623. Umweltbundesamt, Wien.

UMWELTBUNDESAMT (2002): Erdgas-mix in Österreich, Elementaranalyse. Auszug aus der GEMIS-Datenbank des Umweltbundesamt.

UMWELTBUNDESAMT (2003): Rolland, C. & Scheibengraf, M.: Biologisch abbaubarer Kohlenstoff im Restmüll. Berichte, Bd. BE-236. Umweltbundesamt, Wien.

UMWELTBUNDESAMT (2004e): Rolland, C. & Oliva, J.: Erfassung von Deponiegas – Statusbericht von österreichischen Deponien. Berichte, Bd. BE-238. Umweltbundesamt, Wien.

UMWELTBUNDESAMT (2004a): Austria's Informative Inventory Report 2004, Submission under the UNECE Convention on Long-range Transboundary Air Pollution. Berichte, Bd. BE-257. Umweltbundesamt, Wien.

UMWELTBUNDESAMT (2004b): Emissionsfaktoren als Grundlage für die Österreichische Luftschadstoff-Inventur Stand 2003. Berichte, Bd. BE-254. Umweltbundesamt, Wien.

UMWELTBUNDESAMT (2004c): Pilot study on statistics on waste management in agriculture, forestry and fishing – Agriwaste. Umweltbundesamt, Wien.

UMWELTBUNDESAMT (2004d): Erhebung des Anschlussgrades an kommunale Abwasserentsorgungsanlagen. Interner Bericht an das BMLFUW, Wien.

UMWELTBUNDESAMT (2005): Schachermayer E.: Vergleich und Evaluierung verschiedener Modelle zur Berechnung der Methanemissionen aus Deponien. Umweltbundesamt, Wien. Study has not been published, but can be made available upon request.

UMWELTBUNDESAMT (2006a): Neubauer C. & Öhlinger A.: Ist-Stand der mechanisch biologischen Abfallbehandlung (MBA) in Österreich, Zustandsbericht 2006. Umweltbundesamt, Wien.

UMWELTBUNDESAMT (2006b): Salchenegger, S.: Biokraftstoffe im Verkehrssektor in Österreich 2006, Zusammenfassung der Daten der Republik Österreich gemäß Art. 4, Abs. 1 der Richtlinie 2003/30/EG für das Berichtsjahr 2005. Reports, Bd. REP-0068. Umweltbundesamt, Wien.

UMWELTBUNDESAMT (2007a): Anderl, M.; Freudenschuß, A. et al.: Austria's Informative Inventory Report 2006. Submission under the UNECE Convention on Long-range Transboundary Air Pollution. Reports, Bd. REP-0082. Umweltbundesamt, Wien.

UMWELTBUNDESAMT (2007b): Dampfkesseldatenbank, Stand Oktober 2007. Umweltbundesamt, Wien.

UMWELTBUNDESAMT (2007c): Lenz, K. & Kampel, E.: Nitrous Oxide emissions from industrial wastewater, Interne Studie, Umweltbundesamt, Wien.

UMWELTBUNDESAMT (2008d): Neubauer C. & Walter B.: Behandlung von gemischten Siedlungs- und Gewerbeabfällen in Österreich – Betrachtungszeitraum 2003–2008. Umweltbundesamt, Wien.

UMWELTBUNDESAMT (2008a): Winter, R.: Biokraftstoffe im Verkehrssektor in Österreich 2008, Zusammenfassung der Daten der Republik Österreich gemäß Art. 4, Abs. 1 der Richtlinie 2003/30/EG für das Berichtsjahr 2007. Reports, Bd. REP-0169. Umweltbundesamt, Wien.

UMWELTBUNDESAMT (2008b): Query of data from the National Austrian Waste Water Database. Vienna.

UMWELTBUNDESAMT (2008c): Schachermayer, E. & Lampert, C.: Erfasste Deponiegasmengen auf Österreichischen Deponien – Zeitreihe für die Jahre 2002 bis 2007. Reports, Bd. REP-0100. Umweltbundesamt, Wien.

UMWELTBUNDESAMT, ECRA (2006, 2007, 2008): Emissionshandelsregister Österreich Stand der Einhaltung 2006, 2007, 2008. http://www.emissionshandelsregister.at/static/cms/sites/emissionshandelsregister.at/media/download_center/unternehmen/Stand_der_Einhaltung_2006.pdf.

UMWELTBUNDESAMT (2009b): Query of data from the National Austrian Waste Water Database. Vienna 2009.

UMWELTBUNDESAMT (2010): Köther, T.; Anderl, M.; Muik, B.; Pazdernik, K.; Poupa, S.; Stranner, G.: Austria's Informative Inventory Report 2010. Submission under the UNECE Convention on Long-range Transboundary Air Pollution. Reports, Bd. REP-0245 Umweltbundesamt, Wien.

NTERARBEITSGRUPPE N-ADHOC (2004): Überprüfung und Überarbeitung der N-Anfallswerte für einzelne Tierkategorien. Unterlagen ausgearbeitet vom Fachbeirat für Bodenfruchtbarkeit und Bodenschutz des BMLFUW.

VITOVEC, W. (1991): N_2O-Emissionen anthropogener Quellen in Österreich. Dissertation, TU Vienna, Austria.

WEST T.O. (2008): Country-level estimates for Carbon distribution in U.S. croplands, 1990–2005. Environmental Science Division, Oak Ridge National Laboratory. http://cdiac.ornl.gov/carbonmanagement/cropcarbon/.

WINDSPERGER, A. & HINTERMEIER, G. (2002): Entschwefelungstechnologien – Die Situation in Österreich. Eine Studie im Auftrag des Umweltbundesamt.

WINDSPERGER, A. & TURI, K. (1997): Emissionserhebung der Industrie für 1993 und 1994. Technische Universität Wien, Forschungsinstitut für Chemie und Umwelt, Wien.

WINDSPERGER, S. & SCHMIDT-STEJSKAL, H. (2008): Austria's Emission Inventroy from solvent use 2009. Institut für Industrielle Ökologie (IIÖ). Studie im Auftrag des Umweltbundesamt. Wien. Study has not been published, but can be made available upon request.

WINDSPERGER, S.; STEINLECHNER, H.; SCHMIDT-STEJSKAL, H.; DRAXLER, S.; FISTER, G., SCHÖNSTEIN, R. & SCHÖRNER, G. (2002a): Gegenüberstellung und Abgleich der Daten von Top-down zu Bottom-up für Lösungsmittel im Jahr 2000. Institut für Industrielle Ökologie (IIÖ) und Forschungsinstitut für Energie und Umweltplanung, Wirtschaft- und Marktanalysen GmbH (FIEU). Studie im Auftrag des Lebensministeriums und Bundesministeriums für Wirtschaft und Arbeit. Wien.

WINDSPERGER, S.; STEINLECHNER, H.; SCHMIDT-STEJSKAL, H.; DRAXLER, S.; FISTER, G., SCHÖNSTEIN, R. & SCHÖRNER, G. (2002b): Verbesserung von Emissionsdaten (Inventur und Projektion bis 2010 für den Bereich Lösungsmittel in Österreich. Institut für Industrielle Ökologie (IIÖ) und Forschungsinstitut für Energie und Umweltplanung, Wirtschaft- und Marktanalysen GmbH (FIEU). Studie im Auftrag des Lebensministeriums und Bundesministeriums für Wirtschaft und Arbeit. Wien.

WINDSPERGER, S.; STEINLECHNER, H.; SCHMIDT-STEJSKAL, H.; DRAXLER, S.; FISTER, G., SCHÖNSTEIN, R. & SCHÖRNER, G. (2004): Studie zur Anpassung der Zeitreihe der Lösungsmittelemissionen der österreichischen Luftschadstoffinventur (OLI) 1980–2002. Institut für Industrielle Ökologie (IIÖ) und Forschungsinstitut für Energie und Umweltplanung, Wirtschaft- und Marktanalysen GmbH (FIEU). Studie im Auftrag des Umweltbundesamt. Wien.

WINIWARTER, W. & ORTHOFER, R. (2000): Unsicherheit der Emissionsinventur für Treibhausgase in Österreich, Seibersdorf Research Report, OEFZS-S-0072, Seibersdorf.

WINIWARTER, W. & RYPDAL, K. (2001): Assessing the Uncertainty Associated with National Greenhouse Gas Emission Inventories: A Case Study for Austria. Atmospheric Environment 35: 5 425–5 440.

WINIWARTER, W. (2007): National Greenhouse Gas Inventories: Understanding Uncertainties vs. Potential for Improving Reliability. Water Air and Soil Pollution 7 (4–5): 443–450.

WINIWARTER, W. (2008): Quantifying Uncertainties of the Austrian Greenhouse Gas Inventory, Seibersdorf Research Report. in press.

WINKLER, N. (1997): Country report for Austria. In: Study on European Forestry Information and Communication System Reports – Reports on Forest Inventory and Survey Systems, Volume 1, Office for Official Publications of the European Communities, Luxembourg, 5–74.

ZAMG – Zentralanstalt für Meteorologie und Geodynamik: Jahrbuch 2004. Data query 2007. http://www.zamg.ac.at/fix/klima/jb2004/Web/index.html.

Zentrale Arbeitsgemeinschaft österreichischer Rinderzüchter (2004): Cattle Breeding in Austria, 148 pp.

ZESSNER, M. (1999): Bedeutung und Steuerung von Nährstoff- und Schwermetallflüssen des Abwassers. Wiener Mitteilung Band 157. Wien.

DATA SOURCES BY SECTOR

All Sectors

EEA – European Environment Agency (1999): EMEP/CORINAIR Emission Inventory Guidebook – Second Edition, Prepared by the EMEP Task Force on Emission Inventories, Edited by Stephen Richardson Task Force Secretary. Technical Report No. 30. Copenhagen 1999.

IPCC (2000): Report on Good Practice Guidance and Uncertainty Management in National Greenhouse Gas Inventories (IPCC Good Practice Report). Japan. [also referenced as "**IPCC GPG**" in the NIR]

IPCC (1997): Revised 1996 IPCC Guidelines for National Greenhouse Gas Inventories, Vol. 1: Reporting Instructions, Vol. 2: Workbook, Vol. 3: Reference Manual. Intergovernmental Panel on Climate Change, Edited by J.T. Houghton, L.G. Meira Filho, B. Lim, K. Tréanton, I. Mamaty, Y. Bonduki, D.J. Griggs and B.A. Callander, Genf.

IPCC (2003): Good Practice Guidance for Land Use, Land-Use Change and Forestry. Edited by J. Penman, M. Gytarsky, T. Hiraishi, T. Krug, D. Kruger, R. Pipatti, L. Buendia, K. Miwa, T. Ngara, K. Tanabe and F. Wagner.

EEA – European Environment Agency (2009): EMEP/EEA air pollutant emission inventory guidebook — 2009. Technical report No 6/2009. Copenhagen.

Energy

ABFALLWIRTSCHAFT (2003): Artikel „Situation der Monoverbrenner, E.H.Reil, Fernwärme Wien" aus „Abfallwirtschaft und Klimaschutz, Umweltbundesamt, Oktober 2003, Wien".

BMUJF (1994a): CH_4-Emissionen in Österreich, Reihe Dokumentation, Band 6. Bundesministerium für Umwelt, Jugend und Familie, Wien.

BMUJF (1994b): N_2O-Emissionen in Österreich. Endbericht zum Forschungsauftrag des BMUJF GZ 01 2943/2-I/7/94 vom 18.Mai 1994. Bundesministerium für Umwelt, Jugend und Familie, Wien.

BMWA–EB (1990): Energiebericht der Österreichischen Bundesregierung 1990. Bundesministerium für wirtschaftliche Angelegenheiten, Wien.

BMWA–EB (1996): Energiebericht der Österreichischen Bundesregierung 1996. Bundesministerium für wirtschaftliche Angelegenheiten, Wien.

BMWA–EB (2003): Energiebericht der Österreichischen Bundesregierung 2003. Bundesministerium für wirtschaftliche Angelegenheiten, Wien.

HACKL & MAUSCHITZ (1996): Methangas und Kohlendioxid aus der Bereitstellung in Österreich genutzter Energieträger, TU-Wien, Wien, 1996.

IEA JQ (2007): IEA/EUROSTAT Joint Questionnaire Submission 2007. Statistik Austria, Wien.

ÖKOINSTITUT (2002): Öko Institut e.V., Institut für angewandte Ökologie, April 2002, Freiburg, Darmstadt, Berlin.

STANZEL, G., JUNGMEIER, J. & SPITZER, J. (1995): Emissionsfaktoren und Energetische Parameter für die Erstellung von Energie- und Emissionsbilanzen im Bereich Raumwärmeversorgung, Joanneum Research Graz.

UMWELTBUNDESAMT (2001): Emissionsfaktoren als Grundlage für die Österreichische Luftschadstoff-Inventur Stand 1999. Interner Bericht, Bd. IB-614. Umweltbundesamt, Wien.

UMWELTBUNDESAMT (2002): Erdgas-mix in Österreich, Elementaranalyse. Auszug aus der GEMIS-Datenbank des Umweltbundesamt.

UMWELTBUNDESAMT (2004): Emissionsfaktoren als Grundlage für die Österreichische Luftschadstoff-Inventur Stand 2003. Berichte, Bd. BE-254. Umweltbundesamt, Wien.

UMWELTBUNDESAMT, ECRA (2006, 2007, 2008): Emissionshandelsregister Österreich Stand der Einhaltung 2006, 2007, 2008. http://www.emissionshandelsregister.at/static/cms/sites/emissionshandelsregister.at/media/download_center/unternehmen/Stand_der_Einhaltung_2006.pdf.

UMWELTBUNDESAMT (2007b): Dampfkesseldatenbank, Stand Oktober 2007. Umweltbundesamt, Wien.

Transport

BMLFUW (2004): Abschätzung der Auswirkungen des Tanktourismus auf den Treibstoffverbrauch und die Entwicklung der CO_2-Emissionen in Österreich. November 2004, Wien.

HANDLER, F. (2003): Abschätzung des Dieselverbrauchs in der österreichischen Landwirtschaft; Bundesanstalt für Landtechnik; BLT-Wieselburg.

HAUSBERGER, S. (1998): GLOBEMI – Globale Modellbildung für Emissions- und Verbrauchsszenarien im Verkehrssektor; Institute for Internal Combustion and Thermodynamics. University of Technology Graz; Volume 71; Graz.

HAUSBERGER, S. (2004): Straßenverkehrsemissionen und Emissionen sonstiger mobiler Quellen Österreichs – gemäß CORINAIR-Methodik – für die Jahre 1990 bis 2002. FVT – Forschungsgesellschaft für Verbrennungskraftmaschinen und Thermodynamik mbH. Erstellt im Auftrag des Umweltbundesamtes GmbH. Graz.

KALIVODA, M. et al (2002): Air Traffic Emission Calculation for Austria 1990–2000, study commissioned by Umweltbundesamt, Vienna. Study has not been published, but can be made available upon request.

MEET (1999): MEET – Methodology for calculating transport emissions and energy consumption. European Commission, DG VII, Belgium.

PISCHINGER, R. (2000): Emissionen des Off-Road-Verkehrs im Bundesgebiet Österreich für die Bezugsjahre 1990 bis 1999. Institut für Verbrennungskraftmaschinen und Thermodynamik TU Graz, Graz.

UMWELTBUNDESAMT (2006b): Salchenegger, S.: Biokraftstoffe im Verkehrssektor in Österreich 2006, Zusammenfassung der Daten der Republik Österreich gemäß Art. 4, Abs. 1 der Richtlinie 2003/30/EG für das Berichtsjahr 2005. Reports, Bd. REP-0068. Umweltbundesamt, Wien.

UMWELTBUNDESAMT (2009): Winter R.; Biokraftstoffe im Verkehrssektor 2009 – Zusammenfassung der Daten der Republik Österreich gemäß Art.4, Abs.1 der Richtlinie 2003/30/EG für das Berichtsjahr 2008, im Auftrag des BMFLUW, Wien 2009.

Industry

Activity Data

BRITISH GEOLOGICAL SURVEY (2001): World Mineral Statistics 1995–1999. Keyworth, Nottingham: British Geological Survey.

BRITISH GEOLOGICAL SURVEY (2005): World mineral production 1999–2003. Keyworth, Nottingham: British Geological Survey.

BRITISH GEOLOGICAL SURVEY (2006): World mineral production 2000–2004. Keyworth, Nottingham: British Geological Survey.

BRITISH GEOLOGICAL SURVEY (2007): World mineral production 2001–2005. Keyworth, Nottingham: British Geological Survey.

BRITISH GEOLOGICAL SURVEY (2008): World mineral production 2002–2006. Keyworth, Nottingham: British Geological Survey.

HIEBLER, GAMSJÄGER & GOD: Vergleich von metallurgisch und thermisch bedingten CO_2 Emissionen. Montanuniversität Leoben.

STATISTIK AUSTRIA: Statistisches Jahrbuch Österreich 1992–2006;
- Industrie und Gewerbestatistik (1. Teil) 1990–1995;
- Konjunkturerhebung im Produzierenden Bereich (Band 3) 1997–2002; Statistik Austria, Wien.

WINDSPERGER, A. & HINTERMEIER, G. (2002): Entschwefelungstechnologien – Die Situation in Österreich. Eine Studie im Auftrag des Umweltbundesamt.

Emission Data

Cement Production

HACKL, A. & MAUSCHITZ, G. (1995, 1997, 2001, 2003, 2007): Emissionen aus Anlagen der österreichischen Zementindustrie.

MAUSCHITZ, G. (2004): Emissionen aus Anlagen der österreichischen Zementindustrie. TU Wien.

Consumption of Halocarbons and SF_6

HARNISCH, J. & SCHWARZ, W. (2003): Final Report on the Costs and the impact on emissions of potential regulatory framework for reducing emissions of hydrofluorocarbons, perfluorocarbons and sulphur hexafluoride. European Commission (DG ENV).

LEISEWITZ, A.; SCHWARZ, W. (2010): Service contract on the estimation of consumption and emissions of fluorinated gases in Austria. Prepared for Umweltbundesamt Wien. Final Report (in preparation).

OBERNOSTERER, R.; SMUTNY, R. & JÄGER, E. (2004): HFKW Gase in Dämmschäumen des Bauwesens. Umweltbundesamt, Internal Report. Study has not been published, but can be made available upon request.

SCHWARZ, W.; GSCHREY, B. (2009): Service contract to assess the feasibility of options to reduce emissions of SF6 from the EU non-ferrous metal industry and analyse their potential impacts. Prepared for European Commission, DG Environment. Final Report, p. 15ff, Frankfurt/M., October 2009

UMWELTBUNDESAMT (2001): Bichler, B.; Werenskiold, W. & Unterberger S.: Abschätzung der tatsächlichen und potentiellen treibhauswirksamen Emissionen von H-FKW, P-FKW und SF_6 für Österreich. Internal Report. Umweltbundesamt, Wien. Study has not been published, but can be made available upon request.

Emission Factors

Electric Steel Production

WINDSPERGER, A. & TURI, K. (1997): Emissionserhebung der Industrie für 1993 und 1994. Technische Universität Wien, Forschungsinstitut für Chemie und Umwelt, Wien.

Aluminium Production

BARBER, M.A.; (1996): (Alcan International Limited) Alcans's P-FKW Emission Reduction Program. A Case Study, Lecture at the U.S. EPA Workshop on P-FKW's, Washington DC, May 8th–9th 1996.

GIBBS, M. (ICF Inc.) & JACOBS, C. (US EPA) (1996): Reducing P-FKW Emissions from Primary Aluminium Production in the USA, from: Light Metal Age, February 1996.

TABERAUX, A.; (1996): Relationship between Operating Parameters and Emissions, Lecture at the U.S. EPA Workshop on P-FKW's, Washington DC, May 8th–9th 1996.

Ferroalloys

SJARDIN M. (2003): CO_2 emission factors for non-energy use in the non-ferrous metal, ferroalloys and inorganics industry. Copernicus Institute, Department of Science, Technology and Society, University of Utrecht.

Solvent and Other Product Use

BARNERT (1998): Österreichisches Lackinstitut: Möglichkeiten und Grenzen umweltverträglicher Beschichtung (Lacke, Klebstoffe, Bautenschutzmittel, Holzschutzmittel), Wien.

EUROSTAT (2008): Structural business statistics (NACE Rev.1.1) – online statistics. Luxembourg. http://epp.eurostat.ec.europa.eu.

Good Practice Guidance for CLRTAP Emission Inventories – Draft chapter for the UNECE Corinair Guidebook on Emissions inventories, Tino Pulles, Jon van Aardenne, European Topic centre on air and climate change (ETC/ACC), November 2001.

ÖIGV – Österreichischer Industriegaseverband (2007): N_2O use in medical and industrial field (personal communication), Schwechat.

RAMIREZ, A.; DE KEIZER, C.; & VAN DER SLUIJS, J. P. (2006): Monte Carlo Analysis of Uncertainties in the Netherlands Greenhouse Gas Emission Inventory for 1990 – 2004. Report NWS-E-2006-58, Copernicus Institute for Sustainable Development and Innovation, Utrecht.

SCHMIDT A., VITOVEC W., PUXBAUM H. & KNIERIDER R. (1998): TU Wien, Gesellschaft Österreichischer Chemiker: Die ökologischen Auswirkungen der Lösungsmittelverordnung 1991 und 1995. September 1998, Wien.

Statistik Austria: Statistisches Jahrbuch Österreich 1992–2008;
- Industrie und Gewerbestatistik (1. Teil) 1990–1995;
- Konjunkturerhebung im Produzierenden Bereich (Band 2 bzw. 3) 1997–2007;
- Der Außenhandel Österreichs 1. bis 4. Vierteljahr 1980–2007, Spezialhandel nach Waren und Ländern. Statistik Austria, Wien.

Umweltbundesamt (2007a): Anderl, M.; Freudenschuß, A. et al.: Austria's Informative Inventory Report 2006. Submission under the UNECE Convention on Long-range Transboundary Air Pollution. Reports, Bd. REP-0082. Umweltbundesamt, Wien.

Windsperger, S. & Schmidt-Stejskal, H. (2008): Austria's Emission Inventroy from solvent use 2009. Institut für Industrielle Ökologie (IIÖ). Studie im Auftrag des Umweltbundesamt. Wien. Study has not been published, but can be made available upon request.

Windsperger, S.; Steinlechner, H.; Schmidt-Stejskal, H.; Draxler, S.; Fister, G., Schönstein, R. & Schörner, G. (2002a): Gegenüberstellung und Abgleich der Daten von Top-down zu Bottom-up für Lösungsmittel im Jahr 2000. Institut für Industrielle Ökologie (IIÖ) und Forschungsinstitut für Energie und Umweltplanung, Wirtschaft- und Marktanalysen GmbH (FIEU). Studie im Auftrag des Lebensministeriums und Bundesministeriums für Wirtschaft und Arbeit. Wien.

Windsperger, S.; Steinlechner, H.; Schmidt-Stejskal, H.; Draxler, S.; Fister, G., Schönstein, R. & Schörner, G. (2002b): Verbesserung von Emissionsdaten (Inventur und Projektion bis 2010 für den Bereich Lösungsmittel in Österreich. Institut für Industrielle Ökologie (IIÖ) und Forschungsinstitut für Energie und Umweltplanung, Wirtschaft- und Marktanalysen GmbH (FIEU). Studie im Auftrag des Lebensministeriums und Bundesministeriums für Wirtschaft und Arbeit. Wien.

Windsperger, S.; Steinlechner, H.; Schmidt-Stejskal, H.; Draxler, S.; Fister, G., Schönstein, R. & Schörner, G. (2004): Studie zur Anpassung der Zeitreihe der Lösungsmittelemissionen der österreichischen Luftschadstoffinventur (OLI) 1980–2002. Institut für Industrielle Ökologie (IIÖ) und Forschungsinstitut für Energie und Umweltplanung, Wirtschaft- und Marktanalysen GmbH (FIEU). Studie im Auftrag des Umweltbundesamt. Wien.

Agriculture

Emission estimation for *4 A*, *4 B* and *4 D* were carried out by scientific institutes, results were provided as in the following studies:

Amon B.; Hopfner- Sixt K. & Amon T. (2002): Emission Inventory for the Agricultural Sector in Austria – Manure Management, Institute of Agricultural, Environmental and Energy Engineering (BOKU – University of Agriculture, Vienna), July 2002.

Amon, B. & Hörtenhuber, S. (2010): Revision of Austria's National Greenhouse Gas Inventory, Sector Agriculture. Final Report. Division of Agricultural Engineering (DAE) of the Department for Sustainable Agricultural Systems of the University of Natural Resources and Applied Life Sciences (BOKU), study on behalf of Umweltbundesamt GmbH. Wien (unpublished)

Gebetsroither E.; Strebl F. & Orthofer R. (2002): Greenhouse Gas Emissions from Enteric Fermentation in Austria; Report ARC-S-0175, ARC Seibersdorf research, July 2002.

Strebl F.; Gebetsroither E. & Orthofer R. (2002): Greenhouse Gas Emissions from Agricultural Soils in Austria; ARC Seibersdorf research, revised version, February 2003.

As these studies are not published, a detailed description of the applied methods is given in the NIR. In the following data sources used in the studies mentioned above are summarized.

AMON, B.; MOITZI, G., SCHIMPL, M., KRYVORUCHKO, V. & WAGNER-ALT, C. (2002a): Methane, Nitrous Oxide and Ammonia Emissions from Management of Liquid Manures. Final Report November 2002. Research project no. 1107, BMLF GZ 24.002/24-IIA1a/98 and extension GZ 24.002/33-IIA1a/00. On behalf of Federal Ministry of Agriculture, Forestry, Environment and Water Management, and Federal Ministry for Education, Science and Culture. Vienna.

AMON, B.; KRYVORUCHKO, V. & AMON, T. (2006): Influence of different levels of covering on greenhouse gas and ammonia emissions from slurry stores. International Congress Series (ICS) No 1293 "2nd International Conference on Greenhouse Gases and Animal Agriculture.

AMON, B.; FRÖHLICH, M.; WEIßENSTEINER, R; ZABLATNIK, B. & AMON, T. (2007): Tierhaltung und Wirtschaftsdüngermanagement in Österreich. Studie im Auftrag des Bundesministeriums für Land- und Forstwirtschaft, Umwelt- und Wasserwirtschaft, Wien.

AMON, B.; KRYVORUCHKO, V.; FRÖHLICH, M.; AMON, T.; PÖLLINGER, A.; MÖSENBACHER, I.; HAUSLEITNER, A. (2007a). Ammonia and greenhouse gas emissions from a straw flow system for fattening pigs: Housing and manure storage. Livestock Science 112, 199–207.

AMON, B. & HÖRTENHUBER, S. (2008): Revision der österreichischen Luftschadstoff-Inventur (OLI) für NH_3, NMVOC und NO_x; Sektor 4, Landwirtschaft. Endbericht. Universität für Bodenkultur, Institut für Landtechnik im Auftrag vom Umweltbundesamt. Wien (unpublished)

AMON, B (2010): expert judgement, personal communication. Vienna.

BMLFUW (2000–2009): Grüner Bericht 1999, 2000, 2002, 2005, 2006, 2007, 2008, 2009. Bericht über die Situation der österreichischen Land- und Forstwirtschaft. Grüner Bericht gemäß § 9 des Landwirtschaftsgesetzes BGBl. Nr. 375/1992. Bundesministerium für Land- und Forstwirtschaft, Umwelt und Wasserwirtschaft, Wien. www.gruenerbericht.at.

BMLFUW (2007): Sonderrichtlinie des Bundesministers für Land- und Forstwirtschaft, Umwelt und Wasserwirtschaft (BMLFUW) für das Österreichische Programm zur Förderung einer umweltgerechten, extensiven und den natürlichen Lebensraum schützenden Landwirtschaft. Anlage I, Anhänge zum Agrarumweltprogramm und zur Tierschutzmaßnahme (ÖPUL 2007). http://www.ama.at/Portal.Node/ama/public?gentics.rm=PCP&gentics.pm=gti_full&p.contentid=10008.47092&SRL_O4_20071126.pdf.

BUNDESANSTALT FÜR AGRARWIRTSCHAFT (2009): Federal Institute of Agricultural Economics. Download from data pool. http://www.awi.bmlfuw.gv.at/framesets/datapoolframeset.html.

DETZEL, A; VOGT, R; FEHRENBACH, H. et al. (2003): Anpassung der deutschen Methodik zur rechnerischen Emissionsermittlung an internationalen Richtlinien. Institut für angewandte Ökologie (IFEU). Institute for Applied Ecology.

E-CONTROL (2009): Ökostrombericht 2009. Bericht der Energie-Control GmbH gemäß § 25 Abs 1 Ökostromgesetz. Juli 2009. Wien.

EEA – European Environment Agency (1999): EMEP/CORINAIR Emission Inventory Guidebook – Second Edition, Prepared by the EMEP Task Force on Emission Inventories, Edited by Stephen Richardson Task Force Secretary. Technical Report No. 30. Copenhagen 1999.

EEA – European Environment Agency (2007): EMEP/CORINAIR Emission Inventory Guidebook – 2007, Technical report No 16/2007. Copenhagen.

EEA – European Environment Agency (2009): EMEP/EEA air pollutant emission inventory guidebook — 2009. Technical report No 6/2009. Copenhagen.

FAO AGR. STATISTICAL SYSTEM (2001): FAO Agricultural Statistical System. http://apps.fao.org/page/-collections?-subset-=agriculture.

FRANKHAUSER JOHANNES (2007): Personal Communication, Austrian Chamber of Agriculture, May. Vienna.

FREIBAUER, A. & KALTSCHMITT, M. (2001): Biogenic greenhouse gas emissions from agriculture in Europe. European Summary Report (Project Report Task 3) of the EU-Concerted Action FAIR3-CT96-1877 "Biogenic Emissions of Greenhouse Gases Caused by Arable and Animal Agriculture".

GEWÄSSERSCHUTZBERICHT (2002): Gewässerschutzbericht gemäß § 33e Wasserrechtsgesetz BGBl. Nr. 215/1959 i.d.F. BGBl. I Nr. 156/2002. Bundesministerium für Land- und Forstwirtschaft, Umwelt und Wasserwirtschaft, Wien.

GRABNER, R.; KLATZER, R.; MEIER, W.; STEINWIDDER, A.; STÖGER, E. & TOIFL, G. (2004): Mutterkuh- und Ochsenhaltung 2003. Ergebnisse und Konsequenzen der Betriebszweigauswertung aus den Arbeitskreisen Mutterkuh und Ochsenhaltung [Husbandry of mother cows and bullocks 2003]. Bundesministerium für Land- und Forstwirtschaft, Umwelt und Wasserwirtschaft. Wien.

GRUBER & STEINWIDDER, (1996): Einfluß der Fütterung auf die Stickstoff- und Phosphorausscheidung landwirtschaftlicher Nutztiere – Modellkalkulationen auf Basis einer Literaturübersicht in: Die Bodenkultur – Austrian Journal of Agricultural Research, 47. Band/Heft 4/Dezember 1996/ISBN 0006-5471, WUV-Universitätsverlag, Wien.

GRUBER, L.; PÖTSCH, E. M. (2006): Calculation of nitrogen excretion of dairy cows in Austria. Die Bodenkultur, 2006, Vol. 57, Heft 1–4, Vienna.

HÄUSLER, J. (2009): Das Leistungspotenzial von Fleckviehmutterkühen – Versuchsergebnisse des LFZ Raumberg-Gumpenstein. Fachtag „Erfolgreiche Mutterkuhhaltung“ Fachschule Warth.

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.

HEIM, P. (2005): Fütterung von Kuh und Kalb. [Feeding of mother cow and calve]. Article in UFA-Revue 3/05, an agricultural journal of Switzerland.

KIRNER & SCHNEEBERGER (1999): Strukturanalyse der Betriebe mit der ÖPUL-Maßnahme "Verzicht auf bestimmte ertragssteigernde Betriebsmittel (Betrieb)". Der Förderungsdienst 47(6).

KONRAD, S. (1995): Die Rinder-, Schweine- und Legehennenhaltung in Österreich aus ethologischer Sicht, WUV Universitätsverlag, Wien.

LÖHR, L. (1990): Faustzahlen für den Landwirt.

MENZI, H , RUETTIMANN, L , REIDY, B (2003): DYNAMO: A new calculation model for dynamic emission inventories for ammonia. Proc. International Symposium 'Gaseous and odour emissions from animal production facilities', Horsens, Denmark, June 1-4.

PHILIPPITSCH, R., GRATH, J., SCHIMON, W. GMEINER, C. DEUTSCH, K. GRUBER, D. TOMEK, H. BONANI, M. & LASSNIG M. (2001): Wassergüte in Österreich. Jahresbericht 2000 ("Austrian water protection report"). Erhebung der Wassergüte gemäß Hydrographiegesetz (BGBl. Nr. 252/90, i.d.g.F.). Bundesministerium für Land- und Forstwirtschaft, Umwelt und Wasserwirtschaft in Zusammenarbeit mit der Umweltbundesamt GmbH, Wien.

PÖTSCH, E.M.; GRUBER, L. & STEINWIDDER, A. (2005): Answers and comments on the additional questions, following the meeting in Bruxelles. Internal statement, HBLFA Raumberg-Gumpenstein.

PÖLLINGER, A. (2008): national expert at the Agricultural Research and Education Centre Raumberg-Gumpenstein. Expert judgement to AWMS distribution 1990-2008 carried out in June 2008. Vienna.

REIDY, B , MENZI, H (2005): Ammoniakemissionen in der Schweiz: Neues Emissionsinventar 1990 bis 2000 mit Hochrechungen bis 2003 Technischer Schlussbericht Schweizerische Hochschule für Zollikofen.

REIDY, B , RIHM, B , MENZI, H (2007): A new Swiss inventory of ammonia emissions from agriculture based on a survey on farm and manure management and farm-specific model calculations, Reference: AEA7495, IN Journal: Atmospheric Environment.

REIDY, B.; DÄMMGEN, U.; DÖHLER, H.; EURICH-MENDEN, B.; EVERT, F. K. VAN; HUTCHINGS, N. J.; LUESINK, H. H.; MENZI, H.; MISSELBROOK, T. H.; MONTENY, G.J.; WEBB, J. (2008): Comparison of models used for national agricultural ammonia emission inventories in Europe : liquid manure systems. Atmospheric environment, Band 42, Heft 14, Seite 3452-3464, englisch. ISSN: 0004-6981.

REIDY, B.; WEBB, J.; MISSELBROOK, T.H.; MENZI, H.; LUESINK, H.H.; HUTCHINGS, N.J.; EURICH-MENDEN, B.; DÖHLER, H.; DÄMMGEN, U. (2009): Comparison of models used for national agricultural ammonia emission inventories in Europe: Litter-based manure systems. Atmospheric environment, Band 43, Heft 9, Seite 1632-1640, englisch. ISSN: 0004-6981

RWA (2008): Expert judgement based on annual sales data of urea. Personal communication, Raiffeisen Ware Austria AG, Wien.

RWA (2009): Expert judgement based on annual sales data of urea. Personal communication, Raiffeisen Ware Austria AG, Wien.

UMWELTBUNDESAMT (1997): Scharf S., Schneider M. & Zethner G.: Zur Situation der Verwertung und Entsorgung des kommunalen Klärschlamms in Österreich. Monographien, Bd. M-095. Umweltbundesamt, Wien.

SCHÄFER, R. (2002): Neues Konzept zum Düngemitteleinsatz. In: VKS News 65. Ausgabe 08/2002.

SCHECHTNER (1991): Wirtschaftsdünger – Richtige Gewinnung und Anwendung, Sonderausgabe des Förderungsdienst 1991, BMLF, Wien.

SBV – Swiss Farmers Union (2007): Statistische Erhebungen und Schätzungen über Landwirtschaft und Ernährung 2006. Swiss Farmers Union, Brugg.

STANZEL, W.; JUNGMEIER, G. & SPITZER, J. (1995): Emissionsfaktoren und energietechnische Parameter für die Erstellung von Energie- und Emissionsbilanzen im Bereich Raumwärmeversorgung, Joanneum Research, Institut für Energieforschung.

STATISTIK AUSTRIA: Statistisches Jahrbuch Österreich 1992–2002; Statistik Austria, Wien.

STATISTIK AUSTRIA (2006): Allgemeine Viehzählung am 1. Dezember 2006. National livestock counting December 2006 published in (BMLFUW 2007a).

STATISTIK AUSTRIA (2007): Allgemeine Viehzählung am 1. Dezember 2007. National livestock counting December 2006, published in (BMLFUW 2008).

STATISTIK AUSTRIA (2008): Allgemeine Viehzählung am 1. Dezember 2008. National livestock counting December 2006. Wien.

STEINWENDER, R. & GOLD, H. (1989): Produktionstechnik und Gebrauchskreuzungen in der Mutterkuhhaltung. Versuchsbericht. Agricultural Research Center for Alpine Regions, Gumpenstein.

STEINWIDDER, A. & GUGGENBERGER, T. (2003): Erhebungen zur Futteraufnahme und Nährstoffversorgung von Milchkühen sowie Nährstoffbilanzierung auf Grünlandbetrieben in Österreich. Die Bodenkultur 54 (1), 49–66.

STEINWIDDER, A; HÄUSLER, J.; SCHAUER, A.; MAIERHOFER, G.; GRUBER, L.; GASTEINER, J. & PODSTATZKY, L. (2006): Einfluss des Absetztermins auf die Milchleistung und Körpermasse von Mutterkühen sowie die Zuwachsleistung von Mutterkuh-Jungrindern. Versuchsbericht. Extensively managed beef cows – Effects on animal health, reproductive success, performance of calves and economics. Experiment 2004 to 2008. Interim report. Agricultural Research and Education Centre, HBLFA Raumberg-Gumpenstein.

UMWELTBUNDESAMT (1998a): Götz, B.: Stickstoffbilanz der österreichischen Landwirtschaft nach den Vorgaben der OECD. Aktualisierte und erweiterte Fassung. Berichte, Bd. BE-087a, Umweltbundesamt, Wien, July 1998.

UMWELTBUNDESAMT (2009b): Query of data from the National Austrian Waste Water Database. Vienna 2009.

UMWELTBUNDESAMT (2010): Köther, T.; Anderl, M.; Muik, B.; Pazdernik, K.; Poupa, S.; Stranner, G.: Austria's Informative Inventory Report 2010. Submission under the UNECE Convention on Long-range Transboundary Air Pollution. Reports, Bd. REP-0245 Umweltbundesamt, Wien.

UNTERARBEITSGRUPPE N-ADHOC (2004): Überprüfung und Überarbeitung der N-Anfallswerte für einzelne Tierkategorien. Unterlagen ausgearbeitet vom Fachbeirat für Bodenfruchtbarkeit und Bodenschutz des BMLFUW.

ZAMG – Zentralanstalt für Meteorologie und Geodynamik: Jahrbuch 2004. Data query 2007. http://www.zamg.ac.at/fix/klima/jb2004/Web/index.html.

ZENTRALE ARBEITSGEMEINSCHAFT ÖSTERREICHISCHER RINDERZÜCHTER (2004): Cattle Breeding in Austria, 148 pp.

ZESSNER, M. (1999): Bedeutung und Steuerung von Nährstoff- und Schwermetallflüssen des Abwassers. Wiener Mitteilung Band 157. Wien, 1999.

LULUCF

AMT DER BURGENLÄNDISCHEN LANDESREGIERUNG 1996: Bodenzustandsinventur Burgenland. Amt der Burgenländischen Landesregierung, Eisenstadt.

AMT DER KÄRNTNER LANDESREGIERUNG 1999: Kärntner Bodenzustandsinventur. Amt der Kärntner Landesregierung, Klagenfurt.

AMT DER NIEDERÖSTERREICHISCHEN LANDESREGIERUNG 1994: Bodenzustandsinventur Niederösterreich. Amt der Niederösterreichischen Landesregierung, St. Pölten.

AMT DER OBERÖSTERREICHISCHEN LANDESREGIERUNG 1993: Oberösterreichischer Bodenkataster – Bodenzustandsinventur 1993. Amt der Oberösterreichischen Landesregierung, Linz.

AMT DER SALZBURGER LANDESREGIERUNG 1993: Salzburger Bodenzustandsinventur. Amt der Salzburger Landesregierung, Salzburg.

AMT DER STEIERMÄRKISCHEN LANDESREGIERUNG 1988–1996: Steiermärkische Bodenschutzberichte 1988–1996. Amt der Steiermärkischen Landesregierung, Graz.

AMT DER TIROLER LANDESREGIERUNG 1988: Bericht über den Zustand der Tiroler Böden. Amt der Tiroler Landesregierung, Innsbruck.

BELLAMY, P.H.; LOVELAND, P.J.; BRADLEY R.I.; LARK R.M. & KIRK G.J.D. (2005): Carbon losses from all soils across England and Wales 1978–2003. Nature 437: 245–248.

BEV (2007): Regional Information derived from the Austrian real estate database (BEV – Austrian Federal Office of Metrology and Surveying, as of 1.1. of the respective year 2006).

BFW (1992): Österreichische Waldbodenzustandsinventur. Mitteilungen der Forstlichen Bundesversuchsanstalt Wien, Vol. 168/I, Vol. 168/II, Federal Office and Research Centre for Forests, Wien.

BFW (2004a): Österreichische Waldinventur 2000/02. CD-Rom, Federal Office and Research Centre for Forests, Wien.

BFW (2004b): Österreichische Waldinventur 2000/02 – Hauptergebnisse. Praxis Information Nr. 3, Federal Office and Research Centre for Forests, Wien.

BFW (2005): Annual growth indices. Personal communication, Federal Office and Research Centre for Forests, Wien.

BFW (2006): Figures on needle, branch and root biomasses for the Austrian forests for the individual NFI periods. Personal communication, Federal Office and Research Centre for Forests, Wien.

BITTERMANN, W. & GERHOLD, S. (1995): Wirtschaftliche Aspekte und Holzbilanz. In: Östereichisches Statistisches Zentralamt, Forstliche Bundesversuchsanstalt (eds.): Ökobilanz Wald. Statistik Austria, Wien, 99–110.

BMLFUW (1964–2003): Österreichische Waldberichte; Jahresberichte über die Forstwirtschaft. Edited annually by the Federal Ministry for Agriculture, Forestry, Environment and Water Management, Wien.

BMLFUW (1985, 1990, 1995, 2003): Grüner Bericht 1985,1990,1995, 2003. Bericht über die Lage der österreichischen Land- und Forstwirtschaft. Wien.

BORIS – Bodeninformationssystem des Umweltbundesamtes: http://www.borisdaten.com.

DÖRFLINGER, A.; HIETZ, P.; MAIER, R.; PUNZ, W.; FUSSENEGGER, K. (1995): Ökosystem Großstadt Wien – Quantifizierung ökologischer Parameter unter besonderer Berücksichtigung der Vegetation; Bundesministerium für Wissenschaft und Forschung und MA 22.

ECKMÜLLNER O. (2006): Allometric relations to estimate needle and branch mass of Norway spruce and Scots pine in Austria. Austrian Journal on Forest Science, Special Issue on Austrian biomassfunctions. 123. Jg., Heft 1/2, 7-16.

FAOSTAT (2005): Online statistics of the FAO. http://faostat.fao.org/faostat/form?collection=Trade.CropsLivestockProducts&Domain=Trade&servlet=1&hasbulk=&version=ext&language=EN.

GERZABEK, M. H., STREBL F., TULIPAN M. & SCHWARZ S. (2003). Quantification of carbon pools in agriculturally used soils of Austria by use of a soil information system as basis for the Austrian carbon balance model. OECD Expert Meeting: Soil Organic Carbon and Agriculture: Developing Indicators for Policy Analyses., C. A. S. Smith (ed., 14–18 October 2002, Ottawa, Canada, Agriculture and Agri-Food Canada, Ottawa, CA & Organisation of Economic Co-operation and Development, Paris, FR.

GERZABEK, M. H., STREBL F., TULIPAN M. & SCHWARZ S. (2005). Quantification of organic carbon pools for Austria's agricultural soils using a soil information system. Can. J. Soil Sci. 85: 491–498.

GSCHWANTNER TH. & SCHADAUER K. (2006): Branch biomass functions for broadleaved tree species in Austria. Austrian Journal on Forest Science, Special Issue on Austrian biomassfunctions, in press.

HARRISON, K.G. (1996): Using bulk soil radiocarbon measurements to estimate soil organic matter turnover times: Implications for atmospheric CO_2 levels. Radiocarbon 38 (2): 181–190.

HARRISON, K.G.; BROECKER, W. & BONANI, G.; (1993a) A strategy for estimating the impact of CO_2 fertilization on soil carbon storage. Global Biogeochem. Cycles 7 (1): 69–80.

HARRISON, K.G.; BROECKER, W. & BONANI, G.; (1993b) The effect of changing land use on soil radiocarbon. Science 262: 725–726.

HARRISON, K.G.; POST, W.M. & RICHTER, D.D. (1995): Soil carbon turnover in a recovering temperate forest. Global Biogeochem. Cycles 9 (4): 449–454.

HASENAUER, H.; NEMANI, R.R.; SCHADAUER, K. & RUNNING, S.W. (1999a): Forest growth response to changing climate between 1961 and 1990. Forest Ecology and Management 122: 209–219.

HASENAUER, H.; NEMANI, R.R.; SCHADAUER, K. & RUNNING, S.W. (1999b): Climate variations and tree growth between 1961 and 1995 in Austria. In: Karjalainen, T.; Spiecker, H. & Laroussini, O. (eds.): Causes and consequences of accelerating tree growth in Europe. European Forest Institute Joensuu, Proceedings No. 27: 75–86.

HOCHBICHLER E., BELLOS P. & LICK E. (2006): Biomass functions and expansion factors for spruce, pine, beech and oak in Austria. Austrian Journal on Forest Science, Special Issue on Austrian biomass-functions. 123. Jg., Heft 1/2, 35-46.

IPCC (2003): Good Practice Guidance for Land Use, Land-Use Change and Forestry. Edited by J. Penman, M. Gytarsky, T. Hiraishi, T. Krug, D. Kruger, R. Pipatti, L. Buendia, K. Miwa, T. Ngara, K. Tanabe and F. Wagner.

JÄGER, F. (2003): Forstrecht. 3rd Edition, Verlag Österreich, Wien.

BGBL. NR. 440/1975: Forest Act of the Republic of Austria. Federal Ministry of Agriculture, Forestry, Environment and Water Management – Vienna/Austria.

LEDERMANN T. & NEUMANN M. (2006): Biomass equations from data of old long-term experimental plots. Austrian Journal on Forest Science, Special Issue on Austrian biomassfunctions. 123. Jg., Heft 1/2, 47-64.

KOLLMANN F. (1982): Technologie des Holzes und der Holzwerkstoffe. 1. Band, 2. Aufl., Springer-Verlag, Berlin, Heidelberg, New York.

KÖRNER, C.; SCHILCHER, B. &PELAEZ-RIEDL, S. (1993): Bestandsaufsaufnahme anthropogene Klimaänderungen: Mögliche Auswirkungen auf Österreich – Mögliche Maßnahmen. Dokumentation, Kapitel 6.1. Österreichische Akademie der Wissenschaften. Wien.

LOHMANN, U. (1987): Holzhandbuch. 3. Aufl., DRW-Verlag, Leinfelden-Echterdingen.

NESTROY, O., DANNEBERG, O. H. & ENGLISCH, M. (2000): Systematische Gliederung der Böden Österreichs (Österreichische Bodensystematik 2000). Mitt. d. Österr. Bodenkundl. Ges., H. 60, Wien 2000.

OFFENTHALER I. & HOCHBICHLER E. (2006): Estimation of root biomass for Austrian forest tree species. Austrian Journal on Forest Science, Special Issue on Austrian biomassfunctions. 123. Jg., Heft 1/2, 65-86.

RUBATSCHER D., MUNK K., STÖHR D., BAHN M., MADER-OBERHAMMER M. & CERNUSCA A. (2006): Biomass expansion functions for Larix decidua: a contribution to the estimation of forest carbon stocks. Austrian Journal on Forest Science, Special Issue on Austrian biomassfunctions. 123. Jg., Heft 1/2, 86-101.

RUSS W. (2004): Mehr Wald – ein positiver Trend? BFW Praxis Information 3/2004, pp. 4-7, Federal Research and Training Centre for Forests, Natural Hazards and Landscape, Vienna, download at: http://bfw.ac.at/700/pdf/BFW_praxis2004_kl.pdf

SCHIELER, K.; BÜCHSENMEISTER, R. & SCHADAUER, K. (1995): Österreichische Forstinventur – Ergebnisse 1986/90. Bericht 92, Federal Office and Research Centre for Forests, Wien.

SCHIELER, K. & HAUK, E. (2001): Instruktion für die Feldarbeit – Österreichische Waldinventur 2000/2002, Fassung 2001. Federal Office and Research Centre for Forests, Wien.

STATISTIK AUSTRIA (1960–2007): Statistik der Landwirtschaft. Statistik Austria, Wien.

STEINER, G., M. & REITER, K. (1992): Österreichischer Moorschutzkatalog-Datenbank. Styria Medien Service. Wien.

STREBL, F., GEBETSROITHER, E. & ORTHOFER, R. (2003): Greenhouse Gas Emission from Cropland & Grassland Management in Austria. ARC-S-0221. Austrian Research Centre, Seibersdorf.

TRUMBORE, S.E.; CHADWICK, O.A. & AMUNDSON, R. (1996): Rapid exchange between soil carbon and atmospheric carbon dioxide driven by temperature change. Science 272: 393–396.

UMWELTBUNDESAMT (2004c): Pilot study on statistics on waste management in agriculture, forestry and fishing – Agriwaste. Umweltbundesamt, Wien.

WEST T.O. (2008): Country-level estimates for Carbon distribution in U.S. croplands, 1990–2005. Environmental Science Division, Oak Ridge National Laboratory. http://cdiac.ornl.gov/carbonmanagement/cropcarbon/.

WINKLER, N. (1997): Country report for Austria. In: Study on European Forestry Information and Communication System Reports – Reports on Forest Inventory and Survey Systems, Volume 1, Office for Official Publications of the European Communities, Luxembourg, 5–74.

KP-LULUCF

BGBL. NR. 440/1975: Forest Act of the Republic of Austria.

FAO: Country Report Austria., Rome, in print.

FRA (2010): Country Report Austria: Global Forest Resources Assessment 2010

JÄGER F.(2003): Forstrecht. 3rd Edition, Verlag Österreich, Wien.

MCPFE LIAISON UNIT AND UNECE/FAO (2003): "State of Europe's Forest 2003". Ministerial Conference on the Protection of Forests in Europe, Liaison Unit Vienna, ISBN 3-902073-09-8.

MCPFE LIAISON UNIT AND UNECE/FAO (2007): "State of Europe's Forest 2007". Ministerial Conference on the Protection of Forests in Europe, Liaison Unit Warsaw, ISBN 10-83-922396-8-7.

RUSS, W. (2004): Mehr Wald – ein positiver Trend? BFW Praxis Information 3/2004, pp. 4-7, Federal Research and Training Centre for Forests, Natural Hazards and Landscape, Vienna, download at: http://bfw.ac.at/700/pdf/BFW_praxis2004_kl.pdf

SCHADAUER K., HAUK E., NIESE G., MEHRANI-MYLANY H., GABLER K., PRSKAWETZ M., MATZIK H., SCHILD A., REGNER B. (2007): Instruktionen für die Feldarbeit der Österreichischen Waldinventur 2007 – 2009. Bundesamt und Forschungszentrum für Wald, Wien.

SCHIELER K., HAUK E. (2001): Instruktion für die Feldarbeit der Österreichischen Waldinventur 2000 – 2002, Fassung 2001. Bundesamt und Forschungszentrum für Wald, Wien, http://bfw.ac.at/700/pdf/da_ges_neu.pdf

Waste

AMLINGER, F.; PEYR, S.; HILDEBRANDT, U.; MÜSKEN, J.; CUHLS, C. & CLEMENS, J. (2005): Stand der Technik der Kompostierung. Grundlagenstudie. Bundesministerium für Land- und Forstwirtschaft, Umwelt und Wasserwirtschaft, Wien. http://www.umweltnet.at/article/articleview/30919/1/6954.

AMLINGER (2003): information from Dipl.Ing. Florian Amlinger – Compost Consulting & Development, Hochbergstrasse A-2380 Perchtoldsdorf.

ANGERER, T. (1997): Stand der Mechanisch-Biologischen Restabfallbehandlung vor der Deponierung (MBRVD) in Österreich – November 1997 – MUL Leoben.

ANGERER, T. & FRÖHLICH, M. (2002): Thermisch Regenerative Oxidation als Verfahren der Abluftreinigung bei mechanisch-biologischen Anlagen zur Behandlung von Abfällen. Schriftenreihe des BMLFUW. Study is not published but can be made available to the ERT upon request.

BAUMELER, BRUNNER, FEHRINGER; KISLIAKOVA & SCHACHMAYER (1998): Reduktion von Treibhausgasen durch Optimierung der Abfallwirtschaft (CH_4). Schriftenreihe der Energieforschungsgemeinschaft im Verband der E-Werke Österreichs. Wien.

UMWELTBUNDESAMT (1995): Boos, R., Neubacher, F.; Reiter, B.; Schindlbauer, H. & Twrdik, F.: Zusammensetzung und Behandlung von Altölen in Österreich. Monographien, Bd. M-054. Umweltbundesamt, Wien.

BUNDESABFALLWIRTSCHAFTSPLAN (BAWP): Bundesabfallbericht 1995. Bundesministerium für Umwelt, Jugend und Familie, Wien.

BUNDESABFALLWIRTSCHAFTSPLAN (BAWP): Bundesabfallbericht 2001. Bundesministerium für Land- und Forstwirtschaft, Umwelt und Wasserwirtschaft, Wien 2001.

BUNDESABFALLWIRTSCHAFTSPLAN (BAWP): Bundesabfallbericht 2006, Bundesministerium für Land- und Forstwirtschaft, Umwelt und Wasserwirtschaft, Wien 2006. Latest (2008) of the annual updates of specific chapters: Statusbericht 2008: http://www.bundesabfallwirtschaftsplan.at/filemanager/download/34724.

BMLFUW (2006): Kommunale Abwasserrichtlinie der EU – 91/271 EWG, Österreichischer Bericht 2006. Wien.

BMLFUW (2008): Kommunale Abwasserrichtlinie der EU – 91/271/EWG. Österreichischer Bericht 2008. Wien 2008.

BMLFUW (2009): Kommunale Abwasserrichtlinie der EU – 91/271/EWG. Fragebogen 2009 der Europäischen Kommission – Überprüfung des Umsetzungsstandes in Österreich. Wien.

DOEDENS, H.; CUHLS, C.; MÖNKEBERG, F.; LEVSEN, K.; KRUPPA, J.; SÄNGER, U. & KOCK, H. (1999): Bilanzierung von Umweltchemikalien bei der biologischen Vorbehandlung von Restabfällen, Phase 2: Emissionen, Schadstoffbilanzen und Abluftbehandlung. BMB+F Verbundvorhaben: Mechanisch-biologische Vorbehandlung von zu deponierenden Abfällen.

DOMENIG (2004): information from Mag. Manfred Domenig, expert for waste management at the Umweltbundesamt Klagenfurt.

GEWÄSSERSCHUTZBERICHT (1993, 1996, 1999, 2002): Gewässerschutzbericht gemäß § 33e Wasserrechtsgesetz BGBl. Nr. 215/1959 i.d.F. BGBl. I Nr. 156/2002. Bundesministerium für Land- und Forstwirtschaft, Umwelt und Wasserwirtschaft, Wien.

GILBERG et al. (2005): Waste management in Europe and the Landfill Directive, Background paper from the ETC/RWM to the ETC/ACC workshop „Inventories and Projections of Greenhouse Gas Emissions from Waste"; European Environment Agency.

HACKL, A. & MAUSCHITZ, G. (1999): Beiträge zum Klimaschutz durch nachhaltige Restmüllbehandlung. Studie im Auftrag des Bundesministeriums für Umwelt, Jugend und Familie, Weitra.

KAUSEL, A.: (1998): Ein halbes Jahrhundert des Erfolges, Der ökonomische Aufstieg Österreichs im OECD-Raum seit 1950. Österreichische Nationalbank, Wien.

LAHL U., ZESCHMAR-LAHL B. & SCHEIDL K. (1998): Abluftemissionen aus der mechanisch-biologischen Abfallbehandlung in Österreich. Klagenfurt.

LAHL U., ZESCHMAR-LAHL B. & ANGERER T. (2000): Entwicklungspotentiale der mechanisch-biologischen Abfallbehandlung. Eine ökologische Analyse. Wien.

ORTHOFER R., KNOFLACHER M. & ZÜGER J. (1995): N_2O Emissionen in Österreich. Seibersdorf Research, Seibersdorf.

UMWELTBUNDESAMT (1998): Scharf S., Schneider M. & Zethner G.: Zur Situation der Verwertung und Entsorgung des kommunalen Klärschlammes in Österreich. Monographien, Bd. M-095. Umweltbundesamt, Wien.

UMWELTBUNDESAMT (2001a): Emissionsfaktoren als Grundlage für die Österreichische Luftschadstoff-Inventur Stand 1999. Interne Berichte, Bd. IB-614. Umweltbundesamt, Wien.

UMWELTBUNDESAMT (2001c): Häusler, G.: Emissionen aus Abfalldeponien 1980–1998, Interner Bericht, Bd. IB-623. Umweltbundesamt, Wien.

UMWELTBUNDESAMT (2001d): Perz, K.: Materialien zum Bundesabfallwirtschaftsplan 2001, Monographien, Bd. M-138, Umweltbundesamt, Klagenfurt.

UMWELTBUNDESAMT (2001e): Grech H. & Rolland C.: Stand der Abfallbehandlung in Österreich im Hinblick auf das Jahr 2004. Berichte, Bd. BE-182. Umweltbundesamt, Wien.

UMWELTBUNDESAMT (2003): Rolland, C. & Scheibengraf, M.: Biologisch abbaubarer Kohlenstoff im Restmüll. Berichte, Bd. BE-236. Umweltbundesamt, Wien.

UMWELTBUNDESAMT (2004): Rolland, C. & Oliva, J.: Erfassung von Deponiegas – Statusbericht von österreichischen Deponien. Berichte, Bd. BE-238. Umweltbundesamt, Wien.

UMWELTBUNDESAMT (2005): Schachermayer E.: Vergleich und Evaluierung verschiedener Modelle zur Berechnung der Methanemissionen aus Deponien. Umweltbundesamt, Wien. Study has not been published, but can be made available upon request.

UMWELTBUNDESAMT (2006a): Neubauer C. & Öhlinger A.: Ist-Stand der mechanisch biologischen Abfallbehandlung (MBA) in Österreich, Zustandsbericht 2006. Umweltbundesamt, Wien.

UMWELTBUNDESAMT (2007c): Lenz, K. & Kampel, E.: Nitrous Oxide emissions from industrial wastewater, Interne Studie, Umweltbundesamt, Wien.

UMWELTBUNDESAMT (2008b): Query of data from the National Austrian Waste Water Database. Vienna.

UMWELTBUNDESAMT (2008c): Schachermayer, E. & Lampert, C.: Erfasste Deponiegasmengen auf Österreichischen Deponien – Zeitreihe für die Jahre 2002 bis 2007. Reports, Bd. REP-0100. Umweltbundesamt, Wien.

UMWELTBUNDESAMT (2008d): Neubauer C. & Walter B.: Behandlung von gemischten Siedlungs- und Gewerbeabfällen in Österreich – Betrachtungszeitraum 2003–2008. Umweltbundesamt, Wien.

STEINLECHNER, E.; BERGHOLD, H.; CATE, F.M.; JUNGMEIER, G.; SPITZER, J. & WUTZL, C. (1994): Möglichkeiten zur Vermeidung und Nutzung anthropogener Methanemissionen. Report des Joanneum Research: Institut für Umweltgeologie und Ökosystemforschung.

UBA BERLIN (1999): MBA Bericht: Ökologische Vertretbarkeit mechanisch-biologischer Vorbehandlung von Restabfällen.

ANNEX

ANNEX 1: KEY CATEGORY ANALYSIS

Methodology for identification of key categories

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 A-9 of Annex 1 presents the 152 defined source categories and their greenhouse gas emissions expressed in CO_2 equivalent emissions for the years 1990 to 2008.

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 2008 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 2008 29 source categories comprised > 95% of the cumulative total and were thus rated as key categories. For the year 1990 30 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 2008 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 1.2.

Level Assessment including LULUCF

The level assessment was repeated for the full inventory including the LULUCF categories for the years 1990 and 2008 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 1.2.

Trend Assessment including LULUCF

Also the trend assessment was repeated for the full inventory including the LULUCF categories for the years 1990 and 2008 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 1.2.

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.

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 descending order of magnitude of contribution to total national GHG emissions.

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.

Results of the key category analysis

Results are presented for the level assessments for the years 1990 and 2008, and for the trend assessment 1990-2008, 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 2008 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	14.46%	14.46%
2	1 A 3 b gasoline	Road Transportation	CO2	Gg	7 941.6	10.16%	24.62%
3	1 A 4 stat-liquid	Other Sectors	CO2	Gg	7 319.1	9.36%	33.98%
4	1 A 1 a solid	Public Electricity and Heat Production	CO2	Gg	6 247.0	7.99%	41.97%
5	1 A 3 b diesel oil	Road Transportation	CO2	Gg	5 341.5	6.83%	48.80%
6	1 A 2 solid	Manufacturing Industries and Construction	CO2	Gg	5 016.3	6.42%	55.22%
7	4 A 1	Cattle	CH4	Gg CO2 e	3 550.8	4.54%	59.76%
8	2 C 1	Iron and Steel Production	CO2	Gg	3 545.7	4.54%	64.30%
9	6 A	Solid Waste Disposal on Land	CH4	Gg CO2 e	3 314.3	4.24%	68.54%
10	1 A 2 stat-liquid	Manufacturing Industries and Construction	CO2	Gg	2 883.6	3.69%	72.23%
11	1 A 4 solid	Other Sectors	CO2	Gg	2 654.1	3.40%	75.62%
12	2 A 1	Cement Production	CO2	Gg	2 033.4	2.60%	78.22%
13	1 A 1 b liquid	Petroleum refining	CO2	Gg	1 957.7	2.50%	80.73%
14	4 D 1	Direct Soil Emissions	N2O	Gg CO2 e	1 908.8	2.44%	83.17%
15	4 D 3	Indirect Emissions	N2O	Gg CO2 e	1 352.2	1.73%	84.90%
16	1 A 1 a liquid	Public Electricity and Heat Production	CO2	Gg	1 228.7	1.57%	86.47%
17	2.C.3	Aluminium production	PFC	Gg CO2 e	1 050.2	1.34%	87.81%
18	2 B 2	Nitric Acid Production	N2O	Gg CO2 e	912.0	1.17%	88.98%
19	4 B 1	Cattle	N2O	Gg CO2 e	758.5	0.97%	89.95%
20	1 A 4 mobile-diesel	Other Sectors	CO2	Gg	737.2	0.94%	90.89%
21	2 B 1	Ammonia Production	CO2	Gg	516.6	0.66%	91.56%
22	2 A 7 b	Sinter Production	CO2	Gg	481.2	0.62%	92.17%
23	2 A 2	Lime Production	CO2	Gg	396.2	0.51%	92.68%
24	1 A 4 other	Other Sectors	CO2	Gg	349.6	0.45%	93.13%
25	1 A 4 biomass	Other Sectors	CH4	Gg CO2 e	315.9	0.40%	93.53%
26	4 B 1	Cattle	CH4	Gg CO2 e	282.3	0.36%	93.89%
27	3	Solvent and other Product Use	CO2	Gg	279.3	0.36%	94.25%
28	1 A 2 other	Manufacturing Industries and Construction	CO2	Gg	264.1	0.34%	94.59%
29	1 A 2 mobile-liquid	Manufacturing Industries and Construction	CO2	Gg	255.7	0.33%	94.91%
30	2.C.4	SF6 Used in Al and Mg Foundries	SF6	Gg CO2 e	253.3	0.32%	95.24%

Table A 2: Level Assessment of the key category analysis excluding LULUCF for the year 2008.

Rank	IPCC Source Categories		GHG	Unit	2008	Level Assessment	Cumulative Total
1	1 A gaseous	Fuel Combustion (stationary)	CO2	Gg	16 832.8	19.4%	19.43%
2	1 A 3 b diesel oil	Road Transportation	CO2	Gg	16 017.7	18.5%	37.92%
3	1 A 4 stat-liquid	Other Sectors	CO2	Gg	5 786.0	6.7%	44.59%
4	2 C 1	Iron and Steel Production	CO2	Gg	5 770.2	6.7%	51.25%
5	1 A 2 solid	Manufacturing Industries and Construction	CO2	Gg	5 453.5	6.3%	57.55%
6	1 A 3 b gasoline	Road Transportation	CO2	Gg	5 393.0	6.2%	63.77%
7	1 A 1 a solid	Public Electricity and Heat Production	CO2	Gg	4 439.8	5.1%	68.90%
8	4 A 1	Cattle	CH4	Gg CO2 e	3 019.8	3.5%	72.38%
9	1 A 1 b liquid	Petroleum refining	CO2	Gg	2 403.4	2.8%	75.16%
10	2 A 1	Cement Production	CO2	Gg	2 133.0	2.5%	77.62%
11	1 A 2 stat-liquid	Manufacturing Industries and Construction	CO2	Gg	1 923.8	2.2%	79.84%
12	4 D 1	Direct Soil Emissions	N2O	Gg CO2 e	1 878.3	2.2%	82.01%
13	6 A	Solid Waste Disposal	CH4	Gg CO2 e	1 557.5	1.8%	83.80%
14	4 D 3	Indirect Emissions	N2O	Gg CO2 e	1 199.6	1.4%	85.19%
15	1 A 2 mobile-liquid	Manufacturing Industries and Construction	CO2	Gg	1 152.2	1.3%	86.52%
16	2 F 1/2/3/4/5	ODS Substitutes	HFC,PFC	Gg CO2 e	1 057.9	1.2%	87.74%
17	1 A 4 mobile-diesel	Other Sectors	CO2	Gg	797.8	0.9%	88.66%
18	4 B 1	Cattle	N2O	Gg CO2 e	736.4	0.8%	89.51%
19	1 A 1 a liquid	Public Electricity and Heat Production	CO2	Gg	688.6	0.8%	90.30%
20	1 A 2 other	Manufacturing Industries and Construction	CO2	Gg	685.8	0.8%	91.10%
21	2 A 2	Lime Production	CO2	Gg	621.1	0.7%	91.81%
22	1 A 1 a other	Public Electricity and Heat Production	CO2	Gg	553.0	0.6%	92.45%
23	2 B 1	Ammonia Production	CO2	Gg	532.5	0.6%	93.07%
24	1 A 4 solid	Other Sectors	CO2	Gg	399.8	0.5%	93.53%
25	2 A 7 b	Sinter Production	CO2	Gg	332.0	0.4%	93.91%
26	2 B 2	Nitric Acid Production	N2O	Gg CO2 e	325.8	0.4%	94.29%
27	2 A 3	Limestone and Dolomite Use	CO2	Gg	280.7	0.3%	94.61%
28	2.F.7	Semiconductor Manufacture	FC	Gg CO2 e	279.5	0.3%	94.93%
29	6 B	Waste Water Handling	N2O	Gg CO2 e	260.1	0.3%	95.23%

Table A 3: Trend Assessment of the key category analysis excluding LULUCF for the trend 1990 - 2008

Rank	IPCC Source Categories		GHG	Unit	BY	2008	LA	TA	Contribution to Trend	Cumulative Total
1	1 A 3 b diesel oil	Road Transportation	CO2	Gg	5 341.5	16 017.7	18.49%	0.105	24.75%	24.75%
2	1 A gaseous	Fuel Combustion (stationary)	CO2	Gg	11 300.5	16 832.8	19.43%	0.045	10.56%	35.31%
3	1 A 3 b gasoline	Road Transportation	CO2	Gg	7 941.6	5 393.0	6.22%	0.036	8.36%	43.67%
4	1 A 4 solid	Other Sectors	CO2	Gg	2 654.1	399.8	0.46%	0.026	6.23%	49.90%
5	1 A 1 a solid	Public Electricity and Heat Production	CO2	Gg	6 247.0	4 439.8	5.12%	0.026	6.09%	55.99%
6	1 A 4 stat-liquid	Other Sectors	CO2	Gg	7 319.1	5 786.0	6.68%	0.024	5.70%	61.69%
7	6 A	Solid Waste Disposal on Land	CH4	Gg CO2 e	3 314.3	1 557.5	1.80%	0.022	5.19%	66.87%
8	2 C 1	Iron and Steel Production	CO2	Gg	3 545.7	5 770.2	6.66%	0.019	4.51%	71.39%
9	1 A 2 stat-liquid	Manufacturing Industries and Construction	CO2	Gg	2 883.6	1 923.8	2.22%	0.013	3.12%	74.50%
10	2.C.3	Aluminium production	PFC	Gg CO2 e	1 050.2	0.0	0.00%	0.012	2.85%	77.36%
11	2 F 1/2/3/4/5	ODS Substitutes	HFC,PFC	Gg CO2 e	24.4	1 057.9	1.22%	0.011	2.53%	79.88%
12	4 A 1	Cattle	CH4	Gg CO2 e	3 550.8	3 019.8	3.49%	0.010	2.24%	82.13%
13	1 A 2 mobile-liquic	Manufacturing Industries and Construction	CO2	Gg	255.7	1 152.2	1.33%	0.009	2.13%	84.26%
14	2 B 2	Nitric Acid Production	N2O	Gg CO2 e	912.0	325.8	0.38%	0.007	1.68%	85.94%
15	1 A 1 a liquid	Public Electricity and Heat Production	CO2	Gg	1 228.7	688.6	0.79%	0.007	1.65%	87.59%
16	1 A 1 a other	Public Electricity and Heat Production	CO2	Gg	118.0	553.0	0.64%	0.004	1.03%	88.62%
17	1 A 2 other	Manufacturing Industries and Construction	CO2	Gg	264.1	685.8	0.79%	0.004	0.96%	89.59%
18	4 D 3	Indirect Emissions	N2O	Gg CO2 e	1 352.2	1 199.6	1.38%	0.003	0.73%	90.32%
19	2.C.4	SF6 Used in Al and Mg Foundries	SF6	Gg CO2 e	253.3	0.3	0.00%	0.003	0.69%	91.01%
20	4 D 1	Direct Soil Emissions	N2O	Gg CO2 e	1 908.8	1 878.3	2.17%	0.002	0.58%	91.59%
21	1 A 1 b liquid	Petroleum refining	CO2	Gg	1 957.7	2 403.4	2.77%	0.002	0.57%	92.16%
22	2 A 7 b	Sinter Production	CO2	Gg	481.2	332.0	0.38%	0.002	0.49%	92.65%
23	2 A 2	Lime Production	CO2	Gg	396.2	621.1	0.72%	0.002	0.45%	93.10%
24	2 C 3	Aluminium production	CO2	Gg	158.4	0.0	0.00%	0.002	0.43%	93.53%
25	1 A 4 biomass	Other Sectors	CH4	Gg CO2 e	315.9	202.1	0.23%	0.002	0.36%	93.89%
26	6 B	Wastewater Handling	N2O	Gg CO2 e	108.4	260.1	0.30%	0.001	0.34%	94.24%
27	1 A 4 other	Other Sectors	CO2	Gg	349.6	252.7	0.29%	0.001	0.33%	94.57%
28	2.F.7	Semiconductor Manufacture	FC	Gg CO2 e	133.1	279.5	0.32%	0.001	0.32%	94.89%
29	2 A 1	Cement Production	CO2	Gg	2 033.4	2 133.0	2.46%	0.001	0.30%	95.19%

Table A 4: Level Assessment of the key category analysis including LULUCF for the base 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	-11 511.2	11 511.2	11.6%	11.6%
2	1 A gaseous	Fuel Combustion (stationary)	CO2	Gg	11 300.5	11 300.5	11.3%	22.9%
3	1 A 3 b gasoline	Road Transportation	CO2	Gg	7 941.6	7 941.6	8.0%	30.9%
4	1 A 4 stat-liquid	1 A 4 stat-liquid	CO2	Gg	7 319.1	7 319.1	7.3%	38.2%
5	1 A 1 a solid	Public Electricity and Heat Production	CO2	Gg	6 247.0	6 247.0	6.3%	44.5%
6	1 A 3 b diesel oil	Road Transportation	CO2	Gg	5 341.5	5 341.5	5.4%	49.9%
7	1 A 2 solid	Manufacturing Industries and Construction	CO2	Gg	5 016.3	5 016.3	5.0%	54.9%
8	5 A 2	Land converted to forest land	CO2	Gg	-4 402.2	4 402.2	4.4%	59.3%
9	4 A 1	Cattle	CH4	Gg CO2 e	3 550.8	3 550.8	3.6%	62.9%
10	2 C 1	Iron and Steel Production	CO2	Gg	3 545.7	3 545.7	3.6%	66.4%
11	6 A	SOLID WASTE DISPOSAL ON LAND	CH4	Gg CO2 e	3 314.3	3 314.3	3.3%	69.8%
12	1 A 2 stat-liquid	Manufacturing Industries and Construction	CO2	Gg	2 883.6	2 883.6	2.9%	72.7%
13	1 A 4 solid	Other Sectors	CO2	Gg	2 654.1	2 654.1	2.7%	75.3%
14	2 A 1	Cement Production	CO2	Gg	2 033.4	2 033.4	2.0%	77.4%
15	1 A 1 b liquid	Petroleum refining	CO2	Gg	1 957.7	1 957.7	2.0%	79.3%
16	4 D 1	Direct Soil Emissions	N2O	Gg CO2 e	1 908.8	1 908.8	1.9%	81.2%
17	5 B 2	Land converted to cropland	CO2	Gg	1 825.0	1 825.0	1.8%	83.1%
18	4 D 3	Indirect Emissions	N2O	Gg CO2 e	1 352.2	1 352.2	1.4%	84.4%
19	1 A 1 a liquid	Public Electricity and Heat Production	CO2	Gg	1 228.7	1 228.7	1.2%	85.7%
20	5 C 2	Land converted to grassland	CO2	Gg	-1 060.7	1 060.7	1.1%	86.7%
21	2.C.3	Aluminium production	PFC	Gg CO2 e	1 050.2	1 050.2	1.1%	87.8%
22	2 B 2	Nitric Acid Production	N2O	Gg CO2 e	912.0	912.0	0.9%	88.7%
23	5 F 2	Land converted to Other land	CO2	Gg	809.9	809.9	0.8%	89.5%
24	5 E 2	Land converted to Settlements	CO2	Gg	759.1	759.1	0.8%	90.3%
25	4 B 1	Cattle	N2O	Gg CO2 e	758.5	758.5	0.8%	91.0%
26	1 A 4 mobile-diesel	1 A 4 mobile-diesel	CO2	Gg	737.2	737.2	0.7%	91.8%
27	2 B 1	Ammonia Production	CO2	Gg	516.6	516.6	0.5%	92.3%
28	2 A 7 b	Sinter Production	CO2	Gg	481.2	481.2	0.5%	92.8%
29	5	Total land use categories	N2O	Gg CO2e	431.5	431.5	0.4%	93.2%
30	2 A 2	Lime Production	CO2	Gg	396.2	396.2	0.4%	93.6%
31	1 A 4 other	Other Sectors	CO2	Gg	349.6	349.6	0.4%	94.0%
32	5 B 1	Cropland remaining cropland	CO2	Gg	-320.0	320.0	0.3%	94.3%
33	1 A 4 biomass	Other Sectors	CH4	Gg CO2 e	315.9	315.9	0.3%	94.6%
34	4 B 1	Cattle	CH4	Gg CO2 e	282.3	282.3	0.3%	94.9%
35	3	SOLVENT AND OTHER PRODUCT USE	CO2	Gg	279.3	279.3	0.3%	95.2%

Table A 5: Level Assessment of the key category analysis including LULUCF for the year 2008.

Rank		IPCC Source Categories	GHG	Unit	2008	2008 ABS	Level Assessment	Cumulative Total
1	5 A 1	Forest land remaining forest l	CO2	Gg	-16 974.3	16 974.3	15.27%	15.27%
2	1 A gaseous	Fuel Combustion (stationary)	CO2	Gg	16 832.8	16 832.8	15.14%	30.41%
3	1 A 3 b diesel oil	Road Transportation	CO2	Gg	16 017.7	16 017.7	14.41%	44.82%
4	1 A 4 stat-liquid	Other Sectors	CO2	Gg	5 786.0	5 786.0	5.21%	50.03%
5	2 C 1	Iron and Steel Production	CO2	Gg	5 770.2	5 770.2	5.19%	55.22%
6	1 A 2 solid	Manufacturing Industries and	CO2	Gg	5 453.5	5 453.5	4.91%	60.12%
7	1 A 3 b gasoline	Road Transportation	CO2	Gg	5 393.0	5 393.0	4.85%	64.98%
8	1 A 1 a solid	Public Electricity and Heat Pro	CO2	Gg	4 439.8	4 439.8	3.99%	68.97%
9	4 A 1	Cattle	CH4	Gg CO2 e	3 019.8	3 019.8	2.72%	71.69%
10	5 A 2	Land converted to forest land	CO2	Gg	-2 537.8	2 537.8	2.28%	73.97%
11	1 A 1 b liquid	Petroleum refining	CO2	Gg	2 403.4	2 403.4	2.16%	76.13%
12	2 A 1	Cement Production	CO2	Gg	2 133.0	2 133.0	1.92%	78.05%
13	1 A 2 stat-liquid	Manufacturing Industries and	CO2	Gg	1 923.8	1 923.8	1.73%	79.78%
14	4 D 1	Direct Soil Emissions	N2O	Gg CO2 e	1 878.3	1 878.3	1.69%	81.47%
15	5 B 2	Land converted to cropland	CO2	Gg	1 787.6	1 787.6	1.61%	83.08%
16	6 A	Solid Waste Disposal on Lan	CH4	Gg CO2 e	1 557.5	1 557.5	1.40%	84.48%
17	5 C 2	Land converted to grassland	CO2	Gg	-1 330.3	1 330.3	1.20%	85.68%
18	4 D 3	Indirect Emissions	N2O	Gg CO2 e	1 199.6	1 199.6	1.08%	86.75%
19	1 A 2 mobile-liqu	Manufacturing Industries and	CO2	Gg	1 152.2	1 152.2	1.04%	87.79%
20	2 F 1/2/3/4/5	ODS Substitutes	HFC,PFC	Gg CO2 e	1 057.9	1 057.9	0.95%	88.74%
21	1 A 4 mobile-die	Other Sectors	CO2	Gg	797.8	797.8	0.72%	89.46%
22	4 B 1	Cattle	N2O	Gg CO2 e	736.4	736.4	0.66%	90.12%
23	1 A 1 a liquid	Public Electricity and Heat Pro	CO2	Gg	688.6	688.6	0.62%	90.74%
24	1 A 2 other	Manufacturing Industries and	CO2	Gg	685.8	685.8	0.62%	91.36%
25	2 A 2	Lime Production	CO2	Gg	621.1	621.1	0.56%	91.92%
26	1 A 1 a other	Public Electricity and Heat Pro	CO2	Gg	553.0	553.0	0.50%	92.42%
27	2 B 1	Ammonia Production	CO2	Gg	532.5	532.5	0.48%	92.90%
28	5 E 2	Land converted to Settlements	CO2	Gg	517.5	517.5	0.47%	93.36%
29	5 F 2	Land converted to Other land	CO2	Gg	456.7	456.7	0.41%	93.77%
30	1 A 4 solid	Other Sectors	CO2	Gg	399.8	399.8	0.36%	94.13%
31	5 D 2	Land converted to Wetlands	CO2	Gg	377.0	377.0	0.34%	94.47%
32	2 A 7 b	Sinter Production	CO2	Gg	332.0	332.0	0.30%	94.77%
33	2 B 2	Nitric Acid Production	N2O	Gg CO2 e	325.8	325.8	0.29%	95.06%

Table A 6: Trend Assessment of the key category analysis including LULUCF for the trend 1990–2008.

Rank		IPCC Source Categories	GHG	Unit	BY	2008	2008 ABS	Level Assessment	Trend Assessment	Contribution to Trend	Cumulative Total
1	1 A 3 b diesel oil	Road Transportation	CO2	Gg	5 341.5	16 017.7	16 017.7	14.41%	0.087	21.04%	21.04%
2	1 A gaseous	Fuel Combustion (stationary)	CO2	Gg	11 300.5	16 832.8	16 832.8	15.14%	0.040	9.76%	30.80%
3	5 A 1	Forest land remaining forest land	CO2	Gg	-11 511.2	-16 974.3	16 974.3	15.27%	0.040	9.59%	40.39%
4	1 A 3 b gasoline	Road Transportation	CO2	Gg	7 941.6	5 393.0	5 393.0	4.85%	0.026	6.26%	46.64%
5	1 A 4 solid	Other Sectors	CO2	Gg	2 654.1	399.8	399.8	0.36%	0.021	4.95%	51.59%
6	1 A 1 a solid	Public Electricity and Heat Production	CO2	Gg	6 247.0	4 439.8	4 439.8	3.99%	0.019	4.52%	56.11%
7	5 A 2	Land converted to forest land	CO2	Gg	-4 402.2	-2 537.8	2 537.8	2.28%	0.018	4.39%	60.50%
8	1 A 4 stat-liquid	Other Sectors	CO2	Gg	7 319.1	5 786.0	5 786.0	5.21%	0.017	4.10%	64.60%
9	2 C 1	Iron and Steel Production	CO2	Gg	3 545.7	5 770.2	5 770.2	5.19%	0.017	4.06%	68.66%
10	6 A	Solid Waste Disposal on Land	CH4	Gg CO2 e	3 314.3	1 557.5	1 557.5	1.40%	0.017	4.02%	72.68%
11	2.C.3	Aluminium production	PFC	Gg CO2 e	1 050.2	0.0	0.0	0%	0.015	3.66%	76.34%
12	1 A 2 stat-liquid	Manufacturing Industries and Construction	CO2	Gg	2 883.6	1 923.8	1 923.8	1.73%	0.010	2.34%	78.68%
13	2 F 1/2/3/4/5	ODS Substitutes	HFC,PFC	Gg CO2 e	24.4	1 057.9	1 057.9	0.95%	0.009	2.10%	80.78%
14	1 A 2 mobile-liqu	Manufacturing Industries and Construction	CO2	Gg	255.7	1 152.2	1 152.2	1.04%	0.007	1.79%	82.57%
15	4 A 1	Cattle	CH4	Gg CO2 e	3 550.8	3 019.8	3 019.8	2.72%	0.006	1.56%	84.13%
16	2 B 2	Nitric Acid Production	N2O	Gg CO2 e	912.0	325.8	325.8	0.29%	0.005	1.32%	85.45%
17	1 A 1 a liquid	Public Electricity and Heat Production	CO2	Gg	1 228.7	688.6	688.6	0.62%	0.005	1.26%	86.71%
18	1 A 1 a other	Public Electricity and Heat Production	CO2	Gg	118.0	553.0	553.0	0.50%	0.004	0.87%	87.58%
19	5 F 2	Land converted to Other land	CO2	Gg	809.9	456.7	456.7	0.41%	0.003	0.83%	88.41%
20	1 A 2 other	Manufacturing Industries and Construction	CO2	Gg	264.1	685.8	685.8	0.62%	0.003	0.82%	89.23%
21	1 A 1 b liquid	Petroleum refining	CO2	Gg	1 957.7	2 403.4	2 403.4	2.16%	0.003	0.65%	89.88%
22	5 E 2	Land converted to Settlements	CO2	Gg	759.1	517.5	517.5	0.47%	0.002	0.59%	90.47%
23	2 C 3	Aluminium production	CO2	Gg	158.4	0.0	0.0	0%	0.002	0.55%	91.03%
24	2.C.4	SF6 Used in Al and Mg Foundries	SF6	Gg CO2 e	253.3	0.3	0.3	0%	0.002	0.55%	91.57%
25	5 B 1	Cropland remaining cropland	CO2	Gg	-320.0	-86.4	86.4	0%	0.002	0.52%	92.09%
26	4 D 3	Indirect Emissions	N2O	Gg CO2 e	1 352.2	1 199.6	1 199.6	1.08%	0.002	0.49%	92.59%
27	5 C 2	Land converted to grassland	CO2	Gg	-1 060.7	-1 330.3	1 330.3	1.20%	0.002	0.41%	92.99%
28	2 A 2	Lime Production	CO2	Gg	396.2	621.1	621.1	0.56%	0.002	0.41%	93.40%
29	2 A 7 b	Sinter Production	CO2	Gg	481.2	332.0	332.0	0.30%	0.002	0.37%	93.77%
30	5 D 2	Land converted to Wetlands	CO2	Gg	199.7	377.0	377.0	0.34%	0.001	0.33%	94.10%
31	5 B 2	Land converted to cropland	CO2	Gg	1 825.0	1 787.6	1 787.6	1.61%	0.001	0.32%	94.42%
32	4 D 1	Direct Soil Emissions	N2O	Gg CO2 e	1 908.8	1 878.3	1 878.3	1.69%	0.001	0.32%	94.74%
33	6 B	Wastewater Handling	N2O	Gg CO2 e	108.4	260.1	260.1	0.23%	0.001	0.29%	95.03%

Table A 7: Key categories identified including their ranking in the level and trend assessment for the KCA excluding LULUCF

IPCC Category Description		Gas	LA 1990	LA 2008	TA 2008	Q	Emi BY	Share BY	Emi 2008	Share 2008
1 A 1 a liquid	Public Electricity and Heat Production	CO2	16	19	15		1 228.7	1.6%	688.6	0.8%
1 A 1 a other	Public Electricity and Heat Production	CO2		22	16		118.0	0.2%	553.0	0.6%
1 A 1 a solid	Public Electricity and Heat Production	CO2	4	7	5		6 247.0	8.0%	4 439.8	5.1%
1 A 1 b liquid	Petroleum refining	CO2	13	9	21		1 957.7	2.5%	2 403.4	2.8%
1 A 2 mobile-liquid	Manufacturing Industries and Construction	CO2	29	15	13		255.7	0.3%	1 152.2	1.3%
1 A 2 other	Manufacturing Industries and Construction	CO2	28	20	17		264.1	0.3%	685.8	0.8%
1 A 2 solid	Manufacturing Industries and Construction	CO2	6	5			5 016.3	6.4%	5 453.5	6.3%
1 A 2 stat-liquid	Manufacturing Industries and Construction	CO2	10	11	9		2 883.6	3.7%	1 923.8	2.2%
1 A 3 a jet kerosene	Civil Aviation	CO2				x	24.2	0.0%	61.5	0.1%
1 A 3 b diesel oil	Road Transportation	CO2	5	2	1		5 341.5	6.8%	16 017.7	18.5%
1 A 3 b gasoline	Road Transportation	CO2	2	6	3		7 941.6	10.2%	5 393.0	6.2%
1 A 4 biomass	Other Sectors	CH4	25		25		315.9	0.4%	202.1	0.2%
1 A 4 mobile-diesel	Other Sectors	CO2	20	17			737.2	0.9%	797.8	0.9%
1 A 4 other	Other Sectors	CO2	24		27		349.6	0.4%	252.7	0.3%
1 A 4 solid	Other Sectors	CO2	11	24	4		2 654.1	3.4%	399.8	0.5%
1 A 4 stat-liquid	Other Sectors	CO2	3	3	6		7 319.1	9.4%	5 786.0	6.7%
1 A gaseous	Fuel Combustion (stationary)	CO2	1	1	2		11 300.5	14.5%	16 832.8	19.4%
1 B 2 b	Natural Gas	CH4				x	97.6	0.1%	133.4	0.2%
2 A 1	Cement Production	CO2	12	10	29		2 033.4	2.6%	2 133.0	2.5%
2 A 2	Lime Production	CO2	23	21	23		396.2	0.5%	621.1	0.7%
2 A 3	Limestone and Dolomite Use	CO2		27			203.2	0.3%	280.7	0.3%
2 A 7 b	Sinter Production	CO2	22	25	22		481.2	0.6%	332.0	0.4%
2 B 1	Ammonia Production	CO2	21	23			516.6	0.7%	532.5	0.6%
2 B 2	Nitric Acid Production	N2O	18	26	14		912.0	1.2%	325.8	0.4%
2 C 1	Iron and Steel Production	CO2	8	4	8		3 545.7	4.5%	5 770.2	6.7%
2.C.3	Aluminium production	PFC	17		10		1 050.2	1.3%	0.0	0.0%
2.C.3	Aluminium production	CO2			24	x	158.4	0.2%	0.0	0.0%
2.C.4	SF6 Used in Al and Mg Foundries	SF6	30		19		253.3	0.3%	0.3	0.0%
2 F 1/2/3/4/5	ODS Substitutes	HFC,PFC		16	11		24.4	0.0%	1 057.9	1.2%
2.F.7	Semiconductor Manufacture	FC		28	28		133.1	0.2%	279.5	0.3%
2 F 9	Other Sources of SF6	SF6				x	126.6	0.2%	250.0	0.3%
3	Solvent and other Product Use	CO2	27				279.3	0.4%	231.9	0.3%
4 A 1	Cattle	CH4	7	8	12		3 550.8	4.5%	3 019.8	3.5%
4 B 1	Cattle	N2O	19	18			758.5	1.0%	736.4	0.8%
4 B 1	Cattle	CH4	26				282.3	0.4%	216.8	0.3%
4 B 8	Swine	CH4				x	123.3	0.2%	74.0	0.1%
4 D 1	Direct Soil Emissions	N2O	14	12	20		1 908.8	2.4%	1 878.3	2.2%
4 D 2	Pasture, Range and Paddock Manure	N2O				x	168.7	0.2%	93.6	0.1%
4 D 3	Indirect Emissions	N2O	15	14	18		1 352.2	1.7%	1 199.6	1.4%
6 A	Solid Waste Disposal on Land	CH4	9	13	7		3 314.3	4.2%	1 557.5	1.8%
6 B	Waste Water Handling	N2O		29	26		108.4	0.1%	260.1	0.3%

Table A 8: Key categories identified including their ranking in the level and trend assessment for the KCA including LULUCF

IPCC Category Description		Gas	LA 1990	LA 2008	TA 2008	Q	Emi BY	Emi 2008
1 A 1 a liquid	Public Electricity and Heat Production	CO2	***19***	***23***	***17***		1 228.7	688.6
1 A 1 a other	Public Electricity and Heat Production	CO2		***26***	***18***		118.0	553.0
1 A 1 a solid	Public Electricity and Heat Production	CO2	***5***	***8***	***6***		6 247.0	4 439.8
1 A 1 b liquid	Petroleum refining	CO2	***15***	***11***	***21***		1 957.7	2 403.4
1 A 2 mobile-liquid	Manufacturing Industries and Construction	CO2		***19***	***14***		255.7	1 152.2
1 A 2 other	Manufacturing Industries and Construction	CO2		***24***	***20***		264.1	685.8
1 A 2 solid	Manufacturing Industries and Construction	CO2	***7***	***6***			5 016.3	5 453.5
1 A 2 stat-liquid	Manufacturing Industries and Construction	CO2	***12***	***13***	***12***		2 883.6	1 923.8
1 A 3 a jet kerosene	Civil Aviation	CO2				***x***	24.2	61.5
1 A 3 b diesel oil	Road Transportation	CO2	***6***	***3***	***1***		5 341.5	16 017.7
1 A 3 b gasoline	Road Transportation	CO2	***3***	***7***	***4***		7 941.6	5 393.0
1 A 4 biomass	Other Sectors	CH4	***33***	***42***			315.9	202.1
1 A 4 mobile-diesel	Other Sectors	CO2	***26***	***21***			737.2	797.8
1 A 4 other	Other Sectors	CO2	***31***	***38***			349.6	252.7
1 A 4 solid	Other Sectors	CO2	***13***	***30***	***5***		2 654.1	399.8
1 A 4 stat-liquid	Other Sectors	CO2	***4***	***4***	***8***		7 319.1	5 786.0
1 A gaseous	Fuel Combustion (stationary)	CO2	***2***	***2***	***2***		11 300.5	16 832.8
1 B 2 b	Natural gas	CH4				***x***	59.1	77.2
2 A 1	Cement Production	CO2	***14***	***12***			2 033.4	2 133.0
2 A 2	Lime Production	CO2	***30***	***25***	***28***		396.2	621.1
2 A 3	Limestone and Dolomite Use	CO2				***x***	203.2	280.7
2 A 7 b	Sinter Production	CO2	***28***	***32***	***29***		481.2	332.0
2 B 1	Ammonia Production	CO2	***27***	***27***			516.6	532.5
2 B 2	Nitric Acid Production	N2O	***22***	***33***	***16***		912.0	325.8
2 C 1	Iron and Steel Production	CO2	***10***	***5***	***9***		3 545.7	5 770.2
2.C.3	Aluminium production	PFC	***21***		***11***		1 050.2	0.0
2.C.3	Aluminium production	CO2			***23***		158.4	0.0
2.C.4	SF6 Used in Al and Mg Foundries	SF6			***24***		253.3	0.3
2 F 1/2/3/4/5	ODS Substitutes	HFC,PFC		***20***	***13***		24.4	1 057.9
2 F 7	Semiconductor Manufacture	FCs				***x***	133.1	279.5
2 F 9	Other Sources of SF6	SF6				***x***	126.6	250.0
3	Solvent and Other Product Use	CO2	***35***	***40***			279.3	231.9
4 A 1	Cattle	CH4	***9***	***9***	***15***		3 550.8	3 019.8
4 B 1	Cattle	N2O	***25***	***22***			758.5	736.4
4 B 1	Cattle	CH4	***34***				282.3	216.8
4 B 8	Swine	CH4				***x***	88.1	55.0
4 D 1	Direct Soil Emissions	N2O	***16***	***14***	***32***		1 908.8	1 878.3
4 D 2	Pasture, Range and Paddock Manure	N2O				***x***	168.7	93.6
4 D 3	Indirect Emissions	N2O	***18***	***18***	***26***		1 352.2	1 199.6
5	Total land use categories	N2O	***29***	***34***			431.5	318.1
5 A 1	Forest land remaining forest land	CO2	***1***	***1***	***3***		-11 511.2	-16 974.3
5 A 2	Land converted to forest land	CO2	***8***	***10***	***7***		-4 402.2	-2 537.8
5 B 1	Cropland remaining cropland	CO2	***32***		***25***		-320.0	-86.4
5 B 2	Land converted to cropland	CO2	***17***	***15***	***31***		1 825.0	1 787.6
5 C 2	Land converted to grassland	CO2	***20***	***17***	***27***		-1 060.7	-1 330.3
5 D 2	Land converted to Wetlands	CO2		***31***	***30***		199.7	377.0
5 E 2	Land converted to Settlements	CO2	***24***	***28***	***22***		759.1	517.5
5 F 2	Land converted to Other land	CO2	***23***	***29***	***19***		809.9	456.7
6 A	Solid Waste Disposal on Land	CH4	***11***	***16***	***10***		3 314.3	1 557.5
6 B	Wastewater Handling	N2O			***33***		108.4	260.1

Table A 9: Source/sink categories and emissions/removals for key category analyisis

IPCC 96	Source Categories	Gas	Unit	1990	1995	2000	2001	2002	2003	2004	2005	2006	2007	2008
1 A gaseous	Fuel Combustion Activities	CO2	Gg	11 300.5	14 339.2	14 683.6	15 628.8	15 792.4	17 069.8	16 915.8	18 508.0	16 792.1	15 809.9	16 832.8
1 A 1 a liquid	Public Electricity and Heat Production	CO2	Gg	1 228.7	1 557.5	1 184.3	1 521.0	823.6	1 133.5	1 181.0	1 091.7	1 169.1	768.1	688.6
1 A 1 a solid	Public Electricity and Heat Production	CO2	Gg	6 247.0	4 529.8	4 824.4	5 873.1	5 510.0	6 915.8	6 673.9	5 844.0	5 642.5	5 066.5	4 439.8
1 A 1 a other	Public Electricity and Heat Production	CO2	Gg	118.0	191.2	234.4	344.2	427.3	493.2	587.0	582.4	695.5	658.2	553.0
1 A 1 b liquid	Petroleum refining	CO2	Gg	1 957.7	2 169.0	1 846.9	1 810.0	2 157.5	2 303.6	2 507.7	2 370.7	2 458.8	2 524.0	2 403.4
1 A 1 c liquid	Manufacture of Solid fuels and Other Energy Industries	CO2	Gg	3.9	0.5	NO	NO	NO	NO	NO	NO	NO	NO	NO
1 A 2 mobile-liquid	Manufacturing Industries and Construction	CO2	Gg	255.7	355.7	550.2	517.8	503.2	534.8	592.5	811.4	976.9	1 051.8	1 152.2
1 A 2 stat-liquid	Manufacturing Industries and Construction	CO2	Gg	2 883.6	2 688.6	2 060.6	2 138.7	1 774.3	1 839.5	1 996.4	2 124.6	2 181.3	2 130.2	1 923.8
1 A 2 solid	Manufacturing Industries and Construction	CO2	Gg	5 016.3	4 459.2	4 644.8	4 414.2	4 842.1	4 993.9	4 973.6	5 578.0	5 602.2	5 493.8	5 453.5
1 A 2 other	Manufacturing Industries and Construction	CO2	Gg	264.1	466.8	453.8	568.3	671.7	828.0	860.5	751.2	743.7	703.7	685.8
1 A 3 a aviation gasoline	Civil Aviation	CO2	Gg	7.8	7.1	6.4	5.9	7.5	8.2	7.6	8.8	9.0	9.0	8.3
1 A 3 a jet kerosene	Civil Aviation	CO2	Gg	24.2	50.5	60.8	54.2	54.7	54.4	56.8	58.0	62.7	64.7	61.5
1 A 3 b gasoline	Road Transportation	CO2	Gg	7 941.6	7 438.5	6 118.9	6 163.0	6 635.5	6 785.7	6 600.7	6 409.4	6 151.2	6 005.6	5 393.0
1 A 3 b diesel oil	Road Transportation	CO2	Gg	5 341.5	7 740.0	11 879.5	13 171.6	14 785.7	16 395.1	17 090.3	17 611.1	16 463.0	16 801.4	16 017.7
1 A 3 c liquid	Railways	CO2	Gg	171.4	142.8	132.6	128.2	138.7	139.4	139.4	161.3	163.3	156.1	164.1
1 A 3 c solid	Railways	CO2	Gg	6.6	5.8	2.5	1.7	1.9	1.5	0.6	0.5	0.6	0.5	0.5
1 A 3 d gas/diesel oil	Navigation	CO2	Gg	24.2	31.9	40.8	43.5	46.6	39.4	9.5	2.8	14.5	24.4	26.1
1 A 3 d gasoline	Navigation	CO2	Gg	10.1	9.9	9.6	9.6	9.5	9.4	9.3	9.2	9.1	8.9	8.8
1 A 4 mobile-liquid	Other Sectors	CO2	Gg	144.3	145.5	141.6	141.8	141.5	141.1	141.3	139.1	135.6	133.3	129.7
1 A 4 mobile-diesel	Other Sectors	CO2	Gg	737.2	720.3	757.5	781.6	776.8	743.8	766.9	808.3	785.3	787.6	797.8
1 A 4 mobile-gasoline	Other Sectors	CO2	Gg	33.2	31.4	30.7	30.8	32.0	33.9	33.1	32.8	35.1	36.9	37.1
1 A 4 stat-liquid	Other Sectors	CO2	Gg	7 319.1	7 194.0	6 835.9	7 676.2	7 348.2	7 863.5	7 213.4	7 093.4	6 370.8	5 163.1	5 786.0
1 A 4 solid	Other Sectors	CO2	Gg	2 654.1	1 746.4	971.5	960.5	780.0	712.5	661.6	522.7	495.1	385.8	399.8
1 A 4 other	Other Sectors	CO2	Gg	349.6	180.7	143.7	65.3	64.3	67.6	70.9	71.6	75.9	117.7	252.7
1 A 5 liquid	Other	CO2	Gg	35.0	32.6	40.8	41.4	41.9	42.5	43.0	43.6	44.1	44.6	45.2
1 B 2 a	Oil	CO2	Gg	43.0	38.0	72.0	88.0	84.0	133.0	122.0	122.0	140.0	142.0	135.0
1 B 2 b	Natural gas	CO2	Gg	59.1	89.1	92.6	94.9	83.2	100.2	88.2	83.2	92.2	95.2	77.2
2 A 1	Cement Production	CO2	Gg	2 033.4	1 631.3	1 711.6	1 719.9	1 735.7	1 754.5	1 790.0	1 797.5	1 954.1	2 130.8	2 133.0
2 A 2	Lime Production	CO2	Gg	396.2	394.6	497.5	506.6	546.6	576.9	601.1	578.7	585.7	595.7	621.1
2 A 3	Limestone and Dolomite Use	CO2	Gg	203.2	230.3	257.6	249.9	271.7	271.9	281.6	271.3	275.4	280.3	280.7
2 A 4	Soda Ash Production and use	CO2	Gg	5.1	5.6	7.6	6.7	7.7	8.2	15.6	12.5	12.1	11.4	10.3
2 A 7 a	Bricks and Tiles (decarbonizing)	CO2	Gg	116.5	148.8	115.9	123.7	120.3	115.8	133.7	128.0	129.9	129.9	109.7
2 A 7 b	Sinter Production	CO2	Gg	481.2	409.9	339.2	334.0	373.5	311.5	328.5	309.5	312.4	329.5	332.0
2 A 7 c	Glass Production	CO2	Gg	38.5	42.0	36.3	42.6	37.6	42.5	27.7	35.3	37.1	40.1	44.1
2 B 1	Ammonia Production	CO2	Gg	516.6	537.1	518.0	472.5	486.1	526.4	467.7	503.1	541.8	473.4	532.5
2 B 2	Nitric Acid Production	CO2	Gg	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	Gg	37.5	26.2	48.1	46.7	40.8	41.5	35.8	35.9	30.5	36.3	40.7
2 B 5	Other	CO2	Gg	30.5	20.0	20.8	20.0	24.0	24.2	24.2	24.1	26.5	20.6	19.7
2 C 1	Iron and Steel Production	CO2	Gg	3 545.7	3 921.0	4 201.8	4 159.4	4 606.8	4 523.1	4 446.2	4 995.0	5 192.9	5 482.0	5 770.2
2 C 2	Ferroalloys Production	CO2	Gg	20.8	20.8	18.9	18.1	17.1	16.7	16.9	18.7	18.7	19.7	18.0
2 C 3	Aluminium production	CO2	Gg	158.4	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO

3	Solvent and Other Product Use	CO2	Gg	279.3	190.0	192.6	204.1	225.8	231.3	198.7	211.0	247.7	227.0	231.9
6 C	Waste Incineration	CO2	Gg	26.9	11.0	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 Production	CH4	Gg CO2 e	0.3	0.4	0.3	0.4	0.2	0.2	0.3	0.3	0.4	0.2	0.2
1 A 1 a solid	Public Electricity and Heat Production	CH4	Gg CO2 e	1.5	0.5	0.2	0.2	0.2	0.2	0.3	0.1	0.1	0.1	0.1
1 A 1 a gaseous	Public Electricity and Heat Production	CH4	Gg CO2 e	0.5	0.6	1.0	0.9	1.1	1.4	1.4	0.8	0.9	0.7	0.8
1 A 1 a biomass	Public Electricity and Heat Production	CH4	Gg CO2 e	0.2	0.3	0.5	1.0	0.8	0.9	0.9	1.2	1.5	1.8	2.1
1 A 1 a other	Public Electricity and Heat Production	CH4	Gg CO2 e	0.6	1.0	1.2	1.4	1.7	2.0	2.5	2.5	3.2	3.0	2.5
1 A 1 c liquid	Manufacture of Solid fuels and Other Energy Industries	CH4	Gg CO2 e	0.0	0.0	NO	NO	NO	NO	NO	NO	NO	NO	NO
1 A 1 c gaseous	Manufacture of Solid fuels and Other Energy Industries	CH4	Gg CO2 e	0.3	0.3	0.2	0.2	0.3	0.2	0.3	0.3	0.4	0.4	0.3
1 A 2 mobile-liquid	Manufacturing Industries and Construction	CH4	Gg CO2 e	0.3	0.4	0.5	0.5	0.4	0.4	0.4	0.5	0.5	0.5	0.6
1 A 2 stat-liquid	Manufacturing Industries and Construction	CH4	Gg CO2 e	1.0	0.8	0.6	0.5	0.5	0.6	0.7	0.8	0.8	0.8	0.7
1 A 2 solid	Manufacturing Industries and Construction	CH4	Gg CO2 e	1.6	1.4	1.7	1.5	1.5	2.0	2.1	2.4	2.7	2.5	2.3
1 A 2 gaseous	Manufacturing Industries and Construction	CH4	Gg CO2 e	2.2	2.9	3.2	3.1	3.3	3.4	3.3	3.7	3.6	3.7	3.7
1 A 2 biomass	Manufacturing Industries and Construction	CH4	Gg CO2 e	1.2	1.4	1.7	1.8	1.6	1.7	1.9	2.1	2.2	2.4	2.4
1 A 2 other	Manufacturing Industries and Construction	CH4	Gg CO2 e	0.8	1.3	1.6	2.1	2.4	2.7	3.5	3.0	3.1	2.9	3.2
1 A 3 a jet kerosene	Civil Aviation	CH4	Gg CO2 e	0.0	0.0	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	Gg CO2 e	61.4	61.9	37.5	34.4	32.7	29.9	26.4	23.2	20.0	17.6	14.9
1 A 3 b diesel oil	Road Transportation	CH4	Gg CO2 e	2.4	2.7	2.9	3.0	3.2	3.3	3.3	3.3	3.0	3.0	2.8
1 A 3 c liquid	Railways	CH4	Gg CO2 e	0.2	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.2	0.1	0.1
1 A 3 c solid	Railways	CH4	Gg CO2 e	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 oil	Navigation	CH4	Gg CO2 e	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 gasoline	Navigation	CH4	Gg CO2 e	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	Gg CO2 e	0.1	0.1	0.3	0.3	0.2	0.2	0.2	0.2	0.3	0.3	0.3
1 A 4 mobile-diesel	Other Sectors	CH4	Gg CO2 e	0.9	0.8	0.8	0.8	0.8	0.7	0.7	0.7	0.7	0.7	0.7
1 A 4 mobile-gasoline	Other Sectors	CH4	Gg CO2 e	0.7	0.6	0.5	0.5	0.6	0.6	0.6	0.6	0.6	0.6	0.6
1 A 4 mobile-liquid	Other Sectors	CH4	Gg CO2 e	1.4	1.3	1.1	1.1	1.1	1.0	1.0	1.0	0.9	0.8	0.8
1 A 4 stat-liquid	Other Sectors	CH4	Gg CO2 e	0.8	0.7	0.6	0.7	0.7	0.8	0.7	0.6	0.6	0.4	0.5
1 A 4 solid	Other Sectors	CH4	Gg CO2 e	61.8	43.4	20.6	20.3	16.5	15.0	13.9	11.0	10.3	8.1	8.3
1 A 4 gaseous	Other Sectors	CH4	Gg CO2 e	4.0	1.3	1.2	1.5	1.4	1.6	1.6	1.6	1.3	1.2	1.3
1 A 4 biomass	Other Sectors	CH4	Gg CO2 e	315.9	303.4	238.2	247.0	229.9	230.3	212.2	238.6	206.8	206.6	202.1
1 A 4 other	Other Sectors	CH4	Gg CO2 e	0.8	0.4	0.3	0.2	0.2	0.2	0.2	0.2	0.2	0.3	0.6
1 A 5 liquid	Other	CH4	Gg CO2 e	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	Gg CO2 e	11.0	5.8	5.6	5.4	6.3	5.2	1.1	0.0	0.0	NO	NO
1 B 2 a	Oil	CH4	Gg CO2 e	101.0	98.3	90.2	91.9	93.8	88.2	112.9	115.3	121.3	123.7	121.4
1 B 2 b	Natural gas	CH4	Gg CO2 e	97.6	121.4	116.5	112.8	108.9	117.6	115.4	119.1	122.5	128.4	133.4
2 B	Chemical Industry	CH4	Gg CO2 e	14.8	14.3	14.6	14.0	14.8	14.6	14.7	15.7	19.2	19.0	18.5
2 C	Metal Production	CH4	Gg CO2 e	0.0	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	Gg CO2 e	3 550.8	3 390.0	3 206.5	3 159.2	3 097.5	3 062.1	3 065.2	3 023.2	3 015.9	3 016.7	3 019.8
4 A 3	Sheep	CH4	Gg CO2 e	52.1	61.4	57.0	53.8	51.1	54.7	55.0	54.7	52.5	59.0	56.0
4 A 4	Goats	CH4	Gg CO2 e	3.9	5.7	5.9	6.2	6.1	5.7	5.8	5.8	5.6	6.4	6.6
4 A 6	Horses	CH4	Gg CO2 e	18.6	27.4	30.8	30.8	30.8	32.9	32.9	32.9	32.9	32.9	32.9
4 A 8	Swine	CH4	Gg CO2 e	116.2	116.7	105.5	108.4	104.1	102.2	98.4	99.8	98.9	103.5	96.5
4 A 9	Poultry	CH4	Gg CO2 e	5.6	5.6	4.8	5.1	5.1	5.3	5.3	5.3	5.3	5.3	5.3

4 A-10	Other	CH4	Gg CO2 e	6.2	6.8	6.5	6.5	6.5	6.9	6.9	6.9	6.9	6.9
4 B 1	Cattle	CH4	Gg CO2 e	282.3	265.0	242.8	237.0	230.4	224.9	223.4	220.3	218.4	217.5
4 B 3	Sheep	CH4	Gg CO2 e	1.2	1.5	1.4	1.3	1.2	1.3	1.3	1.3	1.2	1.4
4 B 4	Goats	CH4	Gg CO2 e	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	Gg CO2 e	1.4	2.1	2.3	2.2	2.2	2.3	2.3	2.3	2.3	2.3
4 B 8	Swine	CH4	Gg CO2 e	123.3	116.4	94.9	96.2	91.3	88.3	81.9	82.3	79.6	81.3
4 B 9	Poultry	CH4	Gg CO2 e	22.6	22.7	18.7	19.9	19.8	20.4	20.4	20.3	20.2	20.1
4 B-10	Other	CH4	Gg CO2 e	0.1	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2
4 D	Agricultural Soils	CH4	Gg CO2 e	6.9	9.3	9.4	9.1	7.9	8.6	7.7	7.8	8.6	8.9
4 F	Field Burning of Agricultural Residues	CH4	Gg CO2 e	1.4	1.4	1.4	1.4	1.4	1.3	2.0	1.3	1.2	1.2
6 A	Solid Waste Disposal on Land	CH4	Gg CO2 e	3 314.3	2 822.8	2 226.2	2 140.1	2 099.8	2 143.6	2 001.6	1 881.6	1 795.7	1 682.9
6 B	Wastewater Handling	CH4	Gg CO2 e	101.8	88.3	56.2	51.1	45.8	40.9	41.1	41.4	31.1	31.3
6 C	Waste Incineration	CH4	Gg CO2 e	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
6 D	Other Waste	CH4	Gg CO2 e	10.9	21.8	26.0	29.6	33.1	36.5	45.4	49.0	51.3	53.0
1 A 1 a liquid	Public Electricity and Heat Production	N2O	Gg CO2 e	6.7	7.5	5.9	7.1	4.1	6.0	6.1	5.9	6.2	3.9
1 A 1 a solid	Public Electricity and Heat Production	N2O	Gg CO2 e	23.0	19.6	21.2	23.7	22.9	27.4	29.2	26.2	27.2	26.1
1 A 1 a gaseous	Public Electricity and Heat Production	N2O	Gg CO2 e	8.9	9.9	8.1	9.0	9.1	10.5	10.4	14.6	12.3	10.9
1 A 1 a biomass	Public Electricity and Heat Production	N2O	Gg CO2 e	1.5	4.4	8.9	11.5	15.2	16.6	19.7	24.2	34.5	42.8
1 A 1 a other	Public Electricity and Heat Production	N2O	Gg CO2 e	1.0	1.7	2.0	2.4	2.9	3.4	4.4	4.3	5.4	5.1
1 A 1 b liquid	Petroleum refining	N2O	Gg CO2 e	4.4	5.2	4.3	4.5	5.0	4.6	5.1	5.2	4.9	5.4
1 A 1 b gaseous	Petroleum refining	N2O	Gg CO2 e	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.3	0.2	0.2
1 A 1 c liquid	Manufacture of Solid fuels and Other Energy Industries	N2O	Gg CO2 e	0.0	0.0	NO	NO	NO	NO	NO	NO	NO	NO
1 A 1 c gaseous	Manufacture of Solid fuels and Other Energy Industries	N2O	Gg CO2 e	0.3	0.3	0.2	0.2	0.3	0.2	0.3	0.3	0.4	0.3
1 A 2 mobile-liquid	Manufacturing Industries and Construction	N2O	Gg CO2 e	27.9	41.0	68.8	64.9	61.8	60.3	56.8	64.1	69.9	68.0
1 A 2 stat-liquid	Manufacturing Industries and Construction	N2O	Gg CO2 e	10.8	9.6	8.1	8.2	7.9	8.0	9.0	9.0	8.7	8.7
1 A 2 solid	Manufacturing Industries and Construction	N2O	Gg CO2 e	16.4	16.3	18.9	17.2	17.8	18.2	17.8	19.6	21.1	20.8
1 A 2 gaseous	Manufacturing Industries and Construction	N2O	Gg CO2 e	2.4	3.1	3.4	3.3	3.5	3.5	3.4	3.8	3.6	3.7
1 A 2 biomass	Manufacturing Industries and Construction	N2O	Gg CO2 e	21.1	25.1	30.7	33.0	28.1	30.4	31.1	40.7	42.2	48.1
1 A 2 other	Manufacturing Industries and Construction	N2O	Gg CO2 e	1.4	2.3	2.7	3.6	4.1	4.7	6.1	5.2	5.3	5.0
1 A 3 a jet kerosene	Civil Aviation	N2O	Gg CO2 e	0.3	0.6	1.1	1.0	1.0	1.0	1.0	1.0	1.1	1.1
1 A 3 b gasoline	Road Transportation	N2O	Gg CO2 e	131.9	188.8	186.3	185.2	195.7	192.8	177.9	162.9	143.8	128.2
1 A 3 b diesel oil	Road Transportation	N2O	Gg CO2 e	40.6	57.4	93.8	104.1	118.6	132.2	139.0	144.6	140.3	141.5
1 A 3 c liquid	Railways	N2O	Gg CO2 e	18.5	15.6	14.8	14.4	15.6	15.6	15.6	18.0	18.6	17.6
1 A 3 c solid	Railways	N2O	Gg CO2 e	0.1	0.1	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1 A 3 d gas/diesel oil	Navigation	N2O	Gg CO2 e	2.6	3.5	4.6	4.9	5.3	4.4	1.1	0.3	1.7	2.8
1 A 3 d gasoline	Navigation	N2O	Gg CO2 e	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	Gg CO2 e	0.1	0.1	0.3	0.3	0.2	0.2	0.2	0.2	0.3	0.3
1 A 4 mobile-liquid	Other Sectors	N2O	Gg CO2 e	7.4	8.0	8.0	8.1	7.2	7.1	6.2	5.9	5.7	5.2
1 A 4 mobile-diesel	Other Sectors	N2O	Gg CO2 e	78.4	78.7	88.9	92.6	92.0	86.4	87.0	89.5	86.8	83.9
1 A 4 mobile-gasoline	Other Sectors	N2O	Gg CO2 e	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.2	0.2
1 A 4 stat-liquid	Other Sectors	N2O	Gg CO2 e	25.8	27.5	26.3	29.2	28.4	30.3	28.2	28.2	25.3	20.8

1 A 4 solid	Other Sectors	N2O	Gg CO2 e	20.6	13.4	7.6	7.6	5.9	5.6	5.1	4.0	3.9	3.0	3.1
1 A 4 gaseous	Other Sectors	N2O	Gg CO2 e	14.4	23.1	22.5	27.8	25.4	29.1	29.9	29.2	24.5	21.6	23.2
1 A 4 biomass	Other Sectors	N2O	Gg CO2 e	86.0	89.8	86.6	93.1	89.8	92.9	90.3	100.9	91.6	92.2	96.1
1 A 4 other	Other Sectors	N2O	Gg CO2 e	1.5	0.8	0.6	0.3	0.3	0.3	0.3	0.3	0.3	0.5	1.1
1 A 5 liquid	Other	N2O	Gg CO2 e	0.9	0.8	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	Gg CO2 e	912.0	857.2	951.6	786.5	807.2	883.4	280.9	274.2	280.1	270.0	325.8
3	Solvent and Other Product Use	N2O	Gg CO2 e	232.5	232.5	232.5	220.7	208.9	197.2	185.4	173.6	164.3	160.3	156.6
4 B 1	Cattle	N2O	Gg CO2 e	758.5	759.2	747.5	740.8	730.7	728.6	734.1	725.5	727.6	731.2	736.4
4 B 3	Sheep	N2O	Gg CO2 e	19.8	23.3	21.6	20.5	19.4	20.8	20.9	20.8	19.9	22.4	21.3
4 B 4	Goats	N2O	Gg CO2 e	2.2	3.2	3.4	3.6	3.5	3.3	3.3	3.3	3.2	3.6	3.7
4 B 6	Horses	N2O	Gg CO2 e	18.3	26.5	28.5	28.1	27.8	29.5	29.2	29.0	28.7	28.5	28.3
4 B 8	Swine	N2O	Gg CO2 e	88.1	85.5	70.1	71.6	68.3	66.1	61.5	61.4	60.2	60.4	55.0
4 B 9	Poultry	N2O	Gg CO2 e	45.9	54.6	50.8	54.4	55.3	58.3	59.4	60.4	61.4	62.5	63.6
4 B-10	Other	N2O	Gg CO2 e	2.4	2.6	2.5	2.5	2.5	2.6	2.6	2.6	2.6	2.6	2.6
4 D 1	Direct Soil Emissions	N2O	Gg CO2 e	1 908.8	2 166.6	1 822.4	1 841.9	1 846.1	1 720.9	1 681.2	1 694.4	1 743.7	1 771.1	1 878.3
4 D 2	Pasture, Range and Paddock Manure	N2O	Gg CO2 e	168.7	153.5	129.6	123.0	115.6	113.1	110.7	105.7	100.4	99.0	93.6
4 D 3	Indirect Emissions	N2O	Gg CO2 e	1 352.2	1 411.3	1 239.6	1 231.4	1 226.4	1 182.7	1 126.3	1 131.0	1 135.0	1 151.9	1 199.6
4 F	Field Burning of Agricultural Residues	N2O	Gg CO2 e	0.4	0.4	0.3	0.4	0.4	0.3	0.5	0.3	0.3	0.3	0.3
6 B	Wastewater Handling	N2O	Gg CO2 e	108.4	123.4	195.2	218.6	219.9	221.0	223.0	237.6	251.9	255.9	260.1
6 C	Waste Incineration	N2O	Gg CO2 e	0.1	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	Gg CO2 e	23.6	44.8	52.8	59.8	66.7	73.2	92.4	100.3	105.1	108.6	109.6
2.F.8	Electrical equipment	SF6	Gg CO2 e	12.3	15.9	17.3	18.1	18.9	18.9	20.5	21.9	22.4	24.1	25.4
2.C.3	Aluminium production	PFC	Gg CO2 e	1 050.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2.C.4	SF6 Used in Al and Mg Foundries	SF6	Gg CO2 e	253.3	443.1	37.1	28.7	7.2	3.6	0.0	4.8	12.7	0.3	0.3
2.F.7	Semiconductor Manufacture	FC	Gg CO2 e	133.1	505.7	404.0	444.7	445.9	484.1	509.9	298.2	308.7	288.0	279.5
2 F 1/2/3/4/5	ODS Substitutes	HFC,F	Gg CO2 e	24.4	406.2	915.4	935.0	979.4	959.9	962.2	991.2	967.8	1 062.5	1 057.9
2 F 9	Other Sources of SF6	SF6	Gg CO2 e	126.6	266.3	208.4	246.6	250.3	166.0	96.5	311.5	261.9	251.7	250.0

ANNEX 2: SECTOR 1.A FUEL COMBUSTION

This annex includes detailed information about category 1.A (trend information by subcategory), 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	0,13	10 932
1991	11 645	0,17	0,15	11 697
1992	8 570	0,14	0,12	8 610
1993	8 310	0,15	0,12	8 351
1994	8 600	0,14	0,13	8 641
1995	9 717	0,14	0,14	9 763
1996	10 897	0,17	0,14	10 943
1997	10 968	0,18	0,13	11 013
1998	10 018	0,17	0,15	10 068
1999	9 981	0,16	0,15	10 030
2000	9 677	0,15	0,15	9 727
2001	11 225	0,18	0,17	11 283
2002	10 560	0,19	0,17	10 618
2003	12 995	0,22	0,21	13 064
2004	12 738	0,26	0,23	12 813
2005	12 747	0,24	0,24	12 827
2006	12 004	0,29	0,28	12 096
2007	10 427	0,28	0,29	10 521
2008	10 089	0,27	0,30	10 188
Trend 1990-2008	-7,3%	81,0%	125,8%	-6,8%

Solid fossil fuels and natural gas are 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 5% in 2008.

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	14%	52%	31%	3%
2002	8%	52%	36%	4%
2003	9%	53%	34%	4%
2004	9%	52%	34%	5%
2005	9%	46%	41%	5%
2006	10%	47%	37%	6%
2007	7%	49%	38%	6%
2008	7%	44%	44%	5%

1.A.1.b Petroleum Refining

Table A 12: Greenhouse gas emissions from Category 1.A.1.b.

	CO_2 [Gg]	CH_4 [Gg]	N_2O [Gg]	CO_2 equiv. [Gg]
1990	2 394	IE	0,015	0.015
1991	2 428	IE	0,016	0.016
1992	2 389	IE	0,016	0.016
1993	2 732	IE	0,018	0.018
1994	2 709	IE	0,018	0.018
1995	2 590	IE	0,017	0.017
1996	2 647	IE	0,017	0.017
1997	2 640	IE	0,017	0.017
1998	2 633	IE	0,017	0.017
1999	2 271	IE	0,015	0.015
2000	2 199	IE	0,015	0.015
2001	2 219	IE	0,015	0.015
2002	2 565	IE	0,017	0.017
2003	2 687	IE	0,016	0.016
2004	2 844	IE	0,017	0.017
2005	2 827	IE	0,018	0.018
2006	2 830	IE	0,017	0.017
2007	2 868	IE	0,018	0.018

	CO_2 [Gg]	CH_4 [Gg]	N_2O [Gg]	CO_2 equiv. [Gg]
2008	2 806	IE	0,016	0.016
Trend 1990-2008	17.2%	-	8.2%	8.2%

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	82%	18%
2000	84%	16%
2001	82%	18%
2002	84%	16%
2003	86%	14%
2004	88%	12%
2005	84%	16%
2006	87%	13%
2007	88%	12%
2008	86%	14%

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	333	0.009	0.0006	333
2002	520	0.014	0.0009	520
2003	405	0.011	0.0007	405
2004	569	0.015	0.0010	570
2005	524	0.014	0.0009	524
2006	648	0.018	0.0012	649
2007	624	0.017	0.0011	625
2008	528	0.014	0.0010	528
Trend 1990-2008	3.5%	4.2%	-2.3%	3.5%

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%

	Liquid	Gaseous
2007	NO	100%
2008	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	0.036	0.053	5 208
2002	5 515	0.038	0.053	5 532
2003	5 630	0.078	0.054	5 648
2004	5 725	0.085	0.054	5 743
2005	6 445	0.100	0.059	6 466
2006	6 336	0.108	0.062	6 358
2007	6 309	0.101	0.064	6 331
2008	6 240	0.091	0.062	6 262
Trend 1990-2008	26.2%	259.6%	44.4%	26.3%

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	17.1%	64.4%	18.5%

	Liquid	Solid	Gaseous
2002	11.9%	69.3%	18.8%
2003	9.9%	72.0%	18.1%
2004	12.3%	70.4%	17.4%
2005	12.1%	69.8%	18.1%
2006	12.1%	69.7%	18.1%
2007	13.6%	69.2%	17.1%
2008	12.7%	70.6%	16.7%

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	191	0.004	0.0011	192
2000	194	0.004	0.0010	195
2001	200	0.005	0.0009	201
2002	208	0.005	0.0010	209
2003	220	0.005	0.0010	220
2004	217	0.005	0.0009	218
2005	220	0.005	0.0009	221
2006	222	0.005	0.0009	222
2007	275	0.007	0.0010	276
2008	300	0.008	0.0009	301
Trend 1990-2008	127.6%	150.2%	4.0%	127.4%

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%

	Liquid	Solid	Gaseous
1999	25%	12%	62%
2000	24%	10%	66%
2001	23%	5%	72%
2002	21%	8%	71%
2003	18%	7%	74%
2004	17%	8%	75%
2005	15%	6%	79%
2006	15%	6%	80%
2007	11%	5%	84%
2008	8%	5%	87%

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	1 352	0.065	0.028	1 362
2000	1 379	0.071	0.023	1 388
2001	1 409	0.073	0.016	1 416
2002	1 439	0.088	0.017	1 446
2003	1 538	0.109	0.021	1 547
2004	1 488	0.124	0.022	1 497
2005	1 637	0.107	0.020	1 646
2006	1 422	0.091	0.017	1 429
2007	1 321	0.075	0.016	1 327
2008	1 361	0.066	0.015	1 367
Trend 1990-2008	54.2%	47.6%	-13.3%	53.8%

In 2008 natural gas was still the main source of CO_2 emissions from category *1.A.2.c* while CO_2 emissions from solid and liquid fossil fuel combustion got less important.

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%

	Liquid	Solid	Gaseous	Other
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%	63%	15%
2001	5%	18%	61%	16%
2002	4%	17%	58%	21%
2003	4%	16%	55%	25%
2004	3%	16%	55%	26%
2005	3%	9%	65%	23%
2006	4%	7%	66%	24%
2007	4%	6%	69%	20%
2008	3%	5%	76%	16%

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	2 325	0.14	0.08	2 351
2000	2 349	0.13	0.06	2 371
2001	2 210	0.13	0.08	2 237
2002	2 213	0.13	0.06	2 235
2003	2 388	0.13	0.07	2 412
2004	2 238	0.15	0.07	2 264
2005	2 278	0.15	0.08	2 307
2006	2 187	0.14	0.08	2 215
2007	2 188	0.14	0.08	2 215
2008	2 140	0.14	0.08	2 166
Trend 1990-2008	-3.3%	18.9%	27.9%	-3.0%

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%	15%	77%	1%
2004	6%	18%	75%	1%
2005	6%	19%	74%	0%
2006	6%	21%	73%	0%
2007	5%	17%	78%	1%
2008	4%	15%	80%	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	933	0.020	0.006	935
1991	854	0.018	0.005	856
1992	886	0.016	0.005	888
1993	916	0.019	0.005	918
1994	931	0.019	0.005	933
1995	888	0.019	0.004	889
1996	1 042	0.022	0.004	1 043
1997	943	0.021	0.004	944
1998	828	0.020	0.004	829
1999	887	0.022	0.004	889
2000	888	0.021	0.005	890
2001	1 101	0.028	0.005	1 104
2002	899	0.022	0.004	900
2003	825	0.019	0.003	826
2004	907	0.022	0.005	909
2005	932	0.022	0.006	934
2006	892	0.022	0.005	894
2007	882	0.022	0.005	884
2008	1.4%	21.8%	-7.5%	1.4%
Trend 1990-2008	933	0.020	0.006	935

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%	76%	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%	76%	NO
2008	21%	1%	78%	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	3 644	0.128	0.133	3 688
1991	3 827	0.141	0.147	3 876
1992	3 716	0.146	0.151	3 766
1993	3 954	0.144	0.158	4 006
1994	4 078	0.146	0.162	4 131
1995	4 178	0.151	0.170	4 234
1996	4 428	0.162	0.213	4 497
1997	4 658	0.163	0.202	4 724
1998	4 375	0.171	0.239	4 453
1999	3 653	0.160	0.252	3 734
2000	3 696	0.170	0.282	3 787
2001	3 721	0.184	0.270	3 809
2002	3 573	0.175	0.259	3 657
2003	3 779	0.171	0.257	3 863
2004	3 933	0.188	0.246	4 013
2005	4 500	0.215	0.290	4 595
2006	4 844	0.245	0.322	4 949

	CO_2 [Gg]	CH_4 [Gg]	N_2O [Gg]	CO_2 equiv. [Gg]
2007	4 985	0.264	0.335	5 095
2008	5 073	0.293	0.332	5 182
Trend 1990-2008	39.2%	128.6%	148.7%	40.5%

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	42%	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%	43%	7%
2001	34%	12%	45%	9%
2002	33%	9%	48%	10%
2003	37%	7%	45%	11%
2004	38%	7%	43%	12%
2005	39%	10%	43%	8%
2006	40%	12%	40%	8%
2007	39%	13%	40%	8%
2008	38%	12%	40%	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	3 404
1991	3 538	0.13	0.05	3 555
1992	3 410	0.13	0.04	3 426
1993	3 632	0.13	0.04	3 649
1994	3 742	0.13	0.04	3 757
1995	3 822	0.13	0.04	3 837
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	3 182	0.14	0.06	3 205
2000	3 145	0.15	0.06	3 167
2001	3 204	0.16	0.06	3 226
2002	3 069	0.15	0.06	3 091

	CO_2 [Gg]	CH_4 [Gg]	N_2O [Gg]	CO_2 equiv. [Gg]
2003	3 245	0.15	0.06	3 267
2004	3 341	0.17	0.06	3 364
2005	3 689	0.19	0.08	3 719
2006	3 867	0.22	0.10	3 902
2007	3 934	0.24	0.12	3 975
2008	3 921	0.27	0.11	3 962
Trend 1990-2008	15.7%	131.9%	161.4%	16.4%

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 which is reported as "Other fuels" 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%	56%	12%
2003	26%	8%	53%	13%
2004	27%	8%	51%	14%
2005	25%	13%	52%	10%
2006	25%	15%	50%	10%
2007	22%	17%	50%	11%
2008	20%	16%	52%	12%

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

	CO_2 [Gg]	CH_4 [Gg]	N_2O [Gg]	CO_2 equiv. [Gg]
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	836
2003	821	0.07	0.01	827
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
2008	1 088	0.12	0.02	1 098
Trend 1990-2008	3.1%	112.2%	39.3%	3.4%

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	256	0.01	0.09	284
1991	289	0.02	0.10	321
1992	306	0.02	0.11	340
1993	322	0.02	0.11	358
1994	336	0.02	0.12	374
1995	356	0.02	0.13	397
1996	442	0.02	0.17	496
1997	419	0.02	0.16	470
1998	493	0.02	0.20	554
1999	471	0.02	0.19	530
2000	550	0.02	0.22	619
2001	518	0.02	0.21	583
2002	503	0.02	0.20	566
2003	535	0.02	0.19	595
2004	592	0.02	0.18	650
2005	811	0.02	0.21	876
2006	977	0.03	0.23	1 047
2007	1 052	0.03	0.22	1 120
2008	1 152	0.03	0.22	1 221
Trend 1990-2008	350.6%	100.6%	142.5%	329.9%

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	459	0.012	0.0008	459
2002	277	0.008	0.0005	277
2003	370	0.010	0.0007	371
2004	366	0.010	0.0007	366
2005	366	0.010	0.0007	366
2006	465	0.013	0.0008	465
2007	449	0.012	0.0008	450
2008	574	0.016	0.0010	575
Trend 1990-2008	156.0%	156.0%	156.0%	156.0%

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	14 169	13.31	0.81	14 701
2000	12 897	12.54	0.78	13 401
2001	14 616	12.95	0.83	15 146
2002	13 675	11.95	0.80	14 175
2003	14 763	11.91	0.81	15 265
2004	14 234	11.00	0.80	14 712
2005	13 878	12.10	0.83	14 391

	CO_2 [Gg]	CH_4 [Gg]	N_2O [Gg]	CO_2 equiv. [Gg]
2006	12 270	10.54	0.77	12 729
2007	10 492	10.41	0.73	10 938
2008	11 542	10.23	0.75	11 991
Trend 1990-2008	-16.4%	-44.4%	-0.2%	-16.9%

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%	8%	29%	1%
2000	60%	8%	31%	1%
2001	59%	7%	34%	0%
2002	61%	6%	33%	0%
2003	59%	5%	35%	0%
2004	57%	5%	38%	0%
2005	58%	4%	38%	1%
2006	60%	4%	36%	1%
2007	58%	4%	37%	1%
2008	58%	3%	36%	2%

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

	CO_2 [Gg]	**CH_4 [Gg]**	**N_2O [Gg]**	**CO_2 equiv. [Gg]**	**Heating degree days(1)**
1999	13 215	13.19	0.50	13 646	3 253
2000	11 967	12.43	0.46	12 372	2 958
2001	13 662	12.84	0.51	14 089	3 294
2002	13 662	12.84	0.51	14 089	3 191
2003	13 844	11.80	0.51	14 250	3 463
2004	13 293	10.89	0.50	13 675	3 322
2005	12 898	12.00	0.52	13 313	3 527
2006	11 314	10.44	0.47	11 679	3 315
2007	9 534	10.31	0.45	9 889	3 025
2008	10 578	10.13	0.47	10 937	3 131
Trend 1990-2008	-18.0%	-44.5%	-0.9%	-18.6%	-3.3%

(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%	31%	1.2%
2000	57%	8%	34%	1.2%
2001	56%	7%	36%	0.5%
2002	54%	6%	33%	0.5%
2003	57%	5%	38%	0.5%
2004	54%	5%	40%	0.5%
2005	55%	4%	40%	0.6%
2006	56%	4%	39%	0.7%
2007	54%	4%	41%	1.2%
2008	55%	4%	39%	2.4%

Activity Data Recalculations

Recalculations of activity data are due to the revised energy balance (IEA JQ 2009).

Energy balance update and corrections

The new estimates are mainly due to a revised evaluation of the census data 2004–2008. Major revisions affect the years from 2001 onwards (except for natural gas which has been revised from 1999 onwards). 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 except for gasoil which has been shifted between the years 2003 and 2005–2007.

Natural gas: From 2001 to 2007 up to 5.3 PJ have been shifted between the transformation sectors (public electricity and auto producers; 2007: -0.3 PJ) to *1.A.1.b petroleum refining* (2007: +3.6 PJ) and final consumption of *1.A.2 Industry* (2007: +2 PJ) and *1.A.4 Other* (2007: -5.3 PJ).

Residual fuel oil: Revision of final consumer stock change and final consumption of category *1.A.4 other* for the years 2001 (+3.6 PJ) and 2006 (+1.2 PJ).

Gasoil: Revision of final consumer stock change for the years 2003 and 2005–2007 (up to ±6.3 PJ) to better reflect yearly final consumption instead of fuel sales. This change affects category *1.A.4 Other Sectors* only. The 'net change' for the 4 revised years is +0.4 PJ.

Other solid biomass (such as wood waste, wood chips, pellets): Revision of gross inland consumption from 1999 to 2007 (2007: -6.3 PJ). This affects mainly the categories *1.A.1.a public electricity and heat* (2007: -2.5 PJ), *1.A.4 other* (2007: -2.6 PJ), non metallic mineral products industry (2007: +3 PJ; included in *1.A.2.f*) and wood products industry (2007: -2.6 PJ; included in *1.A.2.f*).

Fuel wood: Revision of gross inland consumption from 2001 (-4.5 PJ) to 2007 (-2.9 PJ). This mainly affects the categories *1.A.4.b Residential* (2007: -1.3 PJ) and wood products industry (2007: -1.7 PJ; included in *1.A.2.f*).

Industrial waste: Revision of gross inland consumption from 2001 (+0.5 PJ) to 2007 (-5.1 PJ), mainly due to chemicals (1.A.2.c), wood product and non metallic mineral products industry (included in 1.A.2.f).

Minor revisions have been carried out for coal and LPG from 2001 to 2007. The changes do not affect gross inland consumption and thus total CO_2 emissions from 1.A fuel combustion activities but emissions were only shifted between sub categories.

Table A 37: Activity data recalculations by sub categories with respect to previous submission [PJ absolut values].

	Fuel Consumption [PJ]								
	1990			2006			2007		
IPCC Category/ Fuel Group	**Subm. 2009**	**Subm. 2010**	**Differ-ence**	**Subm. 2009**	**Subm. 2010**	**Differ-ence**	**Subm. 2009**	**Subm. 2010**	**Differ-ence**
1 A FUEL COMBUSTION ACTIVITIES	**824.76**	**826.81**	**2.05**	**1 148.55**	**1 126.33**	**-22.22**	**1 103.15**	**1 098.36**	**-4.79**
1 A liquid	377.04	379.09	2.05	521.62	501.51	-20.12	498.43	485.03	-13.41
1 A solid	139.89	139.89	-	121.60	121.35	-0.26	113.49	113.24	-0.24
1 A gaseous	203.98	203.98	-	303.20	303.20	-	285.50	285.46	-0.04
1 A biomass	94.86	94.86	-	173.51	174.73	1.22	175.46	190.23	14.77

	Fuel Consumption [PJ]								
	1990			2006			2007		
IPCC Category/ Fuel Group	**Subm. 2009**	**Subm. 2010**	**Difference**	**Subm. 2009**	**Subm. 2010**	**Difference**	**Subm. 2009**	**Subm. 2010**	**Difference**
1 A other	8.99	8.99	-	28.61	25.55	-3.06	30.27	24.40	-5.87
1 A 1 Energy Industries	**188.78**	**188.37**	**-0.42**	**247.85**	**254.76**	**6.91**	**233.89**	**242.20**	**8.30**
1 A 1 liquid	46.45	46.45	-	49.55	49.54	-0.01	46.16	46.20	0.04
1 A 1 solid	61.40	61.40	-	60.20	60.20	-	54.46	54.46	-
1 A 1 gaseous	76.48	76.48	-	96.58	99.57	2.99	85.12	88.48	3.36
1 A 1 biomass	2.04	1.63	-0.42	28.97	32.90	3.93	36.35	41.21	4.85
1 A 1 other	2.41	2.41	-	12.55	12.55	-	11.80	11.85	0.05
1 A 1 a Public Electricity and Heat Production	**140.95**	**140.54**	**-0.42**	**198.54**	**201.68**	**3.14**	**183.56**	**188.27**	**4.71**
1 A 1 a liquid	15.63	15.63	-	14.86	14.86	0.00	9.71	9.74	0.03
1 A 1 a solid	61.40	61.40	-	60.20	60.20	-	54.46	54.46	-
1 A 1 a gaseous	59.46	59.46	-	81.96	81.17	-0.78	71.24	71.01	-0.23
1 A 1 a biomass	2.04	1.63	-0.42	28.97	32.90	3.93	36.35	41.21	4.85
1 A 1 a other	2.41	2.41	-	12.55	12.55	-	11.80	11.85	0.05
1 A 1 b Petroleum refining	**38.63**	**38.63**	**-**	**37.27**	**41.39**	**4.12**	**39.02**	**42.66**	**3.64**
1 A 1 b liquid	30.75	30.75	-	34.70	34.69	-0.01	36.45	36.46	0.01
1 A 1 b solid	NO	NO	-	NO	NO	-	NO	NO	-
1 A 1 b gaseous	7.88	7.88	-	2.57	6.70	4.13	2.57	6.20	3.63
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**	**-**	**12.05**	**11.70**	**-0.36**	**11.31**	**11.26**	**-0.05**
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	-	12.05	11.70	-0.36	11.31	11.26	-0.05
1 A 1 c biomass	NO	NO	-	NO	0.00	-	NO	NO	-
1 A 1 c other	NO	NO	-	NO	0.00	-	NO	NO	-
1 A 2 Manufacturing Industries and Construction	**199.50**	**199.89**	**0.40**	**282.54**	**279.34**	**-3.21**	**283.19**	**285.20**	**2.01**
1 A 2 liquid	40.70	40.68	-0.02	38.15	41.49	3.34	37.64	41.89	4.25
1 A 2 solid	50.28	50.28	-	55.64	55.86	0.23	53.75	54.64	0.89
1 A 2 gaseous	76.99	76.99	-	117.86	116.32	-1.54	117.13	119.06	1.93
1 A 2 biomass	28.30	28.71	0.42	55.57	53.39	-2.18	57.67	58.19	0.52
1 A 2 other	3.22	3.22	-	15.33	12.27	-3.06	17.00	11.42	-5.58
1 A 2 a Iron and Steel	**55.63**	**55.63**	**-**	**74.09**	**73.84**	**-0.24**	**72.37**	**73.41**	**1.04**
1 A 2 a liquid	5.79	5.79	-	9.85	9.85	-	11.04	11.04	0.00
1 A 2 a solid	38.11	38.11	-	43.15	43.16	0.01	41.69	42.62	0.93
1 A 2 a gaseous	11.73	11.73	-	21.10	20.84	-0.25	19.63	19.57	-0.07

	Fuel Consumption [PJ]								
	1990			2006			2007		
IPCC Category/ Fuel Group	**Subm. 2009**	**Subm. 2010**	**Difference**	**Subm. 2009**	**Subm. 2010**	**Difference**	**Subm. 2009**	**Subm. 2010**	**Difference**
1 A 2 a biomass	NO	NO	-	NO	NO	-	NO	0.18	0.18
1 A 2 a other	NO	NO	-	NO	NO	-	NO	NO	-
1 A 2 b Non-ferrous Metals	**2.08**	**2.08**	**-**	**3.80**	**3.75**	**-0.05**	**4.34**	**4.73**	**0.38**
1 A 2 b liquid	0.51	0.51	-	0.45	0.45	-	0.41	0.41	0.00
1 A 2 b solid	0.21	0.21	-	0.12	0.12	-	0.14	0.14	-
1 A 2 b gaseous	1.35	1.35	-	3.23	3.18	-0.05	3.79	4.18	0.39
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 Chemicals	16.09	16.09	-	29.04	25.46	-3.58	28.78	23.75	-5.03
1 A 2 c liquid	1.06	1.06	-	0.65	0.66	0.01	0.71	0.74	0.03
1 A 2 c solid	1.10	1.10	-	1.12	1.12	-	0.84	0.84	-
1 A 2 c gaseous	9.36	9.36	-	17.35	16.82	-0.54	16.01	16.50	0.48
1 A 2 c biomass	2.90	2.90	-	2.19	2.18	-0.01	2.21	2.21	0.00
1 A 2 c other	1.67	1.67	-	7.73	4.69	-3.04	9.01	3.47	-5.55
1 A 2 d Pulp, Paper and Print	54.15	54.15	-	69.91	70.43	0.52	70.48	71.08	0.61
1 A 2 d liquid	10.94	10.94	-	1.65	1.65	-	1.28	1.28	0.00
1 A 2 d solid	4.12	4.12	-	5.23	5.24	0.00	4.01	4.01	0.01
1 A 2 d gaseous	17.01	17.01	-	28.65	28.65	-	30.98	30.98	-
1 A 2 d biomass	21.88	21.88	-	34.21	34.75	0.53	34.01	34.64	0.63
1 A 2 d other	0.19	0.19	-	0.17	0.15	-0.02	0.20	0.17	-0.03
1 A 2 e Food Processing, Beverages and Tobacco	**13.91**	**13.91**	**-**	**16.22**	**16.07**	**-0.15**	**15.65**	**15.56**	**-0.09**
1 A 2 e liquid	4.45	4.45	-	3.23	3.23	0.00	2.77	2.73	-0.04
1 A 2 e solid	0.18	0.18	-	0.10	0.10	-	0.11	0.11	-
1 A 2 e gaseous	9.15	9.15	-	12.37	12.21	-0.16	12.24	12.17	-0.07
1 A 2 e biomass	0.13	0.13	-	0.52	0.52	0.01	0.53	0.55	0.02
1 A 2 e other	NO	NO	-	NO	NO	-	NO	NO	-
1 A 2 f Other	**57.65**	**58.04**	**0.40**	**89.48**	**89.78**	**0.30**	**91.57**	**96.67**	**5.11**
1 A 2 f liquid	17.95	17.93	-0.02	22.32	25.65	3.33	21.42	25.69	4.27
1 A 2 f solid	6.56	6.56	-	5.91	6.13	0.21	6.97	6.93	-0.04
1 A 2 f gaseous	28.38	28.38	-	35.15	34.62	-0.53	34.47	35.67	1.20
1 A 2 f biomass	3.39	3.81	0.42	18.66	15.94	-2.71	20.92	20.60	-0.32
1 A 2 f other	1.36	1.36	-	7.44	7.44	-	7.78	7.78	-
1 A 3 Transport	**184.26**	**186.30**	**2.03**	**337.27**	**331.34**	**-5.93**	**343.62**	**336.00**	**-7.61**
1 A 3 liquid	180.14	182.18	2.03	329.11	311.30	-17.81	335.51	313.91	-21.60
1 A 3 solid	0.07	0.07	-	0.01	0.01	-	0.01	0.01	0.00
1 A 3 gaseous	4.05	4.05	-	8.16	8.39	0.24	8.10	8.11	0.00
1 A 3 biomass	NO	NO	-	NO	11.64	11.64	NO	13.98	13.98
1 A 3 other	NO	NO	-	NO	NO	-	NO	NO	-
1 A 3 a Civil	**0.44**	**0.44**	**-**	**0.99**	**0.99**	**-**	**1.01**	**1.01**	**-**

	Fuel Consumption [PJ]								
	1990			2006			2007		
IPCC Category/ Fuel Group	**Subm. 2009**	**Subm. 2010**	**Differ-ence**	**Subm. 2009**	**Subm. 2010**	**Differ-ence**	**Subm. 2009**	**Subm. 2010**	**Differ-ence**
Aviation									
1 A 3 a aviation gasoline	0.11	0.11	-	0.12	0.12	-	0.12	0.12	-
1 A 3 a jet kerosene	0.33	0.33	-	0.86	0.86	-	0.89	0.89	-
1 A 3 b Road Transportation	**176.73**	**178.96**	**2.23**	**324.84**	**319.26**	**-5.58**	**331.14**	**324.13**	**-7.01**
1 A 3 b gasoline	104.53	106.79	2.26	84.30	84.30	-	83.17	82.25	-0.92
1 A 3 b diesel oil	72.20	72.17	-0.03	240.54	223.48	-17.07	247.97	228.07	-19.91
1 A 3 b LPG	NO	NO	-	NO	NO	-	NO	NO	-
1 A 3 b other liquid	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	11.49	11.49	NO	13.81	13.81
1 A 3 b other	NO	NO	-	NO	NO	-	NO	NO	-
1 A 3 c Railways	**2.33**	**2.38**	**0.05**	**2.35**	**2.34**	**-0.01**	**2.36**	**2.25**	**-0.11**
1 A 3 c solid	2.26	2.32	0.05	2.34	2.22	-0.13	2.35	2.12	-0.23
1 A 3 c liquid	0.07	0.07	-	0.01	0.01	-	0.01	0.01	0.00
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 Navigation	**0.71**	**0.46**	**-0.25**	**0.94**	**0.36**	**-0.58**	**1.00**	**0.50**	**-0.50**
1 A 3 d residual oil	NO	NO	-	NO	NO	-	NO	NO	-
1 A 3 d gas/diesel oil	0.58	0.33	-0.25	0.82	0.20	-0.62	0.88	0.33	-0.54
1 A 3 d gasoline	0.13	0.14	0.00	0.12	0.12	-	0.12	0.12	0.00
1 A 3 d other liquid	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**	**-**	**8.16**	**8.39**	**0.24**	**8.10**	**8.11**	**0.00**
1 A 3 e liquid	NO	NO	-	NO	NO	-	NO	NO	-
1 A 3 e solid	NO	NO	-	NO	NO	-	NO	NO	-
1 A 3 e gaseous	4.05	4.05	-	8.16	8.39	0.24	8.10	8.11	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	**251.74**	**251.77**	**0.03**	**280.27**	**260.29**	**-19.98**	**241.84**	**234.34**	**-7.50**
1 A 4 liquid	109.27	109.30	0.03	104.20	98.57	-5.63	78.51	82.42	3.90
1 A 4 solid	28.14	28.14	-	5.76	5.28	-0.48	5.27	4.13	-1.14
1 A 4 gaseous	46.46	46.46	-	80.61	78.91	-1.69	75.15	69.81	-5.34
1 A 4 biomass	64.52	64.52	-	88.97	76.79	-12.17	81.44	76.86	-4.58
1 A 4 other	3.36	3.36	-	0.73	0.73	-	1.47	1.13	-0.34
1 A 4 a Commecial/Institutional	**39.22**	**39.22**	**-**	**50.11**	**47.58**	**-2.53**	**37.15**	**35.73**	**-1.41**

	Fuel Consumption [PJ]								
	1990			2006			2007		
IPCC Category/ Fuel Group	**Subm. 2009**	**Subm. 2010**	**Differ-ence**	**Subm. 2009**	**Subm. 2010**	**Differ-ence**	**Subm. 2009**	**Subm. 2010**	**Differ-ence**
1 A 4 a liquid	19.10	19.10	-	21.92	16.11	-5.81	8.29	10.99	2.70
1 A 4 a solid	0.95	0.95	-	0.68	0.81	0.14	0.62	0.71	0.09
1 A 4 a gaseous	13.77	13.77	-	21.33	27.46	6.13	20.72	20.57	-0.15
1 A 4 a biomass	2.05	2.05	-	5.46	2.47	-2.99	6.05	2.34	-3.71
1 A 4 a other	3.36	3.36	-	0.73	0.73	-	1.47	1.13	-0.34
1 A 4 b Residential	**191.66**	**191.68**	**0.02**	**207.16**	**191.61**	**-15.55**	**182.57**	**177.05**	**-5.53**
1 A 4 b liquid	74.43	74.45	0.02	69.27	69.92	0.65	57.61	59.05	1.43
1 A 4 b solid	26.64	26.64	-	5.01	4.40	-0.61	4.56	3.35	-1.21
1 A 4 b gaseous	32.33	32.33	-	58.68	50.87	-7.81	53.88	48.69	-5.19
1 A 4 b biomass	58.27	58.27	-	74.21	66.42	-7.79	66.52	65.96	-0.56
1 A 4 b other	NO	NO	-	NO	NO	-	NO	NO	-
1 A 4 c Agriculture/Forestry/Fisheries	**20.85**	**20.86**	**0.01**	**22.99**	**21.09**	**-1.90**	**22.12**	**21.57**	**-0.56**
1 A 4 c liquid	15.74	15.75	0.01	13.01	12.54	-0.48	12.62	12.39	-0.23
1 A 4 c solid	0.55	0.55	-	0.08	0.07	-0.01	0.09	0.07	-0.02
1 A 4 c gaseous	0.37	0.37	-	0.60	0.58	-0.02	0.55	0.55	0.00
1 A 4 c biomass	4.20	4.20	-	9.30	7.90	-1.40	8.87	8.56	-0.31
1 A 4 c other	NO	NO	-	NO	NO	-	NO	NO	-
1 A 5 Other	**0.48**	**0.48**	**-**	**0.61**	**0.61**	**-**	**0.61**	**0.61**	**0.00**
1 A 5 liquid	0.48	0.48	-	0.61	0.61	0.00	0.61	0.61	0.00
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	0.00	0.00	NO	0.00	0.00
1 A 5 other	NO	NO	-	NO	NO	-	NO	NO	-
International Aviation Bunkers	**12.26**	**12.26**	**-**	**28.14**	**28.14**	**-**	**29.88**	**29.88**	**-**
International Marine Bunkers	**NO**	**0.25**	**0.25**	**NO**	**0.58**	**0.58**	**NO**	**0.49**	**0.49**

A "-" indicates that no recalculations were carried out or recalculations are lower than ± 0.005 TJ (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 2008 has been submitted to IEA and EUROSTAT in November 2009 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 2009) 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 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	Division to SNAP categories is performed by means of studies.	07 08 0201	1 A 2 f Manuf. Ind. and Constr. - Other 1 A 3 Transport 1 A 4 b Residential 1 A 4 c Agriculture/ Forestry/ Fisheries
Road			
Rail			
Inland Waterways			
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 030301 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 030311 030317 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 (ISIC 45)		0301	1 A 2 f Manuf. Ind. and Constr. - Other
Textiles and Leather (ISIC 17, 18, 19)		0301	1 A 2 f Manuf. Ind. and Constr. - Other
Non Specified (ISIC 25, 33, 36, 37)		0301	1 A 2 f Manuf. Ind. and Constr. - Other
Total Other sectors, of which:			
Commercial and Public Services (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 (ISIC 95)		0202	1 A 4 b Residential
Agriculture (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 (JQ 2009) 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	28.69	Solid (coal)
104 A	Hard Coal Briquettes	Patent Fuel	31.00	Solid (coal)
105 A	Brown Coal	Lignite/Brown Coal	20.92	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	8.30	Solid
304 A	Coke Oven Gas	Coke Oven Gas	18.21	Solid
305 A	Blast Furnace Gas	Blast Furnace Gas	4.13	Solid

Inventory Fuel Category		**IEA Fuel Category**		**IPCC Fuel Category** [(3)]
Code [(1)]	**Category**	**Category**	**Average Net Calorific Value**[(2)]	
110 A	Petrol Coke	Petrol Coke	31.54	Liquid
203 B	Light Fuel Oil Sulphur Content < 0,2 %	Residual Fuel Oil	40.72	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	43.16	Liquid (gasoline)
224 A	Other Petroleum Products	Other Products	43.36	Liquid
303 A	Liquified Petroleum Gas (LPG)	LPG	46.00	Liquid
308 A	Refinery Gas	Refinery Gas	30.68	Liquid
301 A	Natural Gas	Natural Gas	36.36	Gaseous (natural gas)
114 B	Municipal Waste	Municipal Solid Waste Renewable	(4)9.73	Other Fuels
		Municipal Solid Waste Non Renewable	9.89	Other Fuels
115 A	Industrial Waste	Industrial Wastes	(5)21.20	Other Fuels
111 A	Fuel Wood	*Wood/Wood wastes/Other Solid Wastes, of which:* Wood	14.31	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)	10.96	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	(4)8.15	Biomass
309 A	Biogas	Biogas	(4)20.71	Biomass
309 B	Sewage Sludge Gas	Sewage Sludge Gas	(4)21.19	Biomass
310 A	Landfill Gas	Landfill Gas	(4)20.13	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 2008 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

(4) Heating value of transformation input.

(5) *Heating value derived from ETS data.*

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

The following tables 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 2008 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: 2008 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	47.87	54.27	0.01	4.28	106.43	4.44	5.45	0.00	0.40	10.29
102A	Hard Coal	47.87	8.73	0.01	0.47	57.07	4.44	0.80	0.00	0.04	5.28
104A	Hard Coal Briquettes				0.79	0.79				0.07	0.07
105A	Brown Coal		1.84		0.04	1.89		0.18		0.00	0.18
106A	Brown Coal Briquettes				0.79	0.79				0.08	0.08
107A	Coke		36.20		2.19	38.39		3.77		0.20	3.97
113A	Peat				0.00	0.00				0.00	0.00
304A	Coke Oven Gas		7.50			7.50		0.71			0.71
	Total Liquid	42.05	40.64	295.54	90.78	469.01	3.09	3.08	21.68	6.75	34.64
110A	Petrol Coke	2.08	1.16			3.24	0.21	0.11			0.32
203B	Light Fuel Oil	0.15	3.57		4.99	8.71	0.01	0.28		0.38	0.67
203C	Medium Fuel Oil	1.81				1.81	0.14				0.14
203D	Heavy Fuel Oil	8.09	14.54			22.64	0.64	1.13			1.78
204A	Gasoil	0.19	3.27		67.97	71.43	0.01	0.25		5.10	5.36
2050	Diesel	0.05	15.51	220.04	11.60	247.19	0.00	1.14	16.21	0.85	18.21
206A	Other Kerosene		0.01		0.19	0.20		0.00		0.01	0.02
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	73.94	1.51	75.58		0.01	5.40	0.11	5.52
224A	Other Petroleum Products	8.86				8.86	0.69				0.69
303A	Liquified Petroleum Gas (LPG)	0.95	2.44		4.53	7.92	0.06	0.16		0.29	0.51
308A	Refinery Gas	19.86				19.86	1.32				1.32
301A	**Total Gaseous (Natural Gas)**	96.35	122.49	10.37	74.71	303.92	5.34	6.78	0.57	4.14	16.83
	Total Other Fuel	9.91	12.88		2.43	25.21	0.55	0.69		0.25	1.49
114B	Municipal Waste	8.66				8.66	0.42				0.42
115A	Industrial Waste	1.24	12.88		2.43	16.55	0.13	0.69		0.25	1.07
	Total Biomass(1)	47.34	57.15	17.44	80.46	202.38	(5.23)	(6.23)	(1.23)	(8.2)	(20.89)
111A	Fuel Wood	0.03	1.83		61.64	63.50	0.00	0.18		6.16	6.35
116A	Wood Wastes	36.97	25.42		17.70	80.09	4.07	2.80		1.95	8.81
118A	Sewage Sludge	0.75	0.31			1.06	0.08	0.03			0.12
215A	Black Liquor		27.81			27.81		3.06			3.06
250A	Liquid Biofuels		1.02	17.44	0.82	19.28		0.07	1.23	0.06	1.36
309A	Biogas	9.50	0.38		0.10	9.99	1.06	0.04		0.01	1.12
309B	Sewage Sludge Gas	0.04	0.39		0.04	0.47	0.00	0.04		0.00	0.05
310A	Landfill Gas	0.05			0.15	0.20	0.01			0.02	0.02
	Total(1)	243.51	287.43	323.36	252.65	1 106.95	13.42	16.00	22.25	11.54	63.26

(1) *CO_2 emissions of Biomass are not included in Total.*

Table A 42: 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	54.64	0.01	4.13	113.24	5.07	5.49	0.00	0.39	10.95
102A	Hard Coal	54.46	9.53	0.01	0.91	64.90	5.07	0.88	0.00	0.08	6.03
104A	Hard Coal Briquettes				0.27	0.27				0.03	0.03
105A	Brown Coal	0.00	2.02		0.06	2.08	0.00	0.20		0.01	0.20
106A	Brown Coal Briquettes				0.76	0.76				0.07	0.07
107A	Coke		36.34		2.13	38.47		3.78		0.20	3.98
113A	Peat				0.00	0.00				0.00	0.00
304A	Coke Oven Gas		6.76			6.76		0.64			0.64
	Total Liquid	46.20	41.89	314.52	82.42	485.03	3.29	3.18	23.07	6.12	35.71
110A	Petrol Coke	2.30	1.23			3.53	0.23	0.12			0.35
203B	Light Fuel Oil	0.21	5.24		5.72	11.17	0.02	0.41		0.44	0.87
203C	Medium Fuel Oil	1.88				1.88	0.15				0.15
203D	Heavy Fuel Oil	9.14	14.93			24.08	0.73	1.17			1.89
204A	Gasoil	0.15	3.82		58.68	62.66	0.01	0.29		4.40	4.70
2050	Diesel	0.01	14.15	230.55	11.49	256.19	0.00	1.04	16.98	0.85	18.87
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	82.38	1.53	84.04		0.01	6.01	0.11	6.14
224A	Other Petroleum Products	10.59				10.59	0.83				0.83
303A	Liquified Petroleum Gas (LPG)	1.04	2.37		4.89	8.30	0.07	0.15		0.31	0.53
308A	Refinery Gas	20.87				20.87	1.27				1.27
301A	**Total Gaseous (Natural Gas)**	88.48	119.06	8.11	69.81	285.46	4.90	6.59	0.45	3.87	15.81
	Total Other Fuel	11.85	11.42		1.13	24.40	0.66	0.70		0.12	1.48
114B	Municipal Waste	10.42				10.42	0.51				0.51
115A	Industrial Waste	1.43	11.42		1.13	13.98	0.15	0.70		0.12	0.97
	Total Biomass(1)	41.21	58.19	13.98	76.86	190.23	(4.55)	(6.35)	(0.99)	(7.83)	(19.72)
111A	Fuel Wood	0.03	1.75		59.71	61.50	0.00	0.18		5.97	6.15
116A	Wood Wastes	32.18	27.24		16.16	75.58	3.54	3.00		1.78	8.31
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
250A	Liquid Biofuels		0.81	13.98	0.67	15.47		0.06	0.99	0.05	1.10
309A	Biogas	8.13	0.38		0.12	8.64	0.91	0.04		0.01	0.97
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)	242.20	285.20	336.62	234.34	1 098.36	13.92	15.97	23.52	10.49	63.95

(1) *CO_2 emissions of Biomass are not included in Total.*

Table A 43: 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.	**Industry**	**Trans-port**	**Other Sectors**	**Total**	**Energy Ind.**	**Industry**	**Trans-port**	**Other Sectors**	**Total**
	Total Solid	60.20	55.86	0.01	5.28	121.35	5.64	5.60	0.00	0.50	11.74
102A	Hard Coal	53.98	10.27	0.01	1.44	65.69	5.01	0.94	0.00	0.13	6.09
104A	Hard Coal Briquettes				0.02	0.02				0.00	0.00
105A	Brown Coal	6.22	1.83		0.21	8.26	0.63	0.17		0.02	0.83
106A	Brown Coal Briquettes		0.00		0.92	0.92		0.00		0.09	0.09
107A	Coke		36.40		2.68	39.08		3.79		0.25	4.03
113A	Peat				0.00	0.00				0.00	0.00
304A	Coke Oven Gas		7.36			7.36		0.70			0.70
	Total Liquid	49.54	41.49	311.90	98.57	501.51	3.63	3.16	22.87	7.33	37.03
110A	Petrol Coke	2.02	1.30			3.32	0.20	0.12			0.33
203B	Light Fuel Oil	0.25	6.52		9.66	16.43	0.02	0.51		0.74	1.27
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	4.59		69.65	74.43	0.01	0.34		5.22	5.58
2050	Diesel	0.01	13.14	225.92	11.46	250.53	0.00	0.97	16.64	0.84	18.46
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 Products	12.55				12.55	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	1.25				1.25
301A	**Total Gaseous (Natural Gas)**	99.57	116.32	8.39	78.91	303.20	5.52	6.44	0.46	4.37	16.79
	Total Other Fuel	12.55	12.27		0.73	25.55	0.70	0.74		0.08	1.52
114B	Municipal Waste	11.07				11.07	0.54				0.54
115A	Industrial Waste	1.48	12.27		0.73	14.48	0.15	0.74		0.08	0.97
	Total Biomass(1)	32.90	53.39	11.64	76.79	174.73	(3.63)	(5.84)	(0.82)	(7.8)	(18.1)
111A	Fuel Wood	0.05	1.04		62.07	63.15	0.00	0.10		6.21	6.32
116A	Wood Wastes	25.96	23.12		13.70	62.78	2.86	2.54		1.51	6.91
118A	Sewage Sludge	0.77	0.06			0.83	0.08	0.01			0.09
215A	Black Liquor		27.40			27.40		3.01			3.01
250A	Liquid Biofuels		0.68	11.64	0.59	12.91		0.05	0.82	0.04	0.91
309A	Biogas	5.51	0.47		0.22	6.20	0.62	0.05		0.02	0.69
309B	Sewage Sludge Gas	0.57	0.62		0.05	1.24	0.06	0.07		0.01	0.14
310A	Landfill Gas	0.04			0.17	0.20	0.00			0.02	0.02
	Total(1)	254.76	279.34	331.95	260.29	1 126.33	15.48	15.94	23.34	12.27	67.08

(1) *CO_2 emissions of Biomass are not included in Total.*

Table A 44: 2005 energy consumption and CO2 emissions from category 1 A Fuel Combustion by fuel type and sector.

		Consumption (PJ)					CO2 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	55.88	0.01	5.58	123.10	5.84	5.58	0.00	0.52	11.95
102A	Hard Coal	51.51	7.74	0.01	1.53	60.79	4.81	0.72	0.00	0.14	5.67
104A	Hard Coal Briquettes				0.03	0.03				0.00	0.00
105A	Brown Coal	10.12	2.53		0.18	12.83	1.04	0.22		0.02	1.28
106A	Brown Coal Briquettes		0.00		0.98	0.98		0.00		0.09	0.09
107A	Coke		34.88		2.86	37.74		3.63		0.26	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	45.09	38.27	329.25	108.51	521.12	3.46	2.94	24.26	8.07	38.78
110A	Petrol Coke	2.07	2.05			4.12	0.21	0.19			0.40
203B	Light Fuel Oil	0.17	5.58		10.15	15.90	0.01	0.44		0.78	1.23
203C	Medium Fuel Oil	2.29	0.00			2.29	0.18	0.00			0.18
203D	Heavy Fuel Oil	12.25	14.11			26.36	0.97	1.10			2.07
204A	Gasoil	0.19	3.85		78.70	82.74	0.01	0.29		5.90	6.21
2050	Diesel	0.02	10.90	241.27	11.80	264.00	0.00	0.80	17.78	0.87	19.45
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	86.49	1.49	88.09		0.01	6.42	0.11	6.54
224A	Other Petroleum Products	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	1.14				1.14
301A	**Total Gaseous (Natural Gas)**	112.07	121.45	6.60	94.05	334.17	6.21	6.72	0.37	5.21	18.51
	Total Other Fuel	9.90	11.99		0.69	22.57	0.58	0.75		0.07	1.41
114B	Municipal Waste	8.12				8.12	0.40				0.40
115A	Industrial Waste	1.78	11.99		0.69	14.45	0.19	0.75		0.07	1.01
	Total Biomass(1)	25.42	50.98	3.19	80.20	159.78	(2.81)	(5.6)	(0.23)	(8.16)	(16.79)
111A	Fuel Wood	0.05	0.78		65.72	66.55	0.01	0.08		6.57	6.66
116A	Wood Wastes	17.37	22.49		13.94	53.80	1.91	2.47		1.53	5.92
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
250A	Liquid Biofuels		0.14	3.19	0.16	3.49		0.01	0.23	0.01	0.25
309A	Biogas	5.92	0.27		0.11	6.29	0.66	0.03		0.01	0.70
309B	Sewage Sludge Gas	1.29	0.59		0.06	1.94	0.14	0.07		0.01	0.22
310A	Landfill Gas	0.04			0.21	0.25	0.00			0.02	0.03
	Total(1)	254.11	278.57	339.04	289.02	1 160.75	16.10	15.99	24.63	13.88	70.63

(1) *CO_2 emissions of Biomass are not included in Total.*

Table A 45: 2004 energy consumption and CO2 emissions from category 1 A Fuel Combustion by fuel type and sector.

		Consumption (PJ)					CO2 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	49.41	0.01	7.06	125.54	6.67	4.97	0.00	0.66	12.31
102A	Hard Coal	59.70	7.50	0.01	1.71	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		3.89	35.78		3.32		0.36	3.67
113A	Peat				0.00	0.00				0.00	0.00
304A	Coke Oven Gas		8.29			8.29		0.78			0.78
	Total Liquid	45.60	33.14	324.49	109.44	512.67	3.69	2.59	23.91	8.15	38.39
110A	Petrol Coke	1.97	3.11			5.08	0.20	0.31			0.51
203B	Light Fuel Oil	1.39	5.91		13.88	21.17	0.11	0.46		1.07	1.64
203C	Medium Fuel Oil				2.29	2.29				0.18	0.18
203D	Heavy Fuel Oil	13.67	11.86			25.53	1.09	0.92			2.01
204A	Gasoil	0.09	2.79		73.76	76.64	0.01	0.21		5.53	5.75
2050	Diesel	0.03	7.93	234.04	11.25	253.24	0.00	0.58	17.24	0.83	18.66
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 Products	14.86				14.86	1.16				1.16
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	1.12				1.12
301A	**Total Gaseous (Natural Gas)**	93.88	108.35	6.60	96.51	305.34	5.20	6.00	0.37	5.35	16.92
	Total Other Fuel	10.09	13.95		0.68	24.72	0.59	0.86		0.07	1.52
114B	Municipal Waste	8.39				8.39	0.41				0.41
115A	Industrial Waste	1.70	13.95		0.68	16.33	0.18	0.86		0.07	1.11
	Total Biomass(1)	16.62	45.20		68.60	130.42	(1.83)	(4.96)		(6.98)	(13.77)
111A	Fuel Wood	0.05	0.89		56.43	57.36	0.00	0.09		5.64	5.74
116A	Wood Wastes	15.51	13.47		11.70	40.68	1.71	1.48		1.29	4.48
118A	Sewage Sludge	0.81				0.81	0.09				0.09
215A	Black Liquor		30.36			30.36		3.34			3.34
250A	Liquid Biofuels										
309A	Biogas	0.16	0.32			0.48	0.02	0.04			0.05
309B	Sewage Sludge Gas	0.04	0.15		0.03	0.23	0.00	0.02		0.00	0.03
310A	Landfill Gas	0.05			0.44	0.49	0.01			0.05	0.05
	Total(1)	235.26	250.04	331.10	282.29	1 098.69	16.15	14.43	24.28	14.23	69.13

(1)CO_2 emissions of Biomass are not included in Total.

Table A 46: 2003 energy consumption and CO2 emissions from category 1 A Fuel Combustion by fuel type and sector.

		Consumption (PJ)					CO2 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	70.88	49.51	0.02	7.60	128.00	6.92	4.99	0.00	0.71	12.62
102A	Hard Coal	57.19	7.13	0.02	1.76	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		0.30	15.70	1.51	0.17		0.03	1.70
106A	Brown Coal Briquettes		0.00		1.38	1.38		0.00		0.13	0.13
107A	Coke		33.05		4.09	37.14		3.44		0.38	3.81
113A	Peat				0.00	0.00				0.00	0.00
304A	Coke Oven Gas		7.62			7.62		0.72			0.72
	Total Liquid	42.10	30.71	317.92	117.64	508.37	3.44	2.37	23.43	8.78	38.07
110A	Petrol Coke	1.85	2.13			3.98	0.19	0.21			0.40
203B	Light Fuel Oil	0.72	5.04		18.25	24.01	0.06	0.39		1.41	1.85
203C	Medium Fuel Oil				2.25	2.25				0.18	0.18
203D	Heavy Fuel Oil	14.36	11.54			25.90	1.15	0.90			2.05
204A	Gasoil	0.16	2.92		78.20	81.28	0.01	0.22		5.87	6.10
2050	Diesel	0.19	7.15	225.01	10.92	243.27	0.01	0.53	16.57	0.80	17.92
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	91.50	1.53	93.14		0.01	6.80	0.11	6.92
224A	Other Petroleum Products	12.24				12.24	0.95				0.95
303A	Liquified Petroleum Gas (LPG)	0.05	1.81		6.29	8.15	0.00	0.12		0.40	0.52
308A	Refinery Gas	12.53				12.53	1.06				1.06
301A	**Total Gaseous (Natural Gas)**	94.60	112.95	6.69	93.88	308.12	5.24	6.26	0.37	5.20	17.07
	Total Other Fuel	7.85	10.90		0.65	19.40	0.49	0.83		0.07	1.39
114B	Municipal Waste	5.88				5.88	0.29				0.29
115A	Industrial Waste	1.98	10.90		0.65	13.52	0.21	0.83		0.07	1.10
	Total Biomass(1)	14.48	39.80		71.96	126.24	(1.59)	(4.37)		(7.33)	(13.29)
111A	Fuel Wood		1.07		58.50	59.57		0.11		5.85	5.96
116A	Wood Wastes	12.86	15.31		13.16	41.34	1.41	1.68		1.45	4.55
118A	Sewage Sludge	1.32				1.32	0.15				0.15
215A	Black Liquor		22.92			22.92		2.52			2.52
250A	Liquid Biofuels										
309A	Biogas	0.19	0.32			0.51	0.02	0.04			0.06
309B	Sewage Sludge Gas	0.03	0.19		0.03	0.25	0.00	0.02		0.00	0.03
310A	Landfill Gas	0.07			0.27	0.33	0.01			0.03	0.04
	Total(1)	229.92	243.87	324.62	291.73	1 090.14	16.09	14.45	23.80	14.76	69.15

(1) CO_2 emissions of Biomass are not included in Total.

Table A 47: 2002 energy consumption and CO2 emissions from category 1 A Fuel Combustion by fuel type and sector.

		Consumption (PJ)					CO2 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	8.33	112.58	5.51	4.84	0.00	0.78	11.13
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		0.35	15.19	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		6.99			6.99		0.66			0.66
	Total Liquid	38.68	29.46	294.13	111.19	473.45	2.98	2.28	21.68	8.30	35.28
110A	Petrol Coke	2.54	2.05			4.59	0.26	0.20			0.46
203B	Light Fuel Oil	0.99	3.12		16.76	20.88	0.08	0.24		1.29	1.61
203C	Medium Fuel Oil				1.91	1.91				0.15	0.15
203D	Heavy Fuel Oil	9.62	12.80			22.41	0.76	1.00			1.76
204A	Gasoil	0.03	2.75		73.63	76.41	0.00	0.21		5.52	5.73
2050	Diesel	0.03	6.73	203.25	11.37	221.39	0.00	0.50	14.97	0.84	16.31
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	89.48	1.51	91.09		0.01	6.65	0.11	6.76
224A	Other Petroleum Products	11.21				11.21	0.87				0.87
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	1.00				1.00
301A	**Total Gaseous (Natural Gas)**	85.31	112.95	5.00	81.80	285.06	4.73	6.26	0.28	4.53	15.79
	Total Other Fuel	6.77	9.39		0.62	16.78	0.43	0.67		0.06	1.16
114B	Municipal Waste	5.03				5.03	0.25				0.25
115A	Industrial Waste	1.74	9.39		0.62	11.74	0.18	0.67		0.06	0.92
	Total Biomass(1)	13.10	37.96		70.34	121.39	(1.44)	(4.16)		(7.14)	(12.75)
111A	Fuel Wood		1.42		59.28	60.70		0.14		5.93	6.07
116A	Wood Wastes	11.88	13.10		10.76	35.74	1.31	1.44		1.18	3.93
118A	Sewage Sludge	1.12				1.12	0.12				0.12
215A	Black Liquor		22.78			22.78		2.51			2.51
250A	Liquid Biofuels										
309A	Biogas		0.65			0.65		0.07			0.07
309B	Sewage Sludge Gas	0.04				0.04	0.00				0.00
310A	Landfill Gas	0.06			0.30	0.36	0.01			0.03	0.04
	Total(1)	199.98	237.86	299.15	272.27	1 009.25	13.64	14.05	21.96	13.67	63.37

(1) CO_2 emissions of Biomass are not included in Total.

Table A 48: 2001 energy consumption and CO2 emissions from category 1 A Fuel Combustion by fuel type and sector.

		Consumption (PJ)					**CO2 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	43.81	0.02	10.22	113.82	5.87	4.41	0.00	0.96	11.25
102A	Hard Coal	45.15	9.36	0.02	2.13	56.66	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	14.63	1.31		0.45	16.38	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		28.99		5.53	34.52		3.01		0.51	3.52
113A	Peat				0.00	0.00				0.00	0.00
304A	Coke Oven Gas		4.15			4.15		0.39			0.39
	Total Liquid	46.76	34.75	265.68	115.33	462.52	3.33	2.66	19.58	8.63	34.24
110A	Petrol Coke	2.27	0.67			2.94	0.23	0.07			0.30
203B	Light Fuel Oil	3.08	6.16		20.50	29.73	0.24	0.48		1.58	2.30
203C	Medium Fuel Oil				1.41	1.41				0.11	0.11
203D	Heavy Fuel Oil	15.69	15.84		0.00	31.53	1.25	1.24		0.00	2.48
204A	Gasoil	0.78	2.87		76.05	79.70	0.06	0.21		5.70	5.98
2050	Diesel	0.02	6.92	181.15	11.45	199.55	0.00	0.51	13.34	0.84	14.70
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 Products	9.90				9.90	0.77				0.77
303A	Liquified Petroleum Gas (LPG)		2.19		4.38	6.58		0.14		0.28	0.42
308A	Refinery Gas	15.01				15.01	0.78				0.78
301A	**Total Gaseous (Natural Gas)**	76.33	107.97	8.28	89.52	282.11	4.23	5.98	0.46	4.96	15.63
	Total Other Fuel	5.58	8.28		0.63	14.49	0.34	0.57		0.07	0.98
114B	Municipal Waste	4.30				4.30	0.21				0.21
115A	Industrial Waste	1.29	8.28		0.63	10.19	0.13	0.57		0.07	0.77
	Total Biomass(1)	10.90	42.21		73.78	126.89	(1.2)	(4.63)		(7.49)	(13.32)
111A	Fuel Wood		1.15		62.81	63.95		0.11		6.28	6.40
116A	Wood Wastes	8.44	17.21		10.53	36.17	0.93	1.89		1.16	3.98
118A	Sewage Sludge	2.35				2.35	0.26				0.26
215A	Black Liquor		23.28			23.28		2.56			2.56
250A	Liquid Biofuels										
309A	Biogas	0.00	0.28		0.01	0.29	0.00	0.03		0.00	0.03
309B	Sewage Sludge Gas	0.04	0.30		0.03	0.36	0.00	0.03		0.00	0.04
310A	Landfill Gas	0.07			0.41	0.48	0.01			0.05	0.05
	Total(1)	199.35	237.02	273.98	289.48	999.83	13.78	13.62	20.04	14.62	62.09

(1)CO_2 emissions of Biomass are not included in Total.

Table A 49: 2000 energy consumption and CO2 emissions from category 1 A Fuel Combustion by fuel type and sector.

		Consumption (PJ)					CO2 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	10.35	105.50	4.82	4.64	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	1.39		0.42	13.61	1.29	0.14		0.05	1.48
106A	Brown Coal Briquettes		0.00		2.06	2.06		0.00		0.20	0.20
107A	Coke		31.91		5.58	37.49		3.32		0.51	3.83
113A	Peat				0.00	0.00				0.00	0.00
304A	Coke Oven Gas		2.35			2.35		0.22			0.22
	Total Liquid	43.00	34.17	247.63	103.90	428.70	3.03	2.61	18.25	7.77	31.70
110A	Petrol Coke	1.61	0.81			2.42	0.16	0.08			0.24
203B	Light Fuel Oil	1.82	5.54		15.67	23.02	0.14	0.43		1.21	1.78
203C	Medium Fuel Oil				1.47	1.47				0.11	0.11
203D	Heavy Fuel Oil	14.59	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	7.37	163.64	11.12	182.16	0.00	0.54	12.05	0.82	13.42
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 Products	9.74				9.74	0.76				0.76
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	0.74				0.74
301A	**Total Gaseous (Natural Gas)**	74.31	108.54	9.70	72.49	265.05	4.12	6.01	0.54	4.02	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)	7.92	40.99		69.68	118.59	(0.87)	(4.5)		(7.07)	(12.45)
111A	Fuel Wood		0.95		59.22	60.17		0.10		5.92	6.02
116A	Wood Wastes	6.85	15.24		9.96	32.05	0.75	1.68		1.10	3.53
118A	Sewage Sludge	0.96				0.96	0.11				0.11
215A	Black Liquor		24.12			24.12		2.65			2.65
250A	Liquid Biofuels										
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)	179.04	235.81	257.36	257.81	930.01	12.21	13.72	18.79	12.90	57.66

(1) CO_2 emissions of Biomass are not included in Total.

Table A 50: 1999 energy consumption and CO2 emissions from category 1 A Fuel Combustion by fuel type and sector.

		Consumption (PJ)					CO2 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	11.39	92.38	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		29.45		5.98	35.43		3.06		0.55	3.61
113A	Peat				0.00	0.00				0.00	0.00
304A	Coke Oven Gas		3.44			3.44		0.33			0.33
	Total Liquid	49.29	33.59	235.53	117.51	435.93	3.63	2.58	17.36	8.79	32.41
110A	Petrol Coke	2.14	1.19			3.32	0.22	0.12			0.34
203B	Light Fuel Oil	1.17	7.24		18.82	27.23	0.09	0.56		1.45	2.11
203C	Medium Fuel Oil	0.09	0.00		2.18	2.26	0.01	0.00		0.17	0.18
203D	Heavy Fuel Oil	21.68	15.37		0.17	37.23	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	6.34	148.45	11.44	166.27	0.00	0.47	10.93	0.84	12.25
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 Products	9.40				9.40	0.73				0.73
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	0.81				0.81
301A	**Total Gaseous (Natural Gas)**	90.26	105.02	7.84	74.97	278.09	5.00	5.82	0.43	4.15	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)	6.26	45.90		73.57	125.73	(0.69)	(5.03)		(7.45)	(13.17)
111A	Fuel Wood		1.87		64.10	65.97		0.19		6.41	6.60
116A	Wood Wastes	5.27	19.83		8.94	34.05	0.58	2.18		0.98	3.75
118A	Sewage Sludge	0.96				0.96	0.11				0.11
215A	Black Liquor		23.65			23.65		2.60			2.60
250A	Liquid Biofuels										
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)	188.43	232.89	243.40	278.90	943.62	12.65	13.19	17.80	14.17	57.84

(1)CO_2 emissions of Biomass are not included in Total.

Table A 51: 1998 energy consumption and CO2 emissions from category 1 A Fuel Combustion by fuel type and sector.

		Consumption (PJ)					CO2 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	45.03	243.45	112.29	461.73	4.38	3.45	17.97	8.40	34.26
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	6.58	149.93	11.31	167.89	0.01	0.49	11.07	0.84	12.40
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	93.50		0.01	6.83	0.11	6.94
224A	Other Petroleum Products	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 (Natural 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
250A	Liquid Biofuels										
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	231.77	249.82	269.75	948.04	12.99	13.99	18.33	13.76	59.11

(1) CO_2 emissions of Biomass are not included in Total.

Table A 52: 1997 energy consumption and CO2 emissions from category 1 A Fuel Combustion by fuel type and sector.

		Consumption (PJ)					CO2 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	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	47.37	216.58	111.83	433.22	4.09	3.64	15.99	8.37	32.13
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	5.60	127.28	11.52	144.71	0.02	0.41	9.40	0.85	10.69
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 Products	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 (Natural 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
250A	Liquid Biofuels										
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	246.92	220.81	270.39	939.80	13.89	15.23	16.23	13.81	59.19

(1)CO_2 emissions of Biomass are not included in Total.

Table A 53: 1996 energy consumption and CO2 emissions from category 1 A Fuel Combustion by fuel type and sector.

		Consumption (PJ)					**CO2 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	47.52	43.99	0.06	17.65	109.23	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		25.65		9.46	35.11		2.67		0.87	3.54
113A	Peat				0.00	0.00				0.00	0.00
304A	Coke Oven Gas		7.25			7.25		0.69			0.69
	Total Liquid	52.93	38.58	229.66	123.38	444.56	3.73	2.95	16.96	9.25	32.93
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	5.94	135.60	11.01	152.71	0.01	0.44	10.01	0.81	11.28
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		0.08	92.68	1.53	94.29		0.01	6.89	0.11	7.01
224A	Other Petroleum Products	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 (Natural 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	32.73		76.52	115.37	(0.67)	(3.59)		(7.69)	(11.96)
111A	Fuel Wood		0.78		72.50	73.29		0.08		7.25	7.33
116A	Wood Wastes	5.32	10.50		3.35	19.16	0.59	1.15		0.37	2.11
118A	Sewage Sludge	0.74				0.74	0.08				0.08
215A	Black Liquor		21.17			21.17		2.33			2.33
250A	Liquid Biofuels										
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	226.62	233.93	294.39	959.11	13.80	13.70	17.20	15.30	60.05

(1)CO$_2$ emissions of Biomass are not included in Total.

Table A 54: 1995 energy consumption and CO2 emissions from category 1 A Fuel Combustion by fuel type and sector.

		Consumption (PJ)					CO2 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	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	39.71	208.61	108.15	408.41	3.73	3.04	15.42	8.09	30.32
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	4.82	107.21	10.64	122.95	0.02	0.36	7.91	0.79	9.08
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 Products	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 (Natural 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)	4.02	34.40		70.05	108.47	(0.44)	(3.77)		(7.04)	(11.26)
111A	Fuel Wood		1.08		66.28	67.35		0.11		6.63	6.74
116A	Wood Wastes	3.25	11.55		3.11	17.91	0.36	1.27		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
250A	Liquid Biofuels										
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)	186.06	223.33	212.76	272.97	895.12	12.92	13.49	15.65	14.14	56.24

(1)CO_2 emissions of Biomass are not included in Total.

Table A 55: 1994 energy consumption and CO2 emissions from category 1 A Fuel Combustion by fuel type and sector.

		Consumption (PJ)					CO2 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	32.97	42.30	0.06	19.73	95.06	3.28	4.24	0.01	1.86	9.38
102A	Hard Coal	22.73	6.39	0.06	4.04	33.22	2.17	0.60	0.01	0.38	3.15
104A	Hard Coal Briquettes										
105A	Brown Coal	10.05	2.20		1.28	13.53	1.09	0.21		0.14	1.44
106A	Brown Coal Briquettes	0.19	0.47		3.20	3.86	0.02	0.05		0.31	0.38
107A	Coke		24.94		11.20	36.14		2.59		1.03	3.62
113A	Peat				0.00	0.00				0.00	0.00
304A	Coke Oven Gas		8.31			8.31		0.79			0.79
	Total Liquid	59.12	41.98	204.91	99.84	405.85	4.23	3.22	15.16	7.46	30.11
110A	Petrol Coke	1.80	0.36			2.16	0.18	0.04			0.22
203B	Light Fuel Oil	1.88	11.31		14.23	27.43	0.15	0.88		1.10	2.13
203C	Medium Fuel Oil	0.09	0.00		2.86	2.95	0.01	0.00		0.22	0.23
203D	Heavy Fuel Oil	27.62	22.57		0.37	50.56	2.20	1.76		0.03	3.99
204A	Gasoil	0.08	0.20		64.72	65.00	0.01	0.01		4.85	4.88
2050	Diesel	0.21	4.50	99.90	11.04	115.65	0.02	0.33	7.39	0.82	8.56
206A	Other Kerosene				0.10	0.10				0.01	0.01
206B	Jet Kerosene			1.17		1.17			0.05		0.08
207A	Aviation Gasoline			0.12		0.12			0.01		0.01
2080	Motor Gasoline		0.06	103.71	1.54	105.31		0.00	7.71	0.11	7.83
224A	Other Petroleum Products	10.60			0.02	10.62	0.83			0.00	0.83
303A	Liquified Petroleum Gas (LPG)	0.13	2.98		4.95	8.06	0.01	0.19		0.32	0.52
308A	Refinery Gas	16.71				16.71	0.84				0.84
301A	**Total Gaseous (Natural Gas)**	73.43	96.51	3.78	62.95	236.67	4.07	5.35	0.21	3.49	13.11
	Total Other Fuel	3.82	4.73		1.98	10.53	0.19	0.43		0.21	0.82
114B	Municipal Waste	3.82				3.82	0.19				0.19
115A	Industrial Waste		4.73		1.98	6.70		0.43		0.21	0.63
	Total Biomass(1)	3.39	33.65		64.71	101.75	(0.37)	(3.69)		(6.5)	(10.57)
111A	Fuel Wood		0.91		61.49	62.39		0.09		6.15	6.24
116A	Wood Wastes	2.65	13.06		2.50	18.22	0.29	1.44		0.28	2.00
118A	Sewage Sludge	0.74				0.74	0.08				0.08
215A	Black Liquor		19.68			19.68		2.16			2.16
250A	Liquid Biofuels										
309A	Biogas										
309B	Sewage Sludge Gas		0.00		0.64	0.64		0.00		0.07	0.07
310A	Landfill Gas				0.09	0.09				0.01	0.01
	Total(1)	172.74	219.17	208.75	249.20	849.85	11.76	13.24	15.37	13.01	53.42

(1) CO_2 emissions of Biomass are not included in Total.

Table A 56: 1993 energy consumption and CO2 emissions from category 1 A Fuel Combustion by fuel type and sector.

		Consumption (PJ)					CO2 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	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	43.00	204.09	107.51	413.71	4.24	3.32	15.10	8.04	30.74
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	4.33	95.34	10.99	110.91	0.02	0.32	7.05	0.81	8.21
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 Products	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 (Natural 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)	3.12	32.70		69.89	105.71	(0.34)	(3.59)		(7.03)	(10.96)
111A	Fuel Wood		0.80		66.38	67.18		0.08		6.64	6.72
116A	Wood Wastes	2.35	13.16		2.81	18.31	0.26	1.45		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
250A	Liquid Biofuels										
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)	168.21	201.00	208.02	273.04	850.27	11.47	12.25	15.32	14.29	53.36

(1)CO_2 emissions of Biomass are not included in Total.

Table A 57: 1992 energy consumption and CO2 emissions from category 1 A Fuel Combustion by fuel type and sector.

		Consumption (PJ)					**CO2 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	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	36.65	202.09	108.07	395.22	3.40	2.83	14.96	8.10	29.33
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	4.08	88.93	10.92	103.93	0.00	0.30	6.58	0.81	7.69
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	112.13	1.50	113.69		0.00	8.34	0.11	8.45
224A	Other Petroleum Products	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 (Natural 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)	3.00	29.77		67.80	100.57	(0.33)	(3.27)		(6.81)	(10.4)
111A	Fuel Wood		0.71		65.28	65.98		0.07		6.53	6.60
116A	Wood Wastes	2.34	10.79		2.53	15.66	0.26	1.19		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
250A	Liquid Biofuels										
309A	Biogas										
309B	Sewage Sludge Gas										
310A	Landfill Gas										
	Total(1)	165.31	192.06	206.12	269.26	832.75	11.48	11.78	15.19	14.47	52.95

(1)CO_2 emissions of Biomass are not included in Total.

Table A 58: 1991 energy consumption and CO2 emissions from category 1 A Fuel Combustion by fuel type and sector.

		Consumption (PJ)					**CO2 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	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	46.18	202.41	114.53	411.65	3.41	3.56	14.98	8.61	30.60
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	3.85	84.14	10.83	98.82	0.00	0.28	6.23	0.80	7.31
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		0.06	117.27	1.49	118.81		0.00	8.72	0.11	8.83
224A	Other Petroleum Products	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 (Natural 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)	2.57	29.09		71.66	103.33	(0.28)	(3.19)		(7.19)	(10.67)
111A	Fuel Wood		0.74		69.23	69.96		0.07		6.92	7.00
116A	Wood Wastes	1.91	10.42		2.44	14.77	0.21	1.15		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
250A	Liquid Biofuels										
309A	Biogas										
309B	Sewage Sludge Gas										
310A	Landfill Gas										
	Total(1)	198.14	206.20	206.54	275.86	886.75	14.62	13.07	15.21	14.91	57.86

(1)CO$_2$ emissions of Biomass are not included in Total.

Table A 59: 1990 energy consumption and CO2 emissions from category 1 A Fuel Combustion by fuel type and sector.

		Consumption (PJ)					**CO2 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	61.40	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	40.68	182.91	109.30	379.34	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	3.41	75.09	10.81	89.31	0.00	0.25	5.56	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	106.93	1.54	108.51		0.00	7.95	0.11	8.07
224A	Other Petroleum Products	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 (Natural 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)	1.63	28.71		64.52	94.86	(0.18)	(3.15)		(6.47)	(9.8)
111A	Fuel Wood		0.66		62.46	63.12		0.07		6.25	6.31
116A	Wood Wastes	0.97	10.07		2.06	13.10	0.11	1.11		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
250A	Liquid Biofuels										
309A	Biogas										
309B	Sewage Sludge Gas										
310A	Landfill Gas										
	Total(1)	188.37	199.89	187.03	251.77	827.06	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 64.

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 64.

Activity data

Production, Imports, Exports, Stock Change

Activity data are taken from the national energy balance (IEA JQ 2009) (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 relevant for aviation and international navigation on rivers and the lake of constance.

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

<u>Activity data</u>

Imports, Exports and Production are updated according to the new version of the energy balance (IEA JQ 2009). Changes of activity data are based on energy balance recalculations as described in Annex 2.

Diesel fuel "loaded into ship" has been considered as an additional bunker fuel.

Results of the Reference Approach

Table A 60-Table A 64 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 60 present the calculation results for each fuel type of the Reference Approach for selected years.

Table A 60: Actual CO_2 emissions (Gg CO_2) for selected years.

Fuel Type	**1990**	**1995**	**2000**	**2001**	**2002**	**2003**	**2004**	**2005**	**2006**	**2007**	**2008**
Crude Oil	24 681	26 751	25 573	27 308	27 771	27 371	26 201	27 135	26 294	26 369	27 032
Orimulsion	0	0	0	0	0	0	0	0	0	0	0
Natural Gas Liquids	116	121	302	154	149	261	249	215	243	503	339
Gasoline	-229	386	519	215	674	1 228	1 306	870	1 216	762	222
Jet Kerosene	-843	-1 206	-1 569	-1 479	-1 387	-1 269	-1 287	-1 713	-1 495	-1 735	-1 322
Other Kerosene	-44	-8	16	-1	10	11	9	8	7	6	5
Shale Oil	0	0	0	0	0	0	0	0	0	0	0
Gas / Diesel Oil	1 796	3 699	6 965	8 148	9 450	11 863	13 319	13 493	12 840	13 222	11 588
Residuel Fuel Oil	995	1 212	1 097	1 356	242	865	467	311	557	376	138
LPG	252	373	405	422	434	376	355	335	391	326	219
Ethane	0	0	0	0	0	0	0	0	0	0	0
Naphtha	-1 060	-1 233	-1 429	-1 569	-1 551	-1 549	-1 757	-1 388	-2 094	-2 218	-2 121
Bitumen	-864	-815	-1 100	-1 291	-1 336	-1 276	-1 391	-1 496	-1 257	-1 319	-1 426
Lubricants	164	-85	-166	-183	-165	-226	-204	-206	-234	-247	-287
Petroleum Coke	-17	14	17	-5	136	134	228	152	107	82	76
Refinery Feedstocks	3 031	1 643	1 516	1 785	1 278	323	1 026	1 461	1 382	1 034	1 253
OtherOil	210	-122	-128	-332	-389	-367	32	-136	-154	-204	-74
Liquid Fossil Totals	**28 188**	**30 731**	**32 017**	**34 530**	**35 317**	**37 745**	**38 552**	**39 042**	**37 804**	**36 956**	**35 642**
Anthracite	40	44	7	4	19	8	18	12	244	508	7
Coking Coal	5 926	4 766	4 658	4 720	4 681	4 696	4 713	4 647	4 622	4 657	4 567
Other Bit.	4 688	3 808	4 784	5 291	4 933	6 134	6 366	5 610	5 876	5 425	5 167

Fuel Type	1990	1995	2000	2001	2002	2003	2004	2005	2006	2007	2008
Coal											
Sub- Bit. Coal	0	0	79	92	123	150	136	136	163	163	167
Lignite	2 707	1 884	1 308	1 534	1 459	1 537	1 129	1 176	734	37	15
Oil Shale	0	0	0	0	0	0	0	0	0	0	0
Peat	0	0	0	0	0	0	0	0	0	0	0
BKB & Patent Fuel	548	308	197	195	118	132	107	92	87	86	161
Coke Oven / Gas Coke	2 008	2 687	3 118	2 746	3 546	3 325	3 344	4 048	4 145	3 974	3 883
Solid Fuel Totals	**15 917**	**13 499**	**14 152**	**14 581**	**14 880**	**15 983**	**15 813**	**15 722**	**15 872**	**14 851**	**13 968**
Gaseous Fossil	**12 238**	**15 048**	**15 388**	**16 309**	**16 494**	**17 833**	**17 621**	**19 307**	**17 605**	**16 476**	**17 639**
TOTAL	**56 343**	**59 278**	**61 557**	**65 420**	**66 691**	**71 561**	**71 985**	**74 070**	**71 281**	**68 283**	**67 249**
Biomass Total	**9 134**	**10 452**	**11 456**	**12 258**	**11 724**	**12 193**	**12 528**	**14 901**	**15 341**	**16 695**	**17 561**
Solid Biomass	9 134	10 360	11 318	12 135	11 610	12 073	12 398	14 027	14 578	15 709	16 433
Liquid Biomass	IE	IE	IE	IE	IE	IE	IE	IE	IE	IE	IE
Gas Biomass	0	92	138	123	114	119	130	874	763	986	1 128

Table A 61 present the apparent fuel consumption for each fuel type of the Reference Approach.

Table A 61: Apparent Consumption (PJ)

Fuel Type	1990	1995	2000	2001	2002	2003	2004	2005	2006	2007	2008
Crude Oil	339.95	368.47	352.24	376.14	382.52	377.01	360.90	373.76	362.18	363.21	372.34
Orimulsion	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	4.84	2.47	2.39	4.18	3.99	3.44	3.89	8.06	5.43
Gasoline	-3.34	5.63	7.56	3.14	9.82	17.90	19.03	12.69	17.73	11.11	3.23
Jet Kerosene	-11.91	-17.04	-22.17	-20.89	-19.60	-17.93	-18.19	-24.19	-21.12	-24.51	-18.67
Other Kerosene	-0.62	-0.11	0.22	-0.01	0.14	0.15	0.13	0.11	0.10	0.08	0.07
Shale Oil	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	24.50	50.45	94.98	111.12	128.88	161.79	181.64	184.02	175.11	180.32	158.04
Residuel Fuel Oil	12.99	15.83	14.32	17.71	3.16	11.29	6.10	4.07	7.28	4.91	1.80
LPG	4.03	5.97	6.49	6.76	6.96	6.03	5.68	5.37	6.26	5.22	3.51
Ethane	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	-0.45	-4.91	-3.11	-4.91
Bitumen	10.80	7.48	9.80	8.69	7.41	8.67	8.55	7.45	11.78	4.63	2.46
Lubricants	5.76	0.56	-0.11	-0.36	-0.54	-1.27	-1.31	-1.23	-1.65	-1.90	-2.49
Petroleum Coke	2.61	0.88	1.89	1.78	3.31	3.61	4.55	3.28	2.36	2.20	2.71
Refinery Feedstocks	41.75	22.63	20.89	24.59	17.60	4.46	14.13	20.12	19.03	14.24	17.26
OtherOil	3.64	-0.93	-1.11	-3.88	-4.66	-4.34	1.08	-1.38	0.83	-1.50	1.01
Liquid	**432.12**	**461.76**	**489.83**	**527.26**	**537.40**	**571.54**	**586.28**	**587.04**	**578.88**	**562.96**	**541.78**

Fuel Type	**1990**	**1995**	**2000**	**2001**	**2002**	**2003**	**2004**	**2005**	**2006**	**2007**	**2008**
Fossil Totals											
Anthracite	0.45	0.48	0.08	0.06	0.22	0.11	0.20	0.14	2.55	5.29	0.08
Coking Coal	65.42	53.43	52.58	52.97	53.15	53.14	53.34	53.16	52.95	53.20	52.17
Other Bit. Coal	50.57	41.08	51.60	57.07	53.21	66.16	68.67	60.51	63.39	58.52	55.73
Sub- Bit. Coal	0.00	0.00	0.84	0.98	1.31	1.60	1.44	1.44	1.73	1.73	1.78
Lignite	27.29	19.00	13.19	15.46	14.71	15.50	11.39	11.86	7.40	0.38	0.15
Oil Shale	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
BKB & Patent Fuel	5.91	3.32	2.13	2.10	1.28	1.42	1.15	1.00	0.94	0.93	1.74
Coke Oven / Gas Coke	19.10	25.55	29.62	26.10	33.67	31.58	31.74	38.43	39.34	37.72	36.84
Solid Fuel Totals	**168.75**	**142.85**	**150.05**	**154.74**	**157.56**	**169.51**	**167.93**	**166.55**	**168.30**	**157.77**	**148.50**
Gaseous Fossil	**219.24**	**269.58**	**275.68**	**292.17**	**295.49**	**319.48**	**315.67**	**345.88**	**315.39**	**295.16**	**315.99**
TOTAL	**820.11**	**874.20**	**915.56**	**974.17**	**990.44**	**1 060.53**	**1 069.88**	**1 099.47**	**1 062.57**	**1 015.90**	**1 006.27**
Biomass Total	**94.67**	**108.23**	**118.59**	**126.91**	**121.39**	**126.24**	**129.71**	**153.44**	**158.13**	**171.91**	**180.72**
Solid Biomass	94.67	107.39	117.31	125.78	120.34	125.14	128.51	145.39	151.10	162.82	170.33
Liquid Biomass	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	1.28	1.13	1.05	1.10	1.20	8.05	7.03	9.08	10.39

Table A 62 present the carbon stored for each fuel type of the Reference Approach.

Table A 62: Carbon Stored (Gg C)

Fuel Type	**1990**	**1995**	**2000**	**2001**	**2002**	**2003**	**2004**	**2005**	**2006**	**2007**	**2008**
Crude Oil	0	0	0	0	0	0	0	0	0	0	0
Orimulsion	0	0	0	0	0	0	0	0	0	0	0
Natural Gas Liquids	0	0	0	0	0	0	0	0	0	0	0
Gasoline	0	0	0	0	0	0	0	0	0	0	0
Jet Kerosene	0	0	0	0	0	0	0	0	0	0	0
Other Kerosene	0	0	0	0	0	0	0	0	0	0	0
Shale Oil	0	0	0	0	0	0	0	0	0	0	0
Gas / Diesel Oil	0	0	0	0	0	0	0	0	0	0	0
Residuel Fuel Oil	0	0	0	0	0	0	0	0	0	0	0
LPG	0	0	0	0	0	0	0	0	0	0	0
Ethane	0	0	0	0	0	0	0	0	0	0	0
Naphtha	294	340	394	432	427	427	484	373	479	549	486
Bitumen	476	389	519	547	531	542	571	576	605	465	447
Lubricants	70	35	43	43	35	37	30	32	32	30	29
Petroleum Coke	77	20	47	50	54	62	62	48	35	38	53
Refinery	0	0	0	0	0	0	0	0	0	0	0

Fuel Type	**1990**	**1995**	**2000**	**2001**	**2002**	**2003**	**2004**	**2005**	**2006**	**2007**	**2008**
Feedstocks											
OtherOil	15	15	13	14	14	14	13	10	59	26	41
Liquid Fossil Totals	**931**	**799**	**1 016**	**1 086**	**1 061**	**1 083**	**1 161**	**1 040**	**1 210**	**1 108**	**1 056**
Anthracite	1	0	0	0	1	1	0	0	0	0	0
Coking Coal	39	52	60	53	68	64	65	78	80	77	75
Other Bit. Coal	0	0	0	0	0	0	0	0	0	0	0
Sub- Bit. Coal	0	0	0	0	0	0	0	0	0	0	0
Lignite	0	0	0	0	0	0	0	0	0	0	0
Oil Shale	0	0	0	0	0	0	0	0	0	0	0
Peat	0	0	0	0	0	0	0	0	0	0	0
BKB & Patent Fuel	0	0	0	0	0	0	0	0	0	0	0
Coke Oven/ Gas Coke	5	6	6	6	6	6	6	7	7	7	6
Solid Fuel Totals	**44**	**58**	**67**	**59**	**76**	**71**	**71**	**86**	**87**	**84**	**82**
Gaseous Fossil	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
TOTAL	**975**	**857**	**1 083**	**1 146**	**1 136**	**1 154**	**1 231**	**1 126**	**1 297**	**1 192**	**1 138**
Biomass Total	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
Solid Biomass	0	0	0	0	0	0	0	0	0	0	0
Liquid Biomass	0	0	0	0	0	0	0	0	0	0	0
Gas Biomass	0	0	0	0	0	0	0	0	0	0	0

Table A 63 present international bunker fuels for the relevant fuel types of the Reference Approach.

Table A 63: International Bunkers [Gg fuel]

Fuel Type	**1990**	**1995**	**2000**	**2001**	**2002**	**2003**	**2004**	**2005**	**2006**	**2007**	**2008**
Jet Kerosene	275	409	522	509	475	447	531	604	631	670	672
Diesel	6	6	6	6	6	5	5	21	14	14	14

Table A 64 present conversion factors, carbon emission factors and the fraction of carbon oxidised for all fuel types of the Reference Approach.

Table A 64: 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

Fuel Type	Conversion Factor [TJ/Gg]	Carbon emission factor [t C/TJ]	Fraction of carbon oxidised [t C/t C]
Other Kerosene	44.75	19.60	0.99
Shale Oil	-	-	-
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 65 present country specific conversion factors. From 2007 on the conversion factor of lignite is higher because indigenous production and use of lignite with a comparable low calorific value (high water content) has been suspended.

Table A 65: Country specific conversion factors [TJ/Gg]

Fuel Type	1990	1995	2000	2001	2002	2003	2004	2005	2006	2007	2008
Other Bit. Coal	28.00	28.00	27.99	27.99	27.50	27.50	28.41	28.15	28.07	27.89	28.28
Lignite	10.90	10.90	9.82	9.79	9.82	9.82	9.96	9.82	10.94	22.07	20.92

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 2009.

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 66: National Energy Balance 1990-2008 Coking Coal [1000 tons].

101A Coking Coal	**1990**	**1995**	**1998**	**1999**	**2000**	**2001**	**2002**	**2003**	**2004**	**2005**	**2006**	**2007**	**2008**
Indigenous Production	0	0	0	0	0	0	0	0	0	0	0	0	0
Total Imports (Balance)	2 376	1 778	2 089	2 146	1 738	1 861	1 864	1 858	1 789	2 063	1 806	1 859	1 931
Total Exports (Balance)	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
Stock Change (National Territory)	-39	130	83	45	139	30	34	40	115	-164	86	41	-68
Gross Inland Deliveries (Obs.)	2 337	1 908	2 172	2 191	1 878	1 892	1 898	1 898	1 905	1 899	1 891	1 900	1 863
Statistical Difference	0	0	0	0	0	0	0	0	0	0	0	0	0
Total Transformation Sector	2 337	1 908	2 172	2 191	1 878	1 892	1 898	1 898	1 905	1 899	1 891	1 900	1 863
Public Electricity	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
Public Heat Plants	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
Auto Producers for CHP	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
Gas Works (Transformation)	0	0	0	0	0	0	0	0	0	0	0	0	0
Coke Ovens (Transformation)	2 337	1 908	2 172	2 191	1 878	1 892	1 898	1 898	1 905	1 899	1 891	1 900	1 863
Blast Furnaces (Transformation)	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
BKB (Transformation)	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
Total Energy Sector	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
Patent Fuel Plants	0	0	0	0	0	0	0	0	0	0	0	1	2
Coke Ovens (Energy)	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
Gas Works (Energy)	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	1	2
Petroleum refineries	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
Non Specified (Energy)	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
Final Consumption	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
Rail	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
Non Specified (Transport)	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
Iron and Steel	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
Non ferrous Metals	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
Transportation Equipment	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
Mining and Quarrying	0	0	0	0	0	0	0	0	0	0	0	0	0

101A Coking Coal	1990	1995	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008
Food, Beverages and Tobacco	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
Wood and Wood Products	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
Textiles and Leather	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
Total Other Sectors	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
Residential	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
Non Specified (Others)	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

Table A 67: National Energy Balance 1990–2008 Bituminous Coal & Anthracite [1000 tons].

102A Bitominous Coal & Anthracite (hard coal)	1990	1995	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008
Indigenous Production	0	1	0	0	0	0	0	0	0	0	0	0	0
Total Imports (Balance)	1 233	1 216	1 653	1 211	1 672	1 862	2 167	2 101	2 659	2 274	2 316	2 569	2 132
Total Exports (Balance)	0	1	0	0	0	0	0	0	21	3	0	1	2
International Marine Bunkers	0	0	0	0	0	0	0	0	0	0	0	0	0
Stock Change (National Territory)	589	268	-97	94	176	179	-225	310	-212	-119	34	-277	-156
Gross Inland Deliveries (Obs.)	1 822	1 484	1 555	1 305	1 848	2 042	1 942	2 411	2 426	2 152	2 349	2 291	1 974
Statistical Difference	0	0	0	0	0	0	0	0	0	0	0	0	0
Total Transformation Sector	1 421	1 082	1 061	907	1 422	1 673	1 617	2 129	2 147	1 885	2 001	1 978	1 735
Public Electricity	964	550	890	731	1 203	1 446	1 373	1 908	1 908	1 665	1 770	1 777	1 510
Public Combined Heat and Power	409	518	127	140	161	180	194	177	193	178	174	164	188
Public Heat Plants	0	0	0	0	0	0	0	0	0	0	0	0	0
Auto Producers of Electricity	0	0	4	4	10	8	8	7	4	4	4	4	4
Auto Producers for CHP	48	14	40	32	48	39	42	38	43	39	53	32	34
Auto Producer Heat Plants	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
Coke Ovens (Transformation)	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
Patent Fuel Plants	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
Non Specified (Transformation)	0	0	0	0	0	0	0	0	0	0	0	0	0
Total Energy Sector	0	0	0	7	33	2	0	0	0	0	0	0	0
Coal Mines	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	1	2
Coke Ovens (Energy)	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
Gas Works (Energy)	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	1	2
Petroleum refineries	0	0	0	0	0	0	0	0	0	0	0	0	0
Power Plants	0	0	0	7	33	2	0	0	0	0	0	0	0
Non Specified (Energy)	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
Final Consumption	400	400	493	390	392	365	323	280	277	267	347	313	237
Total Transport	3	0	1	1	1	1	1	1	0	0	0	0	0
Rail	3	0	1	1	1	1	1	1	0	0	0	0	0
Inland Waterways	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
Total Industry	208	251	383	290	313	288	254	215	217	212	296	280	221
Iron and Steel	0	0	0	0	0	0	0	0	0	3	5	5	1
Chemical (incl.Petro-Chemical)	7	45	70	88	57	68	66	67	61	35	29	22	19
Non ferrous Metals	0	0	0	0	0	0	0	0	0	0	0	0	0
Non metallic Mineral Products	199	164	199	131	170	151	98	74	72	86	140	156	140
Transportation Equipment	0	0	0	0	0	0	0	0	0	0	0	0	0
Machinery	0	0	0	0	0	0	0	0	0	0	1	0	0
Mining and Quarrying	0	0	0	0	0	0	0	0	0	0	0	0	0

102A Bitominous Coal & Anthracite (hard coal)	**1990**	**1995**	**1998**	**1999**	**2000**	**2001**	**2002**	**2003**	**2004**	**2005**	**2006**	**2007**	**2008**
Food, Beverages and Tobacco	0	0	0	0	0	0	0	0	0	0	0	0	1
Pulp, Paper and Printing	2	43	113	72	86	69	90	74	83	87	121	97	60
Wood and Wood Products	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
Textiles and Leather	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
Total Other Sectors	189	148	109	98	78	76	69	64	60	54	51	32	17
Commerce - Public Services	11	10	11	18	8	7	9	9	6	5	5	3	5
Residential	177	137	98	80	69	69	60	55	53	49	46	29	11
Agriculture	1	1	1	1	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
Total Non-Energy Use	2	1	1	1	1	1	2	2	1	1	1	1	1

Table A 68: National Energy Balance 1990-2008. Patent Fuel [1000 tons].

104A Patent Fuel (hard coal briquettes)	**1990**	**1995**	**1998**	**1999**	**2000**	**2001**	**2002**	**2003**	**2004**	**2005**	**2006**	**2007**	**2008**
Indigenous Production	0	0	0	0	0	0	0	0	0	0	0	0	0
Total Imports (Balance)	0	0	4	4	4	1	1	2	1	1	1	9	75
Total Exports (Balance)	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
Stock Change (National Territory)	0	0	0	0	0	0	0	0	0	0	0	0	-25
Gross Inland Deliveries (Obs.)	0	0	4	4	4	1	1	2	1	1	1	9	49
Statistical Difference	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
Public Electricity	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
Public Heat Plants	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
Auto Producers for CHP	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
Gas Works (Transformation)	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
Blast Furnaces (Transformation)	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
BKB (Transformation)	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
Total Energy Sector	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
Patent Fuel Plants	0	0	0	0	0	0	0	0	0	0	0	1	2
Coke Ovens (Energy)	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
Gas Works (Energy)	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	1	2
Petroleum refineries	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
Non Specified (Energy)	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
Final Consumption	0	0	4	4	4	1	1	2	1	1	1	9	49
Total Transport	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
Inland Waterways	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
Total Industry	0	0	0	0	0	0	0	0	0	0	0	0	24
Iron and Steel	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
Non ferrous Metals	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

104A Patent Fuel (hard coal briquettes)	1990	1995	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008
Transportation Equipment	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
Mining and Quarrying	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
Pulp, Paper and Printing	0	0	0	0	0	0	0	0	0	0	0	0	24
Wood and Wood Products	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
Textiles and Leather	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
Total Other Sectors	0	0	4	4	4	1	1	2	1	1	1	9	25
Commerce - Public Services	0	0	1	1	1	0	0	0	0	0	0	2	0
Residential	0	0	3	3	3	0	1	2	1	1	1	7	25
Agriculture	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
Total Non-Energy Use	0	0	0	0	0	0	0	0	0	0	0	0	0

Table A 69: National Energy Balance 1990-2008. Lignite and Brown Coal [1000 tons].

105A Lignite and brown coal	1990	1995	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008
Indigenous Production	0	0	0	0	0	0	0	0	0	0	0	0	0
Total Imports (Balance)	6	0	0	15	2	0	1	0	0	0	0	0	0
Total Exports (Balance)	3	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	1	2
Stock Change (National Territory)	0	0	0	0	0	0	0	0	0	0	0	0	0
Gross Inland Deliveries (Obs.)	0	0	0	0	0	0	0	0	0	0	0	0	0
Statistical Difference	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	1	2
Public Electricity	0	0	0	0	0	0	0	0	0	0	0	0	0
Public Combined Heat and Power	3	0	0	15	2	0	1	0	0	0	0	0	0
Public Heat Plants	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
Auto Producers for CHP	364	219	103	137	149	153	174	178	177	137	98	94	87
Auto Producer Heat Plants	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
Coke Ovens (Transformation)	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
Patent Fuel Plants	147	115	45	84	106	107	138	148	148	126	88	92	85
BKB (Transformation)	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
Total Energy Sector	0	0	0	0	0	0	0	0	0	0	0	0	0
Coal Mines	11	4	3	15	40	44	59	72	68	70	84	87	85
Patent Fuel Plants	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
Blast Furnaces (Energy)	0	0	0	0	0	0	0	0	0	0	0	0	0
Gas Works (Energy)	2	0	0	0	0	0	0	0	0	0	0	0	0
BKB (Transformation)	132	111	42	69	67	63	80	76	79	56	4	4	0
Petroleum refineries	0	0	0	0	0	0	0	0	0	0	0	0	0
Power Plants	2	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
Distribution Losses	0	0	0	0	0	0	0	0	0	0	0	0	0
Final Consumption	217	104	58	53	43	46	36	31	29	11	10	3	2
Total Transport	9	5	3	3	3	3	2	2	2	1	1	0	0
Rail	208	99	55	50	40	43	34	29	28	11	10	2	2
Inland Waterways	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	1	2	3
Total Industry	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
Chemical (incl.Petro-Chemical)	6	0	0	15	2	0	1	0	0	0	0	0	0

105A Lignite and brown coal	**1990**	**1995**	**1998**	**1999**	**2000**	**2001**	**2002**	**2003**	**2004**	**2005**	**2006**	**2007**	**2008**
Non ferrous Metals	3	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	1	2
Transportation Equipment	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
Mining and Quarrying	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	1	2
Pulp, Paper and Printing	0	0	0	0	0	0	0	0	0	0	0	0	0
Wood and Wood Products	3	0	0	15	2	0	1	0	0	0	0	0	0
Construction	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
Non Specified (Industry)	364	219	103	137	149	153	174	178	177	137	98	94	87
Total Other Sectors	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
Residential	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
Non Specified (Others)	147	115	45	84	106	107	138	148	148	126	88	92	85
Total Non-Energy Use	0	0	0	0	0	0	0	0	0	0	0	0	0

Table A 70: National Energy Balance 1990–2008. Brown Coal Briquettes [1000 tons].

106A BKB-PB	**1990**	**1995**	**1998**	**1999**	**2000**	**2001**	**2002**	**2003**	**2004**	**2005**	**2006**	**2007**	**2008**
Indigenous Production	0	0	0	0	0	0	0	0	0	0	0	0	0
Total Imports (Balance)	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
International Marine Bunkers	0	0	0	0	0	0	0	0	0	0	1	2	0
Stock Change (National Territory)	0	0	0	0	0	0	0	0	0	0	0	0	0
Gross Inland Deliveries (Obs.)	0	0	0	0	0	0	0	0	0	0	0	0	0
Statistical Difference	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	1	2	0
Public Electricity	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
Public Heat Plants	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
Auto Producers for CHP	172	103	106	107	108	65	72	58	51	48	39	41	172
Auto Producer Heat Plants	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
Coke Ovens (Transformation)	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
Patent Fuel Plants	14	0	0	0	0	0	0	0	0	0	0	0	14
BKB (Transformation)	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
Total Energy Sector	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
Patent Fuel Plants	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
Blast Furnaces (Energy)	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
BKB (Transformation)	14	0	0	0	0	0	0	0	0	0	0	0	14
Petroleum refineries	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
Non Specified (Energy)	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
Final Consumption	158	103	106	107	108	65	72	58	51	48	39	41	158
Total Transport	6	11	11	34	41	15	32	20	14	13	11	11	6
Rail	146	88	91	70	64	48	38	37	35	33	28	29	146
Inland Waterways	6	4	4	3	3	2	2	2	2	1	1	1	6
Non Specified (Transport)	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
Iron and Steel	0	0	0	0	0	0	0	0	0	0	0	0	0

106A BKB-PB	1990	1995	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008
Chemical (incl.Petro-Chemical)	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
Non metallic Mineral Products	0	0	0	0	0	0	0	0	0	0	1	2	0
Transportation Equipment	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
Mining and Quarrying	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	1	2	0
Pulp, Paper and Printing	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
Construction	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
Non Specified (Industry)	172	103	106	107	108	65	72	58	51	48	39	41	172
Total Other Sectors	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
Residential	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
Non Specified (Others)	14	0	0	0	0	0	0	0	0	0	0	0	14
Total Non-Energy Use	0	0	0	0	0	0	0	0	0	0	0	0	0

Table A 71: National Energy Balance 1990-2008. Coke Oven Coke [1000 tons].

107A Coke Oven Coke	1990	1995	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008
Indigenous Production	0	0	0	0	0	0	0	0	0	0	0	0	0
Total Imports (Balance)	77	68	48	53	52	58	55	50	65	62	61	56	77
Total Exports (Balance)	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	1	2	0
Stock Change (National Territory)	0	0	0	0	0	0	0	0	0	0	0	0	0
Gross Inland Deliveries (Obs.)	77	68	48	53	52	58	55	50	65	62	61	56	77
Statistical Difference	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	1	2	0
Public Electricity	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
Public Heat Plants	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
Auto Producers for CHP	557	422	466	436	344	366	383	435	386	383	348	340	557
Auto Producer Heat Plants	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
Coke Ovens (Transformation)	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
Patent Fuel Plants	196	200	255	242	151	200	241	299	287	290	274	264	196
BKB (Transformation)	178	164	183	200	130	173	206	274	235	266	252	241	178
Non Specified (Transformation)	6	11	18	16	12	11	14	10	9	0	0	0	6
Total Energy Sector	3	6	8	7	3	6	5	6	4	4	5	5	3
Coal Mines	4	13	40	11	2	5	4	5	32	16	13	16	4
Patent Fuel Plants	0	0	0	0	0	0	0	0	0	0	0	0	0
Coke Ovens (Energy)	2	2	3	0	0	0	0	0	0	0	0	0	2
Blast Furnaces (Energy)	0	0	0	0	0	0	0	0	0	0	0	0	0
Gas Works (Energy)	2	4	3	8	4	5	11	4	6	4	4	3	2
BKB (Transformation)	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
Power Plants	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
Distribution Losses	0	0	0	0	0	0	0	0	0	0	0	0	0
Final Consumption	361	222	211	195	193	167	142	136	99	92	73	76	361
Total Transport	9	5	8	11	15	18	15	14	15	14	13	13	9
Rail	345	212	198	180	174	146	125	119	83	77	60	61	345
Inland Waterways	8	5	5	4	4	3	2	2	1	1	1	1	8
Non Specified (Transport)	0	0	0	0	0	0	0	0	0	0	0	0	0
Total Industry	1 010	944	933	1 037	1 025	1 115	1 058	982	1 265	1 195	1 171	1 083	1 010

107A Coke Oven Coke	1990	1995	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008
Iron and Steel	0	0	0	0	0	0	0	0	0	0	0	0	0
Chemical (incl.Petro-Chemical)	77	68	48	53	52	58	55	50	65	62	61	56	77
Non ferrous Metals	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	1	2	0
Transportation Equipment	0	0	0	0	0	0	0	0	0	0	0	0	0
Machinery	77	68	48	53	52	58	55	50	65	62	61	56	77
Mining and Quarrying	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	1	2	0
Pulp, Paper and Printing	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
Construction	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
Non Specified (Industry)	557	422	466	436	344	366	383	435	386	383	348	340	557
Total Other Sectors	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
Residential	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
Non Specified (Others)	196	200	255	242	151	200	241	299	287	290	274	264	196
Total Non-Energy Use	178	164	183	200	130	173	206	274	235	266	252	241	178

Table A 72: National Energy Balance 1990-2008. Peat [1000 tons].

113A Peat	1990	1995	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008
Indigenous Production	0	0	0	0	0	0	0	0	0	0	0	0	0
Total Imports (Balance)	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
International Marine Bunkers	0	0	0	0	0	0	0	0	0	0	1	2	0
Stock Change (National Territory)	0	0	0	0	0	0	0	0	0	0	0	0	0
Gross Inland Deliveries (Obs.)	0	0	0	0	0	0	0	0	0	0	0	0	0
Statistical Difference	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	1	2	0
Public Electricity	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
Public Heat Plants	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
Auto Producers for CHP	1	1	1	1	1	1	1	1	1	1	1	1	1
Auto Producer Heat Plants	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
Coke Ovens (Transformation)	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
Patent Fuel Plants	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
Non Specified (Transformation)	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
Coal Mines	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
Coke Ovens (Energy)	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
Gas Works (Energy)	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
Petroleum refineries	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
Non Specified (Energy)	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
Final Consumption	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
Rail	1	1	1	1	1	1	1	1	1	1	1	1	1
Inland Waterways	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

113A Peat	1990	1995	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008
Total Industry	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
Chemical (incl.Petro-Chemical)	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
Non metallic Mineral Products	0	0	0	0	0	0	0	0	0	0	1	2	0
Transportation Equipment	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
Mining and Quarrying	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	1	2	0
Pulp, Paper and Printing	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
Construction	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
Non Specified (Industry)	1	1	1	1	1	1	1	1	1	1	1	1	1
Total Other Sectors	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
Residential	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
Non Specified (Others)	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

Table A 73: National Energy Balance 1990-2008. Coke Oven Gas [TJ].

304A Coke Oven Gas	1990	1995	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008
Indigenous Production	13 117	10 906	12 166	12 220	10 466	9 776	9 579	10 722	10 911	9 871	9 682	9 524	9 903
Total Imports (Balance)	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
International Marine Bunkers	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
Gross Inland Deliveries (Obs.)	13 117	10 906	12 166	12 220	10 466	9 776	9 579	10 722	10 911	9 871	9 682	9 524	9 903
Statistical Difference	0	0	0	0	0	0	0	0	0	0	0	0	0
Total Transformation Sector	3 385	6 228	3 087	3 732	3 592	3 648	3 187	1 748	2 436	2 332	2 119	2 062	2 230
Public Electricity	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
Public Heat Plants	0	0	0	0	0	0	0	0	0	0	0	0	0
Auto Producers of Electricity	0	0	2 033	2 649	3 256	3 449	2 778	1 255	2 193	2 027	1 915	1 848	1 942
Auto Producers for CHP	3 385	6 228	1 054	1 083	286	199	409	494	243	305	204	214	288
Auto Producer Heat Plants	0	0	0	0	50	0	0	0	0	0	0	0	0
Gas Works (Transformation)	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
Blast Furnaces (Transformation)	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
BKB (Transformation)	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
Total Energy Sector	4 136	3 439	3 836	3 853	3 300	3 083	3 020	4 187	4 326	4 171	4 091	4 091	4 091
Coal Mines	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	1	2
Coke Ovens (Energy)	1 072	892	995	999	856	799	783	708	595	699	644	576	605
Blast Furnaces (Energy)	3 064	2 547	2 841	2 854	2 444	2 283	2 237	3 479	3 730	3 472	3 447	3 514	3 486
Gas Works (Energy)	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	1	2
Petroleum refineries	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
Non Specified (Energy)	0	0	0	0	0	0	0	0	0	0	0	0	0
Distribution Losses	0	0	0	0	0	0	1 023	1 171	1 204	845	728	673	524
Final Consumption	5 596	1 239	5 243	4 635	3 574	3 046	2 348	3 616	2 946	2 523	2 744	2 699	3 059
Total Transport	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
Inland Waterways	0	0	0	0	0	0	0	0	0	0	0	0	0

304A Coke Oven Gas	1990	1995	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008
Non Specified (Transport)	0	0	0	0	0	0	0	0	0	0	0	0	0
Total Industry	5 596	1 239	5 243	4 635	3 574	3 046	2 348	3 616	2 946	2 523	2 744	2 699	3 059
Iron and Steel	5 596	1 239	5 243	4 635	3 574	3 046	2 348	3 616	2 946	2 523	2 744	2 699	3 059
Chemical (incl.Petro-Chemical)	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
Non metallic Mineral Products	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
Machinery	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
Food, Beverages and Tobacco	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
Wood and Wood Products	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
Textiles and Leather	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
Total Other Sectors	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
Residential	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
Non Specified (Others)	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

Table A 74: National Energy Balance 1990–2008. Blast Furnace Gas [TJ].

305A Blast Furnace Gas	1990	1995	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008
Indigenous Production	17 094	19 503	22 528	21 873	25 385	25 098	29 309	28 463	29 577	28 902	32 217	33 031	34 556
Total Imports (Balance)	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
International Marine Bunkers	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
Gross Inland Deliveries (Obs.)	17 094	19 503	22 528	21 873	25 385	25 098	29 309	28 463	29 577	28 902	32 217	33 031	34 556
Statistical Difference	0	0	0	0	0	0	0	0	0	0	0	0	0
Total Transformation Sector	4 822	6 213	7 625	6 802	6 014	8 379	9 181	9 088	11 128	12 095	11 389	12 979	12 161
Public Electricity	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
Public Heat Plants	0	0	0	0	0	0	0	0	0	0	0	0	0
Auto Producers of Electricity	0	0	5 320	4 629	5 011	7 784	8 395	7 956	10 437	10 937	10 474	12 125	11 101
Auto Producers for CHP	4 822	6 213	2 305	2 173	1 003	596	786	1 132	690	1 157	916	854	1 060
Auto Producer Heat Plants	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
Coke Ovens (Transformation)	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
Patent Fuel Plants	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
Non Specified (Transformation)	0	0	0	0	0	0	0	0	0	0	0	0	0
Total Energy Sector	9 682	11 685	13 536	13 156	15 254	15 077	17 304	17 025	16 175	16 290	18 137	18 216	20 449
Coal Mines	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	1	2
Coke Ovens (Energy)	2 391	2 641	3 256	3 231	3 675	3 609	3 941	3 861	4 282	3 647	3 644	7 964	10 811
Blast Furnaces (Energy)	7 291	9 044	10 280	9 924	11 579	11 468	13 363	13 164	11 894	12 643	14 493	10 252	9 638
Gas Works (Energy)	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	1	2
Petroleum refineries	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
Non Specified (Energy)	0	0	0	0	0	0	0	0	0	0	0	0	0
Distribution Losses	0	0	0	0	0	0	1 111	653	967	517	2 691	1 836	1 946
Final Consumption	2 590	1 605	1 367	1 915	4 117	1 642	1 713	1 696	1 307	0	0	0	0
Total Transport	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

305A Blast Furnace Gas	1990	1995	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008
Inland Waterways	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
Total Industry	2 590	1 605	1 367	1 915	4 117	1 642	1 713	1 696	1 307	0	0	0	0
Iron and Steel	2 590	1 605	1 367	1 915	4 117	1 642	1 713	1 696	1 307	0	0	0	0
Chemical (incl.Petro-Chemical)	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
Non metallic Mineral Products	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
Machinery	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
Food, Beverages and Tobacco	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
Wood and Wood Products	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
Textiles and Leather	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
Total Other Sectors	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
Residential	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
Non Specified (Others)	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

Oil

Table A 75: National Energy Balance 1990-2008. Crude Oil [1000 tons].

201A Crude Oil	1990	1995	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008
Indigenous Production	1 149	1 035	959	1 003	971	957	957	1 113	971	855	863	800	906
Refinery Losses	120	153	156	226	122	210	72	28	68	25	35	21	52
Refinery Intake (Calculated)	7 952	8 619	9 190	8 636	8 240	8 799	8 947	8 819	8 442	8 743	8 472	8 496	8 710
Refinery Intake (Observed)	7 952	8 619	9 190	8 636	8 240	8 799	8 947	8 819	8 442	8 743	8 472	8 496	8 710
Refinery Fuel	0	0	0	0	0	0	1	0	0	0	0	0	0
Total Imports (Balance)	6 797	7 590	8 269	7 698	7 315	7 940	8 118	7 819	7 562	7 833	7 699	7 591	7 864
Total Exports (Balance)	0	0	44	51	61	63	0	0	0	0	0	0	0
Stock Change (National Territory)	6	-6	6	-14	16	-36	-128	-114	-91	55	-90	105	-61
Statistical Difference	0	0	0	0	0	0	0	0	0	0	0	0	0

Table A 76: National Energy Balance 1990-2008. Natural Gas Liquids [1000 tons].

302A Natural Gas Liquids	1990	1995	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008
Indigenous Production	41	43	88	60	101	55	53	92	88	76	86	128	120
Refinery Losses	0	0	0	0	0	0	0	0	0	0	0	0	0
Refinery Intake (Calculated)	41	43	226	71	107	55	53	55	51	43	47	141	80
Refinery Intake (Observed)	41	43	226	71	107	55	53	55	51	43	47	141	80
Refinery Fuel	0	0	0	0	0	0	0	38	38	33	39	38	40
Total Imports (Balance)	0	0	135	0	6	0	0	0	0	0	0	50	0
Total Exports (Balance)	0	0	0	0	0	0	0	0	0	0	0	0	0
Stock Change (National Territory)	0	0	2	10	0	0	0	0	0	0	0	0	0
Statistical Difference	0	0	0	0	0	0	0	0	0	0	0	0	0

Table A 77: National Energy Balance 1990-2008. Refinery Feedstocks [1000 tons].

217A Refinery Feedstocks	1990	1995	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008
Refinery Losses	0	0	0	0	0	0	0	0	0	0	0	0	0
Refinery Intake (Calculated)	1 069	582	564	876	541	616	440	152	354	471	468	348	404
Refinery Intake (Observed)	1 069	582	564	873	540	616	440	152	354	471	468	348	404
Refinery Fuel	0	0	0	2	1	14	26	5	45	65	43	53	70
Total Imports (Balance)	1 009	600	746	740	627	534	593	374	223	265	502	305	358
Total Exports (Balance)	0	39	7	64	125	80	32	72	12	18	35	28	18
Stock Change (National Territory)	-26	-28	-182	148	-10	125	-146	-198	122	227	-20	58	66

Table A 78: National Energy Balance 1990-2008. Residual Fuel Oil [1000 tons].

203X; Residual Fuel Oil	**1990**	**1995**	**1998**	**1999**	**2000**	**2001**	**2002**	**2003**	**2004**	**2005**	**2006**	**2007**	**2008**
Refinery Gross Output	1 913	1 502	1 347	1 308	979	1 047	1 012	978	1 031	1 045	915	879	769
Refinery Fuel	81	139	63	22	37	7	7	25	7	26	6	40	36
Total Imports (Balance)	602	531	671	468	262	317	241	328	306	182	199	183	184
Total Exports (Balance)	185	38	18	37	152	228	146	55	55	72	58	37	148
International Marine Bunkers	0	0	0	0	0	0	0	0	0	0	0	0	0
Stock Change (National Territory)	-93	-100	-38	-131	246	352	-17	8	-99	-8	40	-23	8
Gross Inland Deliveries (Obs.)	2 156	1 757	1 899	1 586	1 298	1 481	1 083	1 234	1 176	1 066	1 090	872	777
Statistical Difference	0	0	0	0	0	0	0	0	0	0	0	0	0
Total Transformation Sector	608	573	732	558	380	456	264	355	368	350	370	239	214
Public Electricity	28	88	348	236	109	99	34	106	94	79	91	73	66
Public Combined Heat and Power	253	316	233	241	162	191	168	203	198	182	201	99	95
Public Heat Plants	99	70	106	54	87	149	46	30	65	71	66	61	48
Auto Producers of Electricity	0	0	10	5	5	8	6	6	4	3	3	1	2
Auto Producers for CHP	227	97	33	20	15	9	8	8	8	13	7	5	4
Auto Producer Heat Plants	1	1	1	2	1	1	1	2	0	0	0	0	0
Gas Works (Transformation)	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
Blast Furnaces (Transformation)	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
Patent Fuel Plants	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
Total Energy Sector	116	150	191	191	231	256	154	159	203	234	227	274	224
Coal Mines	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
Coke Ovens (Energy)	0	0	0	0	0	0	0	0	0	0	0	0	0
Blast Furnaces (Energy)	116	150	191	191	231	256	154	159	203	234	227	274	224
Gas Works (Energy)	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
Non Specified (Energy)	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
Final Consumption	1 432	1 035	976	837	687	769	666	719	604	483	493	360	338
Total Transport	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
Domestic Air Transport	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
Rail	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
Pipeline Transport	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
Total Industry	518	550	611	335	277	249	215	225	214	239	258	223	218
Iron and Steel	19	23	9	10	21	13	8	6	10	10	16	6	28
Chemical (incl.Petro-Chemical)	23	27	33	19	11	10	9	10	12	11	11	13	14
Non ferrous Metals	4	7	15	9	9	7	7	7	7	6	6	5	5
Non metallic Mineral Products	115	135	159	80	51	37	35	38	40	44	46	49	48
Transportation Equipment	13	17	5	4	4	5	3	3	4	5	4	4	3
Machinery	29	32	54	31	30	28	25	28	27	30	31	27	27
Mining and Quarrying	6	7	9	13	12	13	11	11	8	10	11	7	3
Food, Beverages and Tobacco	78	89	69	39	38	37	34	34	34	35	42	36	33
Pulp, Paper and Printing	126	108	114	56	41	42	36	41	30	38	36	31	23
Wood and Wood Products	15	21	33	19	9	4	12	13	12	13	12	9	3
Construction	32	22	36	17	16	12	10	12	10	14	21	17	15
Textiles and Leather	27	25	39	17	12	17	12	9	8	10	9	7	5

203X; Residual Fuel Oil	1990	1995	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008
Non Specified (Industry)	30	36	36	22	23	24	13	13	12	13	15	12	11
Total Other Sectors	914	485	365	502	410	520	450	495	391	244	235	137	121
Commerce - Public Services	316	239	58	173	117	231	207	199	109	92	96	27	7
Residential	471	194	241	259	232	229	193	235	223	121	110	87	90
Agriculture	127	53	65	70	60	60	50	61	58	31	29	23	23
Non Specified (Others)	0	0	0	0	0	0	0	0	0	0	0	0	0
Total Non-Energy Use	116	150	191	191	231	256	154	159	203	234	227	274	224

Table A 79: National Energy Balance 1990-2008. Heating and Oher Gas Oil [1000 tons].

204A Heating and Other Gas Oil	1990	1995	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008
Refinery Gross Output	1 239	1 454	1 280	1 245	1 062	1 301	1 062	1 103	928	997	1 004	612	991
Refinery Fuel	0	0	2	6	0	0	0	0	0	0	0	0	0
Total Imports (Balance)	0	165	577	615	533	626	734	860	805	926	950	743	813
Total Exports (Balance)	0	0	0	0	1	3	0	0	17	20	34	10	34
International Marine Bunkers	0	0	0	0	0	0	0	0	0	0	0	0	0
Stock Change (National Territory)	5	39	41	1	65	-63	-11	-63	75	30	-187	123	-100
Gross Inland Deliveries (Obs.)	1 244	1 658	1 895	1 854	1 659	1 861	1 785	1 899	1 791	1 933	1 734	1 467	1 669
Statistical Difference	0	0	0	0	0	0	0	0	0	0	0	0	0
Total Transformation Sector	0	2	3	1	0	18	0	4	2	5	5	5	6
Public Electricity	0	0	0	0	0	14	0	0	0	1	1	1	1
Public Combined Heat and Power	0	2	0	0	0	4	0	1	0	3	1	2	2
Public Heat Plants	0	0	2	0	0	0	0	3	2	1	2	1	1
Auto Producers of Electricity	0	0	0	0	0	0	0	0	0	0	1	1	1
Auto Producers for CHP	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
Gas Works (Transformation)	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
Blast Furnaces (Transformation)	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
Patent Fuel Plants	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
Total Energy Sector	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
Oil and Gas Extraction	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
Blast Furnaces (Energy)	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
Power Plants	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
Distribution Losses	0	0	0	0	0	0	0	0	0	0	0	0	0
Final Consumption	1 244	1 656	1 893	1 853	1 659	1 843	1 785	1 895	1 789	1 928	1 728	1 463	1 663
Total Transport	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
Domestic Air Transport	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
Rail	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
Pipeline Transport	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
Total Industry	1	5	24	24	38	67	64	68	65	90	107	89	76
Iron and Steel	0	0	0	0	0	0	0	0	0	0	0	0	0
Chemical (incl.Petro-Chemical)	0	0	1	1	2	4	4	2	1	1	1	1	1

204A Heating and Other Gas Oil	1990	1995	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008
Non ferrous Metals	0	0	0	2	2	3	3	1	1	1	1	1	1
Non metallic Mineral Products	0	1	5	2	2	3	2	3	3	5	6	5	6
Transportation Equipment	0	0	0	0	0	0	0	0	1	1	1	1	1
Machinery	0	1	6	4	5	10	9	9	7	10	13	12	12
Mining and Quarrying	0	0	1	1	1	2	3	2	3	3	4	3	2
Food, Beverages and Tobacco	0	1	3	6	10	19	19	17	13	21	27	24	21
Pulp, Paper and Printing	0	0	0	0	1	1	1	1	1	2	2	1	1
Wood and Wood Products	0	0	1	1	1	2	2	3	3	6	7	6	1
Construction	0	1	6	5	10	18	17	23	28	32	34	28	26
Textiles and Leather	0	0	1	1	1	2	2	2	2	3	4	2	2
Non Specified (Industry)	0	0	2	1	2	3	3	3	3	5	7	5	3
Total Other Sectors	1 243	1 651	1 868	1 828	1 622	1 776	1 720	1 827	1 723	1 838	1 621	1 373	1 587
Commerce - Public Services	26	92	471	417	204	342	290	372	319	229	186	174	349
Residential	1 216	1 558	1 396	1 410	1 416	1 433	1 429	1 454	1 403	1 608	1 434	1 198	1 236
Agriculture	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
Total Non-Energy Use	0	0	0	0	0	0	0	0	0	0	0	0	0

Table A 80: National Energy Balance 1990-2008. Diesel [1000 tons].

2050 Diesel	1990	1995	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008
Refinery Gross Output	1 531	1 920	2 615	2 430	2 662	2 658	2 922	2 746	2 601	2 931	2 780	2 976	3 108
Refinery Fuel	0	1	1	0	0	0	0	4	0	0	0	0	1
Total Imports (Balance)	576	937	1 898	1 877	2 075	2 433	2 728	3 491	4 078	4 129	4 054	4 273	4 099
Total Exports (Balance)	3	83	467	459	415	415	520	539	563	889	584	945	1 040
International Marine Bunkers	0	0	0	0	0	0	0	0	0	0	0	0	0
Stock Change (National Territory)	-7	112	-108	44	-59	-8	49	-9	-179	91	-145	-8	-76
Gross Inland Deliveries (Obs.)	2 097	2 885	3 937	3 892	4 263	4 668	5 180	5 685	5 936	6 262	6 106	6 296	6 090
Statistical Difference	0	0	0	0	0	0	0	0	0	0	0	0	0
Total Transformation Sector	0	8	1	2	1	1	0	0	0	0	0	0	0
Public Electricity	0	6	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
Public Heat Plants	0	0	0	0	0	0	0	0	0	0	0	0	0
Auto Producers of Electricity	0	0	0	1	0	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
Auto Producer Heat Plants	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
Coke Ovens (Transformation)	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
Petrochemical Industry	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
Non Specified (Transformation)	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
Coal Mines	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
Coke Ovens (Energy)	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
Gas Works (Energy)	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
Non Specified (Energy)	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
Final Consumption	2 096	2 877	3 936	3 890	4 262	4 667	5 179	5 685	5 935	6 262	6 106	6 296	6 090

2050 Diesel	1990	1995	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008
Total Transport	1 766	2 507	3 522	3 484	3 830	4 245	4 760	5 255	5 486	5 740	5 506	5 666	5 423
International Civil Aviation	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
Road	1 705	2 456	3 475	3 436	3 782	4 196	4 713	5 205	5 436	5 668	5 438	5 598	5 354
Rail	54	45	41	42	42	42	41	44	44	52	54	54	54
Inland Waterways	6	6	6	6	6	6	6	5	5	21	14	14	14
Pipeline Transport	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
Total Industry	81	113	154	147	172	162	157	167	185	257	337	366	405
Iron and Steel	0	0	0	0	0	0	0	0	0	0	0	0	0
Chemical (incl.Petro-Chemical)	1	1	1	1	1	1	0	0	0	0	0	0	0
Non ferrous Metals	0	0	0	0	0	0	0	0	0	0	0	0	0
Non metallic Mineral Products	0	0	1	1	1	1	1	0	0	0	1	1	1
Transportation Equipment	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
Mining and Quarrying	2	2	3	3	3	3	4	3	4	4	4	4	4
Food, Beverages and Tobacco	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	0
Wood and Wood Products	0	1	1	1	1	1	1	1	1	1	1	2	1
Construction	77	108	147	141	165	155	151	161	179	251	329	358	398
Textiles and Leather	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
Total Other Sectors	250	257	260	259	260	261	262	263	265	265	263	263	262
Commerce - Public Services	9	13	17	17	19	21	23	24	26	28	27	28	27
Residential	0	0	0	0	0	0	0	0	0	0	0	0	0
Agriculture	241	245	242	242	241	240	240	239	238	237	236	236	235
Non Specified (Others)	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

Table A 81: National Energy Balance 1990–2008. Other Kerosene [1000 tons].

206A Other Kerosene	1990	1995	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008
Refinery Gross Output	31	8	2	1	1	1	1	1	1	1	8	1	3
Refinery Fuel	0	0	0	0	0	0	0	0	0	0	0	0	0
Total Imports (Balance)	14	4	16	15	5	0	3	4	3	3	2	2	2
Total Exports (Balance)	21	6	2	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
Stock Change (National Territory)	-7	0	1	0	0	0	0	0	0	0	0	0	0
Gross Inland Deliveries (Obs.)	18	6	17	16	6	1	4	5	4	3	4	3	5
Statistical Difference	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
Public Electricity	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
Public Heat Plants	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
Auto Producers for CHP	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
Gas Works (Transformation)	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
Blast Furnaces (Transformation)	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
Patent Fuel Plants	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

206A Other Kerosene	1990	1995	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008
Total Energy Sector	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
Oil and Gas Extraction	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
Blast Furnaces (Energy)	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
Power Plants	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
Distribution Losses	0	0	0	0	0	0	0	0	0	0	0	0	0
Final Consumption	18	6	17	16	6	1	4	5	4	3	4	3	5
Total Transport	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
Domestic Air Transport	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
Rail	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
Pipeline Transport	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
Total Industry	0	0	0	1	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
Chemical (incl.Petro-Chemical)	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
Non metallic Mineral Products	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
Machinery	0	0	0	1	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
Food, Beverages and Tobacco	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
Wood and Wood Products	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
Textiles and Leather	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
Total Other Sectors	18	6	17	15	6	1	4	4	4	3	3	3	4
Commerce - Public Services	18	6	17	15	6	1	4	4	4	3	3	3	4
Residential	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
Non Specified (Others)	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

Table A 82: National Energy Balance 1990-2008. Kerosene Type Jet Fuel [1000 tons].

206B Kerosene Type Jet Fuel	1990	1995	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008
Refinery Gross Output	291	420	540	508	544	513	484	446	455	592	526	604	472
Refinery Fuel	0	0	0	0	0	0	0	0	0	0	0	0	0
Total Imports (Balance)	13	23	9	21	35	37	38	47	132	85	190	159	252
Total Exports (Balance)	5	0	6	5	5	1	1	5	4	2	1	1	2
International Marine Bunkers	0	0	0	0	0	0	0	0	0	0	0	0	0
Stock Change (National Territory)	0	4	-2	2	-4	4	-3	4	-4	-22	-32	-38	3
Gross Inland Deliveries (Obs.)	299	447	541	525	569	553	519	491	578	653	683	724	725
Statistical Difference	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
Public Electricity	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

206B Kerosene Type Jet Fuel	1990	1995	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008
Public Heat Plants	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
Auto Producers for CHP	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
Gas Works (Transformation)	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
Blast Furnaces (Transformation)	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
Patent Fuel Plants	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
Total Energy Sector	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
Oil and Gas Extraction	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
Blast Furnaces (Energy)	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
Power Plants	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
Distribution Losses	0	0	0	0	0	0	0	0	0	0	0	0	0
Final Consumption	299	447	541	525	569	553	519	491	578	653	683	724	725
Total Transport	299	447	541	525	569	553	519	491	578	653	683	724	725
International Civil Aviation	269	425	511	489	537	447	484	414	486	549	575	552	585
Domestic Air Transport	30	22	30	36	32	106	34	77	92	104	108	172	140
Road	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
Inland Waterways	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
Non Specified (Transport)	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
Iron and Steel	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
Non ferrous Metals	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
Transportation Equipment	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
Mining and Quarrying	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
Pulp, Paper and Printing	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
Construction	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
Non Specified (Industry)	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
Commerce - Public Services	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
Agriculture	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
Total Non-Energy Use	0	0	0	0	0	0	0	0	0	0	0	0	0

Table A 83: National Energy Balance 1990-2007. Gasoline Type Jet Fuel [1000 tons].

207A Gasoline Type Jet Fuel	1990	1995	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008
Refinery Gross Output	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
Total Imports (Balance)	1	4	3	3	3	4	4	5	7	6	7	5	7
Total Exports (Balance)	0	0	0	1	1	1	2	3	3	3	3	3	4
International Marine Bunkers	0	0	0	0	0	0	0	0	0	0	0	0	0
Stock Change (National Territory)	2	-1	0	0	0	-1	0	1	-1	0	-1	0	0
Gross Inland Deliveries (Obs.)	3	3	3	3	2	2	2	3	2	3	3	3	3
Statistical Difference	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
Public Electricity	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
Public Heat Plants	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
Auto Producers for CHP	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
Gas Works (Transformation)	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
Blast Furnaces (Transformation)	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
Patent Fuel Plants	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
Total Energy Sector	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
Oil and Gas Extraction	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
Blast Furnaces (Energy)	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
Power Plants	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
Distribution Losses	0	0	0	0	0	0	0	0	0	0	0	0	0
Final Consumption	3	3	3	3	2	2	2	3	2	3	3	3	3
Total Transport	3	3	3	3	2	2	2	3	2	3	3	3	3
International Civil Aviation	0	0	0	0	0	0	0	0	0	0	0	0	0
Domestic Air Transport	3	3	3	3	2	2	2	3	2	3	3	3	3
Road	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
Inland Waterways	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
Non Specified (Transport)	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
Iron and Steel	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
Non ferrous Metals	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
Transportation Equipment	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
Mining and Quarrying	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
Pulp, Paper and Printing	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
Construction	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

207A Gasoline Type Jet Fuel	**1990**	**1995**	**1998**	**1999**	**2000**	**2001**	**2002**	**2003**	**2004**	**2005**	**2006**	**2007**	**2008**
Non Specified (Industry)	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
Commerce - Public Services	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
Agriculture	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
Total Non-Energy Use	0	0	0	0	0	0	0	0	0	0	0	0	0

Table A 84: National Energy Balance 1990-2008. Motor Gasoline [1000 tons].

2080 Motor Gasoline	**1990**	**1995**	**1998**	**1999**	**2000**	**2001**	**2002**	**2003**	**2004**	**2005**	**2006**	**2007**	**2008**
Refinery Gross Output	2 631	2 271	2 232	2 141	1 815	1 922	1 927	1 799	1 715	1 798	1 615	1 704	1 684
Refinery Fuel	0	0	0	0	0	0	0	0	0	0	0	0	0
Total Imports (Balance)	259	698	759	762	670	603	706	879	1 043	1 090	959	883	712
Total Exports (Balance)	281	596	824	824	472	582	496	474	614	767	562	646	653
International Marine Bunkers	0	0	0	0	0	0	0	0	0	0	0	0	0
Stock Change (National Territory)	-55	20	37	-24	-32	47	8	-8	-7	-43	-5	8	10
Gross Inland Deliveries (Obs.)	2 545	2 394	2 204	2 054	1 981	1 991	2 144	2 196	2 137	2 078	2 008	1 949	1 753
Statistical Difference	9	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
Public Electricity	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
Public Heat Plants	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
Auto Producers for CHP	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
Gas Works (Transformation)	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
Blast Furnaces (Transformation)	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
Patent Fuel Plants	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
Total Energy Sector	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
Oil and Gas Extraction	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
Blast Furnaces (Energy)	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
Power Plants	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
Distribution Losses	0	0	0	0	0	0	0	0	0	0	0	0	0
Final Consumption	2 545	2 394	2 204	2 054	1 981	1 991	2 144	2 196	2 137	2 078	2 008	1 949	1 753
Total Transport	2 545	2 394	2 204	2 054	1 981	1 991	2 144	2 196	2 137	2 078	2 008	1 949	1 753
International Civil Aviation	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
Road	2 545	2 394	2 204	2 054	1 981	1 991	2 144	2 196	2 137	2 078	2 008	1 949	1 753
Rail	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
Pipeline Transport	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
Total Industry	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
Chemical (incl.Petro-Chemical)	0	0	0	0	0	0	0	0	0	0	0	0	0

2080 Motor Gasoline	1990	1995	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008
Non ferrous Metals	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
Transportation Equipment	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
Mining and Quarrying	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
Pulp, Paper and Printing	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
Construction	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
Non Specified (Industry)	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
Commerce - Public Services	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
Agriculture	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
Total Non-Energy Use	0	0	4	0	0	0	0	0	0	0	0	0	0

Table A 85: National Energy Balance 1990-2008. Lubricants [1000 tons].

219A Lubricants	1990	1995	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008
Refinery Gross Output	31	73	107	105	111	117	100	123	108	111	120	122	135
Refinery Fuel	0	1	0	0	0	0	0	0	0	0	0	0	0
Total Imports (Balance)	177	51	53	52	57	51	47	44	43	53	53	52	54
Total Exports (Balance)	32	41	53	51	58	65	62	80	70	85	91	102	117
International Marine Bunkers	0	0	0	0	0	0	0	0	0	0	0	0	0
Stock Change (National Territory)	-2	4	-1	-3	-1	5	2	4	-6	1	-3	2	1
Gross Inland Deliveries (Obs.)	174	86	106	103	108	108	86	92	75	80	79	75	73
Statistical Difference	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
Public Electricity	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
Public Heat Plants	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
Auto Producers for CHP	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
Gas Works (Transformation)	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
Blast Furnaces (Transformation)	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
Patent Fuel Plants	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
Total Energy Sector	19	9	12	11	12	12	9	10	8	9	9	8	8
Coal Mines	0	0	0	0	0	0	0	0	0	0	0	0	0
Oil and Gas Extraction	1	0	1	1	1	1	0	1	0	0	0	0	0
Coke Ovens (Energy)	6	3	3	3	4	4	3	3	2	3	3	2	2
Blast Furnaces (Energy)	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
Power Plants	2	1	1	1	1	1	1	1	1	1	1	1	1
Non Specified (Energy)	11	5	6	6	6	6	5	6	4	5	5	4	4
Distribution Losses	0	0	0	0	0	0	0	0	0	0	0	0	0
Final Consumption	155	77	94	92	96	96	77	82	67	71	70	67	65
Total Transport	71	35	43	42	44	44	36	38	31	32	32	30	29

219A Lubricants	1990	1995	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008
International Civil Aviation	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
Road	70	34	42	41	43	43	35	37	30	32	31	30	29
Rail	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
Pipeline Transport	0	0	0	0	0	0	0	0	0	0	0	0	0
Non Specified (Transport)	1	1	1	0	1	1	1	1	0	0	0	0	0
Total Industry	81	40	49	48	50	50	40	42	35	38	37	35	34
Iron and Steel	15	7	9	9	9	9	7	7	7	7	7	7	6
Chemical (incl.Petro-Chemical)	7	3	4	4	4	4	3	4	3	3	3	3	3
Non ferrous Metals	2	1	1	1	2	2	1	1	1	1	1	1	1
Non metallic Mineral Products	11	5	6	6	7	7	5	6	5	5	5	5	4
Transportation Equipment	2	1	1	1	1	1	1	1	1	1	1	1	1
Machinery	3	2	2	2	2	4	3	3	3	3	3	3	3
Mining and Quarrying	3	2	2	2	2	2	2	2	1	1	1	1	1
Food, Beverages and Tobacco	11	5	7	7	7	7	5	6	5	5	5	5	5
Pulp, Paper and Printing	9	4	5	5	5	5	4	5	4	4	4	4	4
Wood and Wood Products	3	1	2	2	2	2	1	1	1	1	1	1	1
Construction	2	1	1	1	1	1	1	1	1	1	1	1	1
Textiles and Leather	5	2	3	3	3	3	2	2	2	2	2	2	2
Non Specified (Industry)	9	4	6	5	6	4	3	3	2	3	3	2	2
Total Other Sectors	3	2	2	2	2	2	2	2	1	2	2	1	1
Commerce - Public Services	3	2	2	2	2	2	1	1	1	1	1	1	1
Residential	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
Non Specified (Others)	0	0	0	0	0	0	0	0	0	0	0	0	0
Total Non-Energy Use	174	86	106	103	108	108	86	92	75	80	79	75	73

Table A 86: National Energy Balance 1990-2008. White Spirit [1000 tons].

220A White Spirit	1990	1995	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008
Refinery Gross Output	0	5	0	0	0	0	0	0	41	0	0	0	0
Refinery Fuel	0	0	0	0	0	0	0	0	0	0	0	0	0
Total Imports (Balance)	11	8	12	12	7	6	9	11	10	11	13	12	12
Total Exports (Balance)	0	0	1	0	0	0	1	0	0	0	0	0	0
International Marine Bunkers	0	0	0	0	0	0	0	0	0	0	0	0	0
Stock Change (National Territory)	0	-1	0	1	1	0	0	0	-18	0	0	0	0
Gross Inland Deliveries (Obs.)	11	12	11	13	7	6	8	10	10	12	12	12	11
Statistical Difference	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
Public Electricity	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
Public Heat Plants	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
Auto Producers for CHP	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
Gas Works (Transformation)	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
Blast Furnaces (Transformation)	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
Patent Fuel Plants	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
Total Energy Sector	0	0	0	0	0	0	0	0	0	0	0	0	0

220A White Spirit	1990	1995	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008
Coal Mines	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
Coke Ovens (Energy)	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
Gas Works (Energy)	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
Non Specified (Energy)	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
Final Consumption	11	12	11	13	7	6	8	10	10	12	12	12	11
Total Transport	-2	0	4	7	1	-4	2	4	4	5	3	3	3
International Civil Aviation	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
Road	-2	0	4	7	1	-4	2	4	4	5	3	3	3
Rail	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
Pipeline Transport	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
Total Industry	13	11	6	6	6	6	6	7	6	6	9	8	8
Iron and Steel	0	0	0	0	0	0	0	0	0	0	0	0	0
Chemical (incl.Petro-Chemical)	11	10	5	4	4	4	4	5	4	4	3	3	3
Non ferrous Metals	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
Transportation Equipment	1	1	1	1	1	0	0	0	0	0	0	0	0
Machinery	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
Food, Beverages and Tobacco	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
Wood and Wood Products	0	0	0	0	0	0	0	0	0	0	0	0	0
Construction	0	0	0	1	1	2	2	2	2	2	5	5	5
Textiles and Leather	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
Total Other Sectors	0	0	0	0	0	4	0	0	0	0	0	0	0
Commerce - Public Services	0	0	0	0	0	4	0	0	0	0	0	0	0
Residential	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
Non Specified (Others)	0	0	0	0	0	0	0	0	0	0	0	0	0
Total Non-Energy Use	11	10	5	4	4	4	4	5	4	4	3	3	3

Table A 87: National Energy Balance 1990-2008. Bitumen [1000 tons].

222A Bitumen	1990	1995	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008
Refinery Gross Output	269	254	300	326	343	402	416	398	433	466	392	411	444
Refinery Fuel	0	0	4	0	0	0	0	0	0	0	0	0	0
Total Imports (Balance)	292	187	279	231	292	296	248	296	295	335	415	268	272
Total Exports (Balance)	1	5	1	1	45	78	62	82	81	147	122	151	215
International Marine Bunkers	0	0	0	0	0	0	0	0	0	0	0	0	0
Stock Change (National Territory)	-23	4	-2	4	-3	-1	-1	1	-2	-3	1	-2	5
Gross Inland Deliveries (Obs.)	538	440	572	560	587	618	601	613	646	651	685	526	505
Statistical Difference	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
Public Electricity	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
Public Heat Plants	0	0	0	0	0	0	0	0	0	0	0	0	0

222A Bitumen	1990	1995	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008
Auto Producers of Electricity	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
Auto Producer Heat Plants	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
Coke Ovens (Transformation)	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
Petrochemical Industry	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
Non Specified (Transformation)	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
Coal Mines	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
Coke Ovens (Energy)	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
Gas Works (Energy)	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
Non Specified (Energy)	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
Final Consumption	538	440	572	560	587	618	601	613	646	651	685	526	505
Total Transport	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
Domestic Air Transport	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
Rail	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
Pipeline Transport	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
Total Industry	538	440	572	560	587	618	601	613	646	651	685	526	505
Iron and Steel	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
Non ferrous Metals	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
Transportation Equipment	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
Mining and Quarrying	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
Pulp, Paper and Printing	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
Construction	538	440	572	560	587	618	601	613	646	651	685	526	505
Textiles and Leather	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
Total Other Sectors	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
Residential	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
Non Specified (Others)	0	0	0	0	0	0	0	0	0	0	0	0	0
Total Non-Energy Use	538	440	572	560	587	618	601	613	646	651	685	526	505

Table A 88: National Energy Balance 1990-2008. Other Oil Products [1000 tons].

224A Other Oil Products	**1990**	**1995**	**1998**	**1999**	**2000**	**2001**	**2002**	**2003**	**2004**	**2005**	**2006**	**2007**	**2008**
Refinery Gross Output	499	761	960	927	859	988	1 030	1 048	1 044	851	1 186	1 217	1 082
Refinery Fuel	164	212	264	213	223	226	254	278	344	229	282	241	202
Total Imports (Balance)	126	13	77	69	111	47	45	43	95	45	78	51	54
Total Exports (Balance)	3	39	137	131	139	162	168	149	163	93	180	157	161
International Marine Bunkers	0	0	0	0	0	0	0	0	0	0	0	0	0
Stock Change (National Territory)	-41	-3	6	0	-7	11	-1	-13	104	-8	2	-13	11
Gross Inland Deliveries (Obs.)	472	518	641	651	601	659	652	651	734	566	803	853	784
Statistical Difference	-56	0	0	0	0	0	0	0	0	0	0	5	1
Total Transformation Sector	23	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
Public Combined Heat and Power	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
Auto Producers of Electricity	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
Auto Producer Heat Plants	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
Coke Ovens (Transformation)	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
Petrochemical Industry	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
Non Specified (Transformation)	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
Coal Mines	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
Coke Ovens (Energy)	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
Gas Works (Energy)	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
Non Specified (Energy)	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
Final Consumption	449	518	641	651	601	659	652	651	734	566	803	853	784
Total Transport	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
Domestic Air Transport	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
Rail	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
Pipeline Transport	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
Total Industry	449	518	641	651	601	659	652	651	734	566	803	853	784
Iron and Steel	0	0	0	0	0	0	0	0	0	0	0	0	0
Chemical (incl.Petro-Chemical)	449	518	641	651	601	659	652	651	734	566	803	853	784
Non ferrous Metals	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
Transportation Equipment	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
Mining and Quarrying	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
Pulp, Paper and Printing	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
Construction	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

224A Other Oil Products	1990	1995	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008
Non Specified (Industry)	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
Commerce - Public Services	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
Agriculture	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
Total Non-Energy Use	449	518	641	651	601	659	652	651	734	566	803	853	784

Table A 89: National Energy Balance 1990-2007. LPG [1000 tons].

303A LPG	1990	1995	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008
Refinery Gross Output	47	60	30	19	34	0	23	50	57	107	50	70	98
Refinery Fuel	8	19	1	4	20	0	2	1	3	49	3	22	21
Total Imports (Balance)	97	149	132	152	159	140	155	137	132	133	155	129	112
Total Exports (Balance)	14	42	19	20	17	4	7	9	17	20	21	21	37
International Marine Bunkers	0	0	0	0	0	0	0	0	0	0	0	0	0
Stock Change (National Territory)	2	20	3	0	-5	6	-2	-1	5	0	-2	3	-1
Gross Inland Deliveries (Obs.)	125	166	144	147	150	143	168	176	174	172	179	158	152
Statistical Difference	0	0	0	0	0	0	0	0	0	0	0	0	0
Total Transformation Sector	1	3	1	1	0	0	1	0	0	0	0	0	0
Public Electricity	0	0	0	0	0	0	0	0	0	0	0	0	0
Public Combined Heat and Power	0	0	0	0	0	0	1	0	0	0	0	0	0
Public Heat Plants	1	3	1	1	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
Auto Producers for CHP	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
Gas Works (Transformation)	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
Blast Furnaces (Transformation)	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
Patent Fuel Plants	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
Total Energy Sector	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
Oil and Gas Extraction	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
Blast Furnaces (Energy)	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
Power Plants	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
Distribution Losses	0	0	0	0	0	0	0	0	0	0	0	0	0
Final Consumption	124	163	143	147	150	143	168	176	174	171	179	158	151
Total Transport	9	11	13	13	16	18	20	17	18	18	18	17	17
International Civil Aviation	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
Road	9	11	13	13	16	18	20	17	18	18	18	17	17
Rail	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
Pipeline Transport	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
Total Industry	65	62	66	49	55	48	41	39	31	36	46	52	53
Iron and Steel	4	3	13	0	1	0	0	0	0	0	0	0	0
Chemical (incl.Petro-Chemical)	0	0	0	0	0	0	0	0	0	1	1	1	1

303A LPG	1990	1995	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008
Non ferrous Metals	8	6	5	4	4	4	4	5	4	4	4	4	2
Non metallic Mineral Products	12	23	14	15	15	14	10	11	2	4	5	14	23
Transportation Equipment	1	3	11	0	1	1	1	1	3	2	2	2	2
Machinery	11	13	11	11	14	13	13	11	8	10	12	10	10
Mining and Quarrying	1	1	1	1	1	1	1	1	1	2	2	1	1
Food, Beverages and Tobacco	3	3	2	5	4	5	3	3	4	5	6	4	3
Pulp, Paper and Printing	1	1	1	2	2	1	2	1	1	1	1	1	0
Wood and Wood Products	0	0	0	1	1	1	1	1	1	1	1	6	1
Construction	23	9	7	9	13	6	5	5	5	6	9	7	9
Textiles and Leather	0	0	0	0	0	0	0	0	0	0	1	0	0
Non Specified (Industry)	0	1	1	1	0	1	1	1	1	1	1	1	1
Total Other Sectors	50	90	64	84	79	77	106	120	125	118	115	89	81
Commerce - Public Services	32	61	21	36	23	30	63	81	88	69	68	32	22
Residential	16	26	39	43	51	44	40	36	35	45	44	52	54
Agriculture	2	3	4	4	5	4	3	3	3	4	4	4	4
Non Specified (Others)	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

Table A 90: National Energy Balance 1990-2008. Refinery Gas [1000 tons].

308A Refinery Gas	1990	1995	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008
Refinery Gross Output	373	305	348	341	312	328	306	235	255	309	390	417	383
Refinery Fuel	373	305	348	338	310	327	308	273	293	343	429	454	423
Total Imports (Balance)	-	-	-	-	-	-	-	-	-	-	-	-	-
Total Exports (Balance)	-	-	-	-	-	-	-	-	-	-	-	-	-
International Marine Bunkers	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
Gross Inland Deliveries (Obs.)	0	0	0	2	2	1	0	0	0	0	0	0	0
Statistical Difference	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
Public Electricity	0	0	0	2	2	1	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
Public Heat Plants	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
Auto Producers for CHP	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
Gas Works (Transformation)	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
Blast Furnaces (Transformation)	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
Patent Fuel Plants	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
Total Energy Sector	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
Oil and Gas Extraction	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
Blast Furnaces (Energy)	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
Power Plants	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
Distribution Losses	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
Total Transport	0	0	0	0	0	0	0	0	0	0	0	0	0

308A Refinery Gas	**1990**	**1995**	**1998**	**1999**	**2000**	**2001**	**2002**	**2003**	**2004**	**2005**	**2006**	**2007**	**2008**
International Civil Aviation	0	0	0	2	2	1	0	0	0	0	0	0	0
Domestic Air Transport	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
Rail	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
Pipeline Transport	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
Total Industry	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
Chemical (incl.Petro-Chemical)	0	0	0	2	2	1	0	0	0	0	0	0	0
Non ferrous Metals	0	0	0	0	0	0	0	0	0	0	0	0	0
Non metallic Mineral Products	0	0	0	2	2	1	0	0	0	0	0	0	0
Transportation Equipment	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
Mining and Quarrying	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
Pulp, Paper and Printing	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
Construction	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
Non Specified (Industry)	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
Commerce - Public Services	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
Agriculture	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
Total Non-Energy Use	0	0	0	0	0	0	0	0	0	0	0	0	0

Natural Gas

Table A 91: National Energy Balance 1990-2008. Natural Gas [PJ NCV].

	1990	**1995**	**1998**	**1999**	**2000**	**2001**	**2002**	**2003**	**2004**	**2005**	**2006**	**2007**	**2008**
Indigenous Production	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 Imports (Balance)	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 Exports (Balance)	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
Stock Change (National Territory)	15.8	18.4	12.8	13.6	11.5	12.4	15.6	13.0	14.9	16.0	17.0	14.8	15.5
Gross Inland Deliveries (Obs.)	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
Statistical Difference	6.6	10.8	5.5	6.3	5.2	5.6	9.0	6.9	9.9	9.1	11.3	9.6	9.1
Total Transformation Sector	6.8	7.6	7.3	7.3	6.4	6.8	6.7	6.1	4.9	6.9	5.7	5.2	6.4
Public Electricity	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
Public Combined Heat and Power	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
Public Heat 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
Auto Producers of Electricity	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
Auto Producers for CHP	0.3	0.2	0.2	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1
Auto Producer Heat Plants	113.5	144.6	159.8	161.7	170.6	188.7	182.6	195.9	193.0	202.7	186.6	178.8	188.8
Gas Works (Transformation)	4.1	4.1	6.3	7.8	9.7	8.3	5.0	6.7	6.6	6.6	8.4	8.2	10.4
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
Blast Furnaces (Transformation)	4.1	4.1	6.3	7.8	9.7	8.3	5.0	6.7	6.6	6.6	8.4	8.1	10.4
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
Non Specified (Transformation)	69.0	73.5	80.3	79.2	88.7	91.0	95.8	95.3	89.9	102.1	99.3	100.9	103.7
Total Energy Sector	10.5	11.2	14.2	13.8	13.6	13.4	13.9	14.0	13.7	16.2	16.4	15.6	15.1

Coal Mines	7.7	8.3	9.8	12.6	14.4	13.8	13.6	13.6	12.4	16.4	14.7	14.7	15.9
Oil and Gas Extraction	1.4	2.2	2.3	2.2	2.3	2.6	2.7	2.9	3.0	3.1	3.2	4.2	4.7
Inputs to Oil Refineries	10.1	11.1	12.9	11.0	11.7	12.0	13.6	13.3	13.2	15.1	13.5	14.5	15.1
Coke Ovens (Energy)	1.5	2.6	1.1	1.0	1.3	1.5	1.2	1.7	2.2	2.2	2.2	2.1	1.8
Gas Works (Energy)	4.3	6.1	5.4	4.4	4.8	5.1	4.8	5.1	5.4	6.5	6.9	7.0	7.1
Power Plants	2.6	2.5	2.5	1.7	2.3	2.6	2.8	2.6	2.6	1.6	2.8	2.9	3.0
Non Specified (Energy)	8.9	9.4	9.4	9.7	11.5	11.1	15.1	11.4	10.4	11.5	11.2	11.1	11.5
Distribution Losses	12.9	9.8	16.4	16.1	19.5	20.9	20.4	23.4	20.4	20.7	19.8	20.2	20.0
Final Consumption	1.7	2.0	1.6	1.8	1.7	1.9	1.9	2.1	1.8	3.4	2.8	3.0	3.7
Total Transport	0.7	1.5	0.5	1.6	1.4	1.8	1.8	1.5	1.2	1.6	2.0	1.7	1.7
Road	3.5	3.4	2.3	2.2	2.9	3.0	2.6	2.2	2.0	2.1	2.0	2.1	2.1
Pipeline Transport	3.1	3.4	1.9	1.1	1.2	1.3	1.4	1.5	1.7	1.6	1.7	1.8	1.9
Non Specified (Transport)	40.4	67.0	73.2	74.7	72.2	89.3	81.8	93.9	96.5	94.0	78.9	69.7	74.7
Total Industry	7.7	23.4	18.6	18.0	20.2	33.8	29.2	39.6	44.6	38.5	27.4	20.5	24.4
Iron and Steel	32.3	43.2	54.0	56.1	51.5	54.9	52.0	53.6	51.3	54.9	50.9	48.7	49.7
Chemical (incl.Petro-Chemical)	0.4	0.5	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6
Non ferrous Metals	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 metallic Mineral Products	14.9	10.5	10.6	10.6	10.5	9.9	10.3	11.3	10.3	10.8	11.5	10.1	11.2
Transportation Equipment	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
Machinery	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
Mining and Quarrying	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
Food. Beverages and Tobacco	15.8	18.4	12.8	13.6	11.5	12.4	15.6	13.0	14.9	16.0	17.0	14.8	15.5
Pulp. Paper and Printing	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
Wood and Wood Products	6.6	10.8	5.5	6.3	5.2	5.6	9.0	6.9	9.9	9.1	11.3	9.6	9.1
Construction	6.8	7.6	7.3	7.3	6.4	6.8	6.7	6.1	4.9	6.9	5.7	5.2	6.4
Textiles and Leather	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 (Industry)	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
Total Other Sectors	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
Commerce - Public Services	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
Residential	0.3	0.2	0.2	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1
Agriculture	113.5	144.6	159.8	161.7	170.6	188.7	182.6	195.9	193.0	202.7	186.6	178.8	188.8
Non Specified (Others)	4.1	4.1	6.3	7.8	9.7	8.3	5.0	6.7	6.6	6.6	8.4	8.2	10.4
Total Non-Energy Use	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

Renewable Fuels

Table A 92: National Energy Balance 1990-2008. Fuel Wood [PJ].

111A Fuel Wood	**1990**	**1995**	**1998**	**1999**	**2000**	**2001**	**2002**	**2003**	**2004**	**2005**	**2006**	**2007**	**2008**
Indigenous Production	61.40	65.76	63.42	64.52	58.55	62.33	58.98	57.97	55.36	63.89	59.65	58.71	60.63
Total Imports (Balance)	2.30	1.62	1.60	1.49	1.80	1.80	2.10	2.53	3.32	3.51	4.19	3.36	3.37
Total Exports (Balance)	0.04	0.22	0.14	0.03	0.18	0.18	0.38	0.93	1.32	0.84	0.69	0.57	0.50
Stock Change (National Territory)	-0.55	0.19	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.)	63.12	67.35	64.88	65.97	60.17	63.95	60.70	59.57	57.36	66.55	63.15	61.50	63.50
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
Total Transformation Sector	0.00	0.00	0.21	0.00	0.00	0.00	0.00	0.00	0.05	0.05	0.05	0.03	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
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
Public Heat Plants	0.00	0.00	0.21	0.00	0.00	0.00	0.00	0.00	0.05	0.05	0.05	0.03	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
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
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

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
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
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
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
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
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
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
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
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
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
Final Consumption	63.12	67.35	64.67	65.97	60.17	63.95	60.70	59.57	57.31	66.50	63.11	61.47	63.47
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
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
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
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
Total Industry	0.66	1.08	0.15	1.87	0.95	1.15	1.42	1.07	0.89	0.78	1.04	1.75	1.83
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
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	0.01	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
Non metallic Mineral Products	0.05	0.06	0.00	0.00	0.00	0.00	0.00	0.01	0.01	0.01	0.02	0.01	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
Machinery	0.05	0.06	0.01	0.03	0.03	0.03	0.03	0.03	0.03	0.04	0.06	0.05	0.02
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
Food. Beverages and Tobacco	0.12	0.09	0.01	0.02	0.02	0.02	0.02	0.02	0.02	0.03	0.04	0.04	0.04
Pulp. Paper and Printing	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01
Wood and Wood Products	0.23	0.30	0.04	1.62	0.71	0.86	1.15	0.78	0.61	0.28	0.32	1.17	1.38
Construction	0.00	0.29	0.05	0.12	0.11	0.13	0.13	0.13	0.13	0.21	0.29	0.29	0.29
Textiles and Leather	0.02	0.02	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	0.05	0.08	0.08	0.10	0.09	0.09	0.08	0.20	0.31	0.18	0.07
Total Other Sectors	62.45	66.28	64.52	64.10	59.22	62.80	59.28	58.50	56.43	65.72	62.07	59.71	61.64
Commerce - Public Services	1.33	1.17	0.49	0.48	0.34	0.49	0.48	0.48	0.52	0.50	0.49	0.45	0.47
Residential	57.50	61.25	60.24	59.85	55.38	58.62	55.32	54.58	52.59	61.35	57.92	55.75	57.54
Agriculture	3.63	3.86	3.80	3.77	3.49	3.70	3.49	3.44	3.32	3.87	3.65	3.51	3.63
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

Table A 93: National Energy Balance 1990-2007. Wood Waste [PJ].

116A Wood waste; Other	**1990**	**1995**	**1998**	**1999**	**2000**	**2001**	**2002**	**2003**	**2004**	**2005**	**2006**	**2007**	**2008**
Indigenous Production	13.69	18.77	23.25	38.25	36.38	42.41	39.24	48.83	49.74	60.58	58.12	74.45	79.50
Total Imports (Balance)	2.14	2.49	3.20	2.90	3.14	4.09	4.47	4.24	7.09	6.99	17.51	14.98	14.98
Total Exports (Balance)	2.07	2.62	5.03	6.14	6.51	7.98	6.86	10.41	16.05	13.13	12.41	13.17	13.43
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
Gross Inland Deliveries (Obs.)	13.76	18.64	21.41	35.01	33.02	38.52	36.86	42.66	40.78	54.44	63.22	76.26	81.05
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
Total Transformation Sector	2.27	8.64	9.18	11.86	12.37	14.00	15.38	16.88	18.93	22.18	31.38	40.55	45.64
Public Electricity	0.00	0.00	0.01	0.06	0.01	1.35	1.15	1.31	1.82	2.70	5.48	7.18	6.88
Public Combined Heat and Power	0.00	0.00	0.10	0.38	0.35	0.75	1.07	1.50	3.08	4.37	8.95	12.71	17.64
Public Heat Plants	1.63	3.98	6.69	5.80	7.46	8.69	10.78	11.37	10.72	11.01	12.03	13.06	13.19
Auto Producers of Electricity	0.00	0.19	0.27	2.65	1.51	0.91	1.00	0.72	1.21	1.26	1.09	2.60	2.76
Auto Producers for CHP	0.64	4.46	2.10	2.87	2.96	2.09	1.26	1.79	2.02	2.73	3.83	4.99	5.16
Auto Producer Heat Plants	0.00	0.00	0.00	0.09	0.08	0.21	0.13	0.19	0.09	0.09	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

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
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
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
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
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
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
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
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
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
Final Consumption	11.49	10.00	12.23	23.16	20.65	24.53	21.48	25.78	21.85	32.26	31.84	35.71	35.41
Total Transport	0.08	0.23	0.29	0.34	0.37	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
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
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
Total Industry	9.43	6.89	7.30	15.29	11.70	14.00	10.72	12.61	10.22	18.55	18.54	20.09	19.14
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	0.18	0.00
Chemical (incl.Petro-Chemical)	2.90	1.72	1.58	3.60	2.52	1.07	0.97	1.35	1.14	1.40	1.22	1.38	1.42
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	0.01
Non metallic Mineral Products	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.07	0.05	2.00	2.48	3.21	3.13
Transportation Equipment	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.02	0.02	0.02
Machinery	0.00	0.00	0.02	0.04	0.05	0.14	0.15	0.22	0.25	0.18	0.19	0.31	0.44
Mining and Quarrying	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.00	0.00	0.00	0.00
Food. Beverages and Tobacco	0.01	0.01	0.00	0.19	0.21	0.24	0.23	0.15	0.06	0.06	0.35	0.41	0.22
Pulp. Paper and Printing	3.66	3.90	3.75	4.73	1.95	5.89	3.11	4.08	2.95	6.54	5.51	4.70	4.46
Wood and Wood Products	2.76	1.16	1.75	5.93	6.09	5.52	5.24	5.69	4.78	7.75	7.89	8.48	7.63
Construction	0.04	0.03	0.05	0.31	0.36	0.41	0.40	0.39	0.40	0.26	0.22	0.37	0.49
Textiles and Leather	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.01	0.01	0.00	0.01	0.01
Non Specified (Industry)	0.07	0.07	0.15	0.49	0.52	0.73	0.62	0.65	0.56	0.34	0.65	1.01	1.30
Total Other Sectors	1.98	2.88	4.64	7.53	8.58	10.53	10.75	13.16	11.63	13.71	13.30	15.62	16.27
Commerce - Public Services	0.64	0.60	1.06	1.83	2.27	2.23	2.20	2.74	1.08	1.15	1.14	1.04	1.08
Residential	0.77	1.40	2.50	4.06	4.50	6.20	6.38	7.71	7.44	8.87	8.46	10.16	10.59
Agriculture	0.57	0.87	1.08	1.64	1.81	2.11	2.17	2.71	3.11	3.69	3.70	4.43	4.61
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

Table A 94: National Energy Balance 1990-2007. Black Liquor [PJ].

215A Black Liquor	**1990**	**1995**	**1998**	**1999**	**2000**	**2001**	**2002**	**2003**	**2004**	**2005**	**2006**	**2007**	**2008**
Indigenous Production	17.80	21.39	22.92	23.65	24.12	23.30	22.78	22.92	30.36	24.40	24.73	25.07	25.78
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
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
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
Gross Inland Deliveries (Obs.)	17.80	21.39	22.92	23.65	24.12	23.30	22.78	22.92	30.36	24.40	24.73	25.07	25.78
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
Total Transformation Sector	5.26	9.27	11.35	10.18	7.62	10.30	11.08	10.76	18.15	11.78	11.41	9.78	12.51
Public Electricity	0.00	0.00	0.00	0.00	0.00	0.01	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	0.01	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
Auto Producers of Electricity	2.62	5.27	8.87	6.16	2.00	5.20	6.58	6.65	13.63	6.64	6.71	4.95	6.73
Auto Producers for CHP	2.64	4.00	2.49	4.02	5.62	5.08	4.49	4.11	4.52	5.15	4.70	4.84	5.78
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
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
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

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
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
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
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
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
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
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
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
Final Consumption	12.54	12.12	11.56	13.47	16.50	13.00	11.70	12.15	12.21	12.62	13.32	15.28	13.27
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
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
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
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
Total Industry	12.54	12.12	11.56	13.47	16.50	13.00	11.70	12.15	12.21	12.62	13.32	15.28	13.27
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
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
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
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
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
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
Mining and Quarrying	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01	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
Pulp. Paper and Printing	12.54	12.12	11.56	13.38	16.44	12.93	11.64	12.15	12.21	12.60	13.27	15.28	13.27
Wood and Wood Products	0.00	0.00	0.00	0.09	0.06	0.06	0.06	0.00	0.00	0.00	0.05	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
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
Non Specified (Industry)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01	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
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
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
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
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

Table A 95: National Energy Balance 1990-2007. Biogas [TJ].

309A Biogas	**1990**	**1995**	**1998**	**1999**	**2000**	**2001**	**2002**	**2003**	**2004**	**2005**	**2006**	**2007**	**2008**
Indigenous Production	0.00	0.04	0.03	0.22	0.36	0.29	0.65	0.51	0.48	6.29	6.20	8.64	9.99
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
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
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
Gross Inland Deliveries (Obs.)	0.00	0.04	0.03	0.22	0.36	0.29	0.65	0.51	0.48	6.29	6.20	8.64	9.99
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
Total Transformation Sector	0.00	0.04	0.03	0.12	0.22	0.20	0.19	0.38	0.28	6.11	5.97	8.38	9.73
Public Electricity	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.17	0.08	5.72	5.01	7.53	8.96
Public Combined Heat and Power	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.02	0.09	0.20	0.28	0.31	0.29
Public Heat Plants	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.22	0.29	0.25
Auto Producers of Electricity	0.00	0.00	0.00	0.03	0.12	0.07	0.11	0.11	0.01	0.06	0.34	0.11	0.09
Auto Producers for CHP	0.00	0.04	0.03	0.09	0.10	0.12	0.09	0.09	0.11	0.14	0.12	0.14	0.13
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
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
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
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

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
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
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
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
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
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
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
Final Consumption	0.00	0.00	0.00	0.11	0.15	0.10	0.46	0.13	0.21	0.18	0.23	0.25	0.26
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
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
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
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
Total Industry	0.00	0.00	0.00	0.10	0.15	0.10	0.46	0.13	0.21	0.18	0.23	0.25	0.25
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
Chemical (incl.Petro-Chemical)	0.00	0.00	0.00	0.00	0.00	0.00	0.30	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
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
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
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
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
Food. Beverages and Tobacco	0.00	0.00	0.00	0.00	0.00	0.00	0.02	0.03	0.08	0.07	0.13	0.17	0.17
Pulp. Paper and Printing	0.00	0.00	0.00	0.10	0.12	0.10	0.14	0.11	0.12	0.11	0.10	0.08	0.08
Wood and Wood Products	0.00	0.00	0.00	0.00	0.03	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
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
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
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	0.01
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	0.01
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
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
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

Table A 96: National Energy Balance 1990-2007. Sewage Sludge Gas [PJ].

309B Sewage sludge gas	1990	1995	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008
Indigenous Production	0.00	0.62	0.71	0.37	0.47	0.36	0.04	0.25	0.23	1.50	0.62	0.24	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
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
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
Gross Inland Deliveries (Obs.)	0.00	0.62	0.71	0.37	0.47	0.36	0.04	0.25	0.23	1.50	0.62	0.24	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
Total Transformation Sector	0.00	0.62	0.71	0.02	0.11	0.07	0.04	0.07	0.08	1.35	0.62	0.08	0.08
Public Electricity	0.00	0.01	0.05	0.00	0.08	0.04	0.04	0.03	0.04	1.25	0.53	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	0.04	0.04	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
Auto Producers of Electricity	0.00	0.00	0.00	0.02	0.03	0.03	0.00	0.01	0.01	0.02	0.02	0.01	0.01
Auto Producers for CHP	0.00	0.61	0.66	0.00	0.00	0.00	0.00	0.02	0.02	0.04	0.03	0.03	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
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
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
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
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

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
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
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
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
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
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
Final Consumption	0.00	0.00	0.00	0.35	0.36	0.30	0.00	0.19	0.15	0.15	0.00	0.16	0.12
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
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
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
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
Total Industry	0.00	0.00	0.00	0.35	0.36	0.30	0.00	0.19	0.15	0.15	0.00	0.16	0.12
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
Chemical (incl.Petro-Chemical)	0.00	0.00	0.00	0.35	0.36	0.30	0.00	0.19	0.15	0.15	0.00	0.16	0.12
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
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
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
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
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
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
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
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
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
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
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
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
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
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
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
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

Table A 97: National Energy Balance 1990-2007. Landfill Gas [PJ].

310A Landfill Gas	1990	1995	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008
Indigenous Production	0.00	0.20	0.53	0.50	0.44	0.48	0.36	0.33	0.49	0.25	0.20	0.20	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
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
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
Gross Inland Deliveries (Obs.)	0.00	0.20	0.53	0.50	0.44	0.48	0.36	0.33	0.49	0.25	0.20	0.20	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
Total Transformation Sector	0.00	0.15	0.52	0.50	0.44	0.48	0.36	0.33	0.49	0.25	0.20	0.20	0.20
Public Electricity	0.00	0.00	0.00	0.02	0.01	0.07	0.06	0.07	0.05	0.04	0.04	0.05	0.05
Public Combined Heat and Power	0.00	0.03	0.03	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
Auto Producers of Electricity	0.00	0.12	0.49	0.48	0.43	0.41	0.30	0.27	0.43	0.19	0.17	0.15	0.15
Auto Producers for CHP	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.01	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
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
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
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
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
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

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
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
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
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
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
Final Consumption	0.00	0.05	0.01	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
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
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
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
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
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
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
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
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
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
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
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
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
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
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
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
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
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
Total Other Sectors	0.00	0.05	0.01	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	0.05	0.01	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
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
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

Table A 98: National Energy Balance 1990-2007. Municipal Solid Waste [PJ].

114B Municipal Solid Waste	1990	1995	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008
Indigenous Production	2.41	3.91	4.78	4.74	4.51	4.30	5.03	5.88	8.39	8.13	11.07	10.42	8.66
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
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
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
Gross Inland Deliveries (Obs.)	2.41	3.91	4.78	4.74	4.51	4.30	5.03	5.88	8.39	8.13	11.07	10.42	8.66
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
Total Transformation Sector	2.41	3.91	4.78	4.74	4.51	4.30	5.03	5.88	8.39	8.13	11.07	10.42	8.66
Public Electricity	0.00	0.00	0.00	0.73	0.58	0.32	0.69	1.58	2.91	2.53	2.39	2.60	2.24
Public Combined Heat and Power	1.72	2.32	2.58	2.34	2.23	2.20	2.37	2.50	3.38	3.14	3.15	2.94	2.59
Public Heat Plants	0.69	1.59	2.20	1.67	1.69	1.78	1.96	1.81	1.89	1.97	1.88	1.95	2.05
Auto Producers of Electricity	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.07	0.15	3.34	2.68	1.48
Auto Producers for CHP	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.14	0.33	0.30	0.25	0.30
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
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
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
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
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
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
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

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
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
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
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
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
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
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
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
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
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
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
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
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
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
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
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
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
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
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
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
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
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
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
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
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
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
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
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

Table A 99: National Energy Balance 1990-2007. Industrial Waste [PJ].

115A Industrial Waste	**1990**	**1995**	**1998**	**1999**	**2000**	**2001**	**2002**	**2003**	**2004**	**2005**	**2006**	**2007**	**2008**
Indigenous Production	6.58	7.00	7.50	6.76	7.67	10.19	11.74	13.52	16.33	14.45	15.30	14.84	18.36
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
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
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
Gross Inland Deliveries (Obs.)	6.58	7.00	7.50	6.76	7.67	10.19	11.74	13.52	16.33	14.45	15.30	14.84	18.36
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
Total Transformation Sector	2.54	1.93	2.15	2.32	1.59	1.93	2.67	2.82	3.06	2.95	2.77	3.15	4.69
Public Electricity	0.00	0.00	0.00	0.01	0.13	0.41	1.04	1.16	0.95	1.06	0.69	0.51	0.42
Public Combined Heat and Power	0.00	0.00	0.00	0.00	0.00	0.88	0.70	0.82	0.75	0.72	0.79	0.92	0.82
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
Auto Producers of Electricity	0.00	0.00	0.54	1.12	0.44	0.10	0.14	0.14	0.18	0.18	0.16	0.60	1.88
Auto Producers for CHP	2.54	1.93	1.61	1.20	1.02	0.54	0.79	0.70	1.18	0.99	1.13	1.12	1.56
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
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
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
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
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
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
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
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
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
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
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
Final Consumption	4.03	5.08	5.35	4.45	6.08	8.26	9.07	10.71	13.27	11.51	12.53	11.69	13.67
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
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
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
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
Total Industry	2.92	4.56	4.74	3.84	5.52	7.64	8.45	10.06	12.59	10.82	11.80	10.97	12.92
Iron and Steel	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.82	0.86	1.81
Chemical (incl.Petro-Chemical)	1.57	1.91	1.10	0.09	1.64	2.23	3.28	5.09	6.06	6.99	6.42	4.38	4.17
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
Non metallic Mineral Products	1.31	1.98	2.66	2.88	3.56	4.55	4.56	4.15	5.34	3.23	4.07	5.12	6.38
Transportation Equipment	0.00	0.01	0.01	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	0.01	0.01	0.03	0.01	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
Food. Beverages and Tobacco	0.00	0.00	0.01	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	0.07	0.14	0.00	0.11	0.09	0.16	0.17	0.04	0.04	0.04	0.04
Wood and Wood Products	0.04	0.55	0.79	0.69	0.28	0.69	0.46	0.58	0.94	0.45	0.36	0.39	0.44
Construction	0.00	0.01	0.01	0.02	0.02	0.02	0.02	0.02	0.03	0.03	0.03	0.04	0.04
Textiles and Leather	0.00	0.01	0.01	0.00	0.00	0.01	0.01	0.01	0.00	0.00	0.00	0.00	0.00
Non Specified (Industry)	0.01	0.09	0.09	0.02	0.02	0.03	0.03	0.04	0.04	0.05	0.05	0.12	0.04
Total Other Sectors	1.11	0.52	0.61	0.61	0.56	0.63	0.62	0.65	0.68	0.69	0.73	0.72	0.74
Commerce - Public Services	1.11	0.52	0.61	0.61	0.56	0.63	0.62	0.65	0.68	0.69	0.73	0.72	0.74
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
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
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

Net Calorific Values

The selected net calorific values of each fuel are presented below.

Table A 100 presents the net calorific values (IEA JQ 2009) used for unit conversion.

Table A 100: Net calorific values for 1990-2008 in [MJ/kg], [MJ/m³] taken from (IEA JQ 2009).

Fuel Code	Fuel Name		1990	1995	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008
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
102A	Hard Coal	FC	28.00	28.00	28.00	27.66	27.99	27.99	27.50	27.50	28.41	28.15	28.07	27.89	28.28
		T	28.00	28.00	28.00	27.56	26.74	27.72	27.37	27.43	28.42	27.92	27.78	27.79	27.97
104A	Hard Coal Briquettes	A	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	9.77	9.82	9.79	9.82	9.82	9.96	15.92	20.80	22.07	20.92
		T	10.90	10.90	9.90	9.79	9.86	10.08	9.74	9.48	9.29	9.09	9.48	9.48	9.48
106A	Brown Coal Briquettes	A	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	29.00	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
304A	Coke Oven Gas	P	17.90	17.90	17.90	17.90	17.90	17.90	17.60	17.90	17.90	17.90	17.59	17.36	18.43
305A	Blast Furnace Gas	P	3.10	3.10	3.10	4.10	4.10	4.10	4.27	3.70	3.69	3.65	3.79	3.99	4.13
110A	Petrol Coke	A	34.30	28.40	34.00	33.92	33.92	33.92	31.33	31.33	31.33	31.33	30.89	31.36	31.67
201A	Crude Oil	A	42.50	42.50	42.50	42.52	42.52	42.50	42.50	42.52	42.52	42.69	42.72	42.71	42.72
203X	Residual Fuel Oil	A	41.00	40.50	40.30	41.50	41.49	42.12	41.46	41.43	41.41	41.66	41.19	41.90	41.41
204A	Gasoil	A	42.60	42.70	42.80	42.80	42.80	42.82	42.80	42.80	42.80	42.80	42.93	42.70	42.80
2050	Diesel	A	42.60	42.70	42.70	42.80	42.80	42.80	42.80	42.80	42.80	42.79	42.80	42.80	42.80
206A	Petroleum	A	43.60	43.30	43.40	43.31	43.30	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	43.31	43.30	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	42.51	42.49	42.49	42.49	42.49	43.21	43.18	43.16
2080	Motor Gasoline	A	42.50	42.50	42.50	42.50	42.50	42.51	42.49	42.49	42.49	42.49	43.21	43.18	43.16
217A	Refinery Feedstocks	A	41.87	42.56	42.25	42.27	42.56	42.65	42.77	42.05	42.72	42.28	42.57	34.25	34.78
219A	Lubricants	A	41.40	41.10	40.90	41.80	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	44.10	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	44.04	43.62	43.91	44.15	43.95	43.16	44.02	44.46	44.01	43.84
224A	Other Petroleum Products	FC	34.30	28.40	34.00	33.92	33.92	33.92	31.33	31.33	31.33	31.33	30.89	31.36	31.67
		NE	41.80	41.80	41.80	44.04	43.62	43.91	44.15	43.95	43.16	44.02	44.46	44.01	43.84
302A	NGL	A	42.50	42.50	42.50	42.52	42.52	42.50	42.50	42.52	42.52	42.69	42.72	42.71	42.72
303A	LPG	A	46.30	46.30	46.30	46.00	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	42.23	45.93	45.93	45.93	45.93	45.93	45.93	45.93	45.93	46.93
301A	Natural Gas	A	36.00	36.00	36.00	35.85	35.85	35.85	35.85	35.85	35.85	36.36	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 101 presents the net calorific values from STATISTIK AUSTRIA, which are used for default unit conversion.

Table A 101: 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 102 presents the IPCC default values of net calorific values of gaseous biofuels which are used for default unit conversion.

Table A 102: 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 103: 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 A 7 c	Glass Production	6	WASTE
2 B 1	Ammonia Production	6 B 1	Industrial Wastewater
2 B 5	Other	6 B 2	Domestic and Commercial Wastewater
2 C 1	Iron and Steel Production	6 D 2	Compost production
2 C 2	Ferroalloys 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 104: Recalculation Difference of CO_2 Emissions 1990-1999.

IPCC Cat.	CO_2 [Gg] Differences with respect to Submission 2009									
	1990	**1991**	**1992**	**1993**	**1994**	**1995**	**1996**	**1997**	**1998**	**1999**
Total	-13.40	-15.08	-14.69	-14.90	-14.75	-14.12	-13.48	-12.52	-11.92	-201.44
1	-18.54	-19.58	-20.12	-20.53	-20.17	-19.74	-19.29	-18.94	-18.53	-207.71
1 A 1	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	-193.07
1 A 2	-1.54	-1.73	-1.83	-1.92	-2.04	-2.16	-2.60	-2.32	3.15	121.54
1 A 3	-17.07	-17.91	-18.39	-18.71	-18.25	-17.70	-16.80	-16.73	-21.80	-12.39
1 A 4	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	-123.90
1 B	0.06	0.07	0.10	0.10	0.11	0.12	0.11	0.11	0.11	0.12
2	5.14	4.50	5.43	5.62	5.42	5.62	5.81	6.42	6.62	6.27
2 A 3	-19.13	-22.02	-19.49	-19.51	-20.88	-20.89	-20.89	-19.48	-19.48	-21.37

2 A 4	-14.24	-17.80	-14.30	-14.13	-15.72	-15.54	-15.34	-13.31	-13.11	-15.37
2 A 7 c	38.51	44.32	39.22	39.26	42.02	42.05	42.05	39.21	39.21	43.01
2 C 2	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
3	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
3 A	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
3 B	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
3 C	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
3 D 5	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
4	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
5	-140.66	-148.06	-137.65	-150.45	-159.19	-136.44	-180.56	-185.04	-189.26	-186.48
6	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

Table A 105: Recalculation Difference of CO_2 Emissions 2000-2007.

IPCC Cat.	**CO_2 [Gg] Differences with respect to Submission 2009**							
	2000	**2001**	**2002**	**2003**	**2004**	**2005**	**2006**	**2007**
Total	-152.21	134.95	25.54	-214.72	132.35	764.20	-899.08	-204.25
1	-159.84	128.20	12.02	-228.10	111.70	759.93	-911.67	-197.39
1 A 1	-145.93	-350.93	-25.80	-29.10	-201.26	2.25	-63.11	-10.23
1 A 2	-19.47	81.18	-32.97	25.34	-4.95	304.03	-22.56	303.39
1 A 3	-4.13	11.13	24.72	58.91	-75.06	-368.70	-314.23	-402.63
1 A 4	9.58	386.71	45.95	-283.36	392.85	822.22	-511.88	-88.04
1 B	0.11	0.12	0.12	0.12	0.12	0.12	0.12	0.12
2	7.57	6.72	7.69	8.23	15.58	13.16	12.79	14.72
2 A 3	-18.02	-21.17	-18.70	-23.69	-15.84	-19.41	-20.41	-22.25
2 A 4	-10.68	-14.71	-11.25	-10.54	3.73	-2.75	-3.95	-5.79
2 A 7 c	36.27	42.6	37.64	42.46	27.69	35.31	37.15	40.05
2 C 2	0.00	0.00	0.00	0.00	0.00	0.00	0.00	2.71
3	0.06	0.03	5.82	5.14	5.06	-8.88	-0.19	-21.57
3 A	0.01	0.00	0.81	0.74	0.75	-1.35	-0.03	-3.28
3 B	0.01	0.00	0.81	0.74	0.75	-1.35	-0.03	-3.28
3 C	0.00	0.00	0.43	0.37	0.35	-0.60	-0.01	-1.45
3 D 5	0.03	0.01	2.79	2.44	2.39	-4.16	-0.09	-10.10
4	NA	NA	NA	NA	NA	NA	NA	NA
5	-205.89	-228.69	-157.34	-220.50	-173.89	-190.01	-199.74	-279.85
6	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

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 106: Recalculation Difference of CH_4 Emissions 1990-1999.

IPCC Cat.	CH_4 [Gg] Differences with respect to Submission 2009									
	1990	**1991**	**1992**	**1993**	**1994**	**1995**	**1996**	**1997**	**1998**	**1999**
Total	-41.78	-42.37	-41.93	-43.12	-44.62	-43.24	-44.53	-45.73	-47.07	-46.85
1	-8.37	-9.12	-9.15	-9.94	-10.88	-11.64	-12.96	-13.79	-14.51	-16.09
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	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
1 A 3	-0.03	-0.03	-0.03	-0.02	0.10	0.10	0.09	0.08	0.08	0.07
1 A 4	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
1 B	-8.34	-9.10	-9.12	-9.92	-10.98	-11.74	-13.05	-13.87	-14.59	-16.17
2	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
3	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
4	-30.45	-30.19	-29.66	-29.98	-30.44	-28.22	-28.12	-28.40	-28.94	-27.06
4 A	-0.48	-0.60	-0.25	-0.28	-0.98	0.83	0.49	0.43	0.51	0.73
4 B	-29.96	-29.59	-29.41	-29.70	-29.46	-29.05	-28.61	-28.84	-29.46	-27.78
4 D	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
5	-0.01	0.00	-0.01	-0.01	0.00	0.00	0.00	0.00	-0.01	0.00
6	-2.97	-3.05	-3.13	-3.21	-3.29	-3.37	-3.45	-3.54	-3.62	-3.70
6 A	-2.97	-3.05	-3.13	-3.21	-3.29	-3.37	-3.45	-3.53	-3.62	-3.70
6 B	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
6 D	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

Table A 107: Recalculation Difference of CH_4 Emissions 2000-2007.

IPCC Cat.	CH_4 [Gg] Differences with respect to Submission 2009							
	2000	**2001**	**2002**	**2003**	**2004**	**2005**	**2006**	**2007**
Total	-46.71	-48.60	-50.16	-52.22	-52.05	-51.99	-53.55	-52.12
1	-16.75	-18.51	-20.63	-22.35	-23.87	-23.43	-25.50	-24.02
1 A 1	0.00	-0.01	0.00	0.00	0.00	0.02	0.00	0.01
1 A 2	0.00	0.01	0.00	0.01	0.03	0.02	-0.04	-0.06
1 A 3	0.06	0.05	0.05	0.04	0.03	0.02	0.02	0.02
1 A 4	0.01	-1.25	-2.21	-3.46	-3.75	-2.70	-3.82	-2.40
1 B	-16.82	-17.32	-18.47	-18.94	-20.18	-20.80	-21.67	-21.58
2	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
3	NA	NA	NA	NA	NA	NA	NA	NA
4	-26.31	-26.55	-26.09	-26.24	-24.87	-25.67	-25.54	-26.03
4 A	0.76	0.92	0.52	0.83	1.24	0.68	0.79	0.76
4 B	-27.07	-27.46	-26.62	-27.07	-26.11	-26.35	-26.32	-26.79
4 D	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
5	0.00	0.00	-0.01	-0.01	0.00	0.00	0.00	0.00
6	-3.65	-3.54	-3.43	-3.64	-3.31	-2.90	-2.51	-2.07
6 A	-3.67	-3.71	-3.74	-4.09	-3.94	-3.60	-3.29	-2.92
6 B	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
6 D	0.03	0.17	0.31	0.45	0.64	0.71	0.78	0.85

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 108: Recalculation Difference of N_2O Emissions 1990-1999.

IPCC Cat.	N_2O [Gg] Differences with respect to Submission 2009									
	1990	**1991**	**1992**	**1993**	**1994**	**1995**	**1996**	**1997**	**1998**	**1999**
Total	0.10	0.10	0.13	0.15	0.21	0.24	0.22	0.25	0.28	0.26
1	0.01	0.01	0.01	0.01	0.02	0.02	0.01	0.02	0.02	0.01
1 A 1	-0.01	-0.01	-0.01	-0.01	-0.01	-0.01	0.00	0.00	0.00	-0.01
1 A 2	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
1 A 3	0.02	0.01	0.01	0.01	0.02	0.02	0.02	0.02	0.02	0.02
1 A 4	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
1 B	IE	IE	IE	IE	IE	IE	IE	IE	IE	IE
2	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
3	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
4	0.09	0.09	0.13	0.14	0.19	0.22	0.20	0.23	0.27	0.26
4 B	-0.23	-0.19	-0.15	-0.13	-0.10	-0.08	-0.06	-0.02	-0.02	0.01
4 D	0.31	0.28	0.28	0.27	0.29	0.30	0.26	0.26	0.28	0.26
5	0.58	0.15	0.37	0.31	0.15	0.07	0.06	0.03	0.24	-0.01
6	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	-0.01	-0.01
6 B	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	-0.01	-0.01
6 D	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

Table A 109: Recalculation Difference of N_2O Emissions 2000-2007.

IPCC Cat.	N_2O [Gg] Differences with respect to Submission 2009							
	2000	**2001**	**2002**	**2003**	**2004**	**2005**	**2006**	**2007**
Total	0.23	0.24	0.24	0.18	0.19	0.33	0.31	0.40
1	0.02	-0.01	-0.06	-0.09	-0.11	0.03	0.00	0.06
1 A 1	-0.01	-0.01	-0.01	-0.01	-0.01	0.04	0.05	0.05
1 A 2	-0.01	0.00	-0.02	-0.02	-0.01	0.02	0.03	0.04
1 A 3	0.03	0.03	0.03	0.03	0.01	0.03	0.04	0.03
1 A 4	0.00	-0.03	-0.06	-0.09	-0.09	-0.07	-0.11	-0.06
1 B	IE	IE	IE	IE	IE	IE	IE	IE
2	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
3	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
4	0.23	0.26	0.29	0.24	0.28	0.29	0.29	0.31
4 B	0.00	0.02	0.03	0.06	0.08	0.09	0.09	0.11
4 D	0.23	0.24	0.25	0.18	0.20	0.20	0.19	0.20
5	0.09	0.03	0.52	0.49	0.00	0.04	0.16	0.05

IPCC Cat.	**N_2O [Gg] Differences with respect to Submission 2009**							
	2000	**2001**	**2002**	**2003**	**2004**	**2005**	**2006**	**2007**
6	-0.02	-0.01	0.01	0.03	0.01	0.02	0.02	0.04
6 B	-0.02	-0.03	-0.03	-0.03	-0.07	-0.08	-0.09	-0.08
6 D	0.00	0.02	0.04	0.06	0.09	0.09	0.10	0.11

Recalculation of National Total GHG Emissions

Table A 110 compares national total GHG emissions of UNFCCC submission 2010 with UNFCCC submission 2009. Explanations are provided in Chapter 9 Recalculations and in the sector specific chapters of this report.

Table A 110: Recalculation Difference of National Total GHG Emissions.

Year	**National Total GHG emissions without LUCF**		
	Submission 2008 [Gg CO_2e]	**Submission 2009 [Gg CO_2e]**	**Recalculation Difference [%]**
1990*	79 036.84	78 170.92	-1.10%
1991	83 121.20	82 222.52	-1.08%
1992	76 400.94	75 521.32	-1.15%
1993	76 307.31	75 506.24	-1.05%
1994	77 209.93	76 394.22	-1.06%
1995	80 506.24	79 821.72	-0.85%
1996	83 581.17	82 905.91	-0.81%
1997	83 132.73	82 489.04	-0.77%
1998	82 499.73	81 876.79	-0.76%
1999	80 925.20	80 271.46	-0.81%
2000	81 078.39	80 296.44	-0.96%
2001	85 082.78	84 532.75	-0.65%
2002	87 030.88	86 270.14	-0.87%
2003	93 111.98	91 930.97	-1.27%
2004	91 774.79	90 926.17	-0.92%
2005	92 832.10	92 915.91	0.09%
2006	91 518.47	89 687.53	-2.00%
2007	87 958.35	86 957.35	-1.14%

**Base year is 1990 for all gases*

Table A 111 and Table A 112 present recalculation differences per gas.

Table A 111: Recalculation Difference of National CO_2 and CH_4 Emissions.

Year	CO_2 [Gg CO_2e]			CH_4 [Gg CO_2e]		
	Submission 2009	**Submission 2010**	**Recalc. Difference [%]**	**Submission 2009**	**Submission 2010**	**Recalc. Difference [%]**
1990*	62 081.53	62 068.13	-0.02%	9 183.05	8 305.59	-9.56%
1991	65 671.09	65 656.02	-0.02%	9 161.93	8 272.24	-9.71%
1992	60 226.24	60 211.55	-0.02%	8 874.04	7 993.50	-9.92%
1993	60 542.84	60 527.94	-0.02%	8 851.12	7 945.51	-10.23%
1994	60 929.63	60 914.87	-0.02%	8 658.55	7 721.63	-10.82%
1995	63 965.30	63 951.18	-0.02%	8 541.81	7 633.77	-10.63%
1996	67 407.08	67 393.60	-0.02%	8 352.11	7 416.88	-11.20%
1997	67 200.32	67 187.80	-0.02%	8 074.58	7 114.22	-11.89%
1998	66 774.88	66 762.96	-0.02%	7 953.10	6 964.58	-12.43%
1999	65 553.99	65 352.56	-0.31%	7 780.01	6 796.19	-12.65%
2000	65 951.25	65 799.05	-0.23%	7 621.43	6 640.53	-12.87%
2001	70 056.03	70 190.98	0.19%	7 526.83	6 506.19	-13.56%
2002	72 014.92	72 040.46	0.04%	7 412.94	6 359.63	-14.21%
2003	78 055.04	77 840.32	-0.28%	7 460.41	6 363.68	-14.70%
2004	77 590.77	77 723.12	0.17%	7 312.98	6 219.86	-14.95%
2005	79 008.75	79 772.95	0.97%	7 177.58	6 085.71	-15.21%
2006	77 586.14	76 687.06	-1.16%	7 080.04	5 955.58	-15.88%
2007	74 176.54	73 972.29	-0.28%	6 955.61	5 861.10	-15.74%

**Base year is 1990 for all gases*

Table A 112: Recalculation Difference of National N_2O and HFC, PFC, SF_6 Emissions.

Year	N_2O [Gg CO_2e]			HFC, PFC, SF_6 [Gg CO_2e]		
	Submission 2009	**Submission 2010**	**Recalc. Difference [%]**	**Submission 2009**	**Submission 2010**	**Recalc. Difference [%]**
1990*	6 167.40	6 197.36	0.49%	1 604.86	1 599.84	-0.31%
1991	6 502.52	6 532.88	0.47%	1 785.66	1 761.39	-1.36%
1992	6 091.46	6 132.73	0.68%	1 209.19	1 183.54	-2.12%
1993	5 909.39	5 955.79	0.79%	1 003.95	1 077.01	7.28%
1994	6 370.62	6 434.51	1.00%	1 251.14	1 323.21	5.76%
1995	6 523.93	6 599.54	1.16%	1 475.19	1 637.22	10.98%
1996	6 190.88	6 257.64	1.08%	1 631.10	1 837.79	12.67%
1997	6 213.50	6 290.91	1.25%	1 644.33	1 896.11	15.31%
1998	6 324.22	6 410.77	1.37%	1 447.54	1 738.49	20.10%
1999	6 300.60	6 380.26	1.26%	1 290.60	1 742.46	35.01%
2000	6 203.92	6 274.65	1.14%	1 301.78	1 582.21	21.54%
2001	6 086.84	6 162.45	1.24%	1 413.09	1 673.12	18.40%

2002	6 094.24	6 168.32	1.22%	1 508.78	1 701.74	12.79%
2003	6 037.66	6 094.35	0.94%	1 558.87	1 632.62	4.73%
2004	5 335.53	5 394.06	1.10%	1 535.51	1 589.13	3.49%
2005	5 326.14	5 429.69	1.94%	1 319.62	1 627.56	23.33%
2006	5 375.65	5 471.40	1.78%	1 476.65	1 573.49	6.56%
2007	5 373.29	5 497.31	2.31%	1 452.91	1 626.65	11.96%

**Base year is 1990 for all gases*

ANNEX 6: ADDITIONAL INFORMATION

Additional information on NISA

Austria’s Obligations

Regarding Austria’s obligations under the United Nations Framework Convention on Climate Change UNFCCC and the Kyoto Protocol the 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).
- 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

In addition to the obligation under the UNFCCC and the Kyoto Protocol Austria has to comply with the following obligations regarding air emissions:

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 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).

Obligation under the Austrian Ambient Air Quality Law[1] 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 up-

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

graded 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.

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.

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.*

Adaptation of NISA according to the Kyoto Protocol

Regulations under the UNFCCC and the Kyoto Protocol defined 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. 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 1.

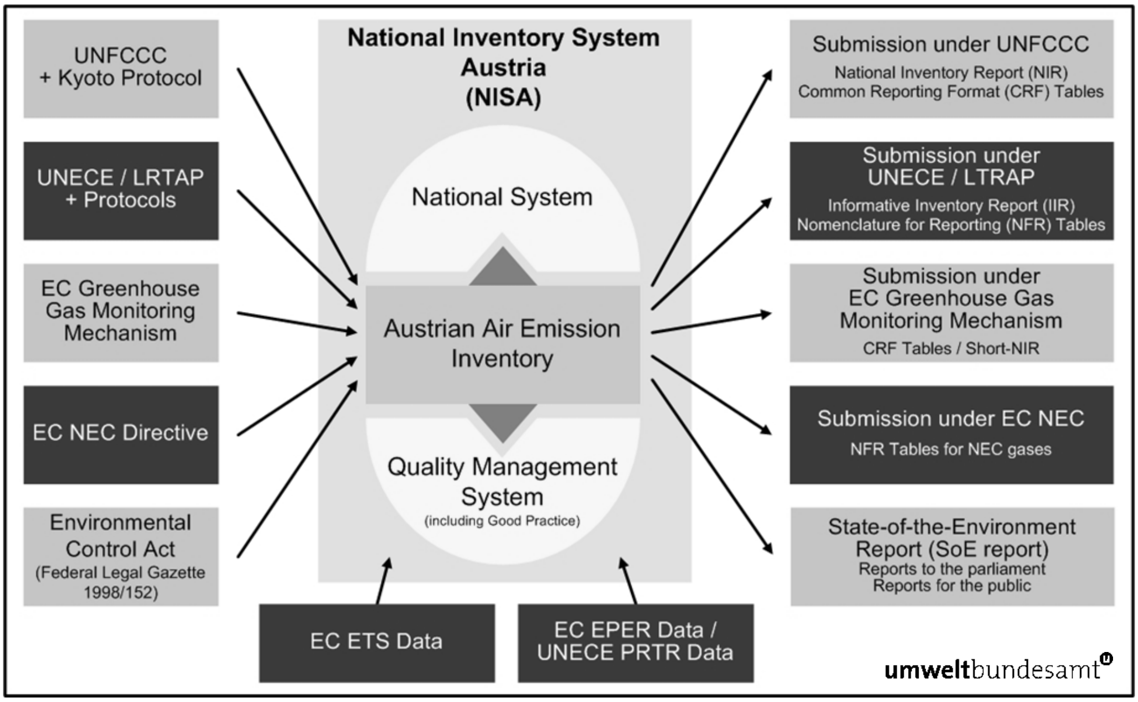

Figure 1: Structure of the emission inventory system in Austria (NISA).

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 sub-chapter 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.

Additional information on the inspection body for emission inventories

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 A 113: presents the timetable for the implementation of the quality management system.

Table A 113:*Timetable for the implementation of the Austrian QMS.*

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

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.

The International Standard ISO/IEC 17020

The QMS was drawn up to meet the requirements of the International Standard ISO/IEC 17020[2]. 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.

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.

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

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 a 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 a 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 2 shows the inter-relationship between the Austrian Accreditation Act, the EN 45000/ISO 17000 series and the ISO 9000 series.

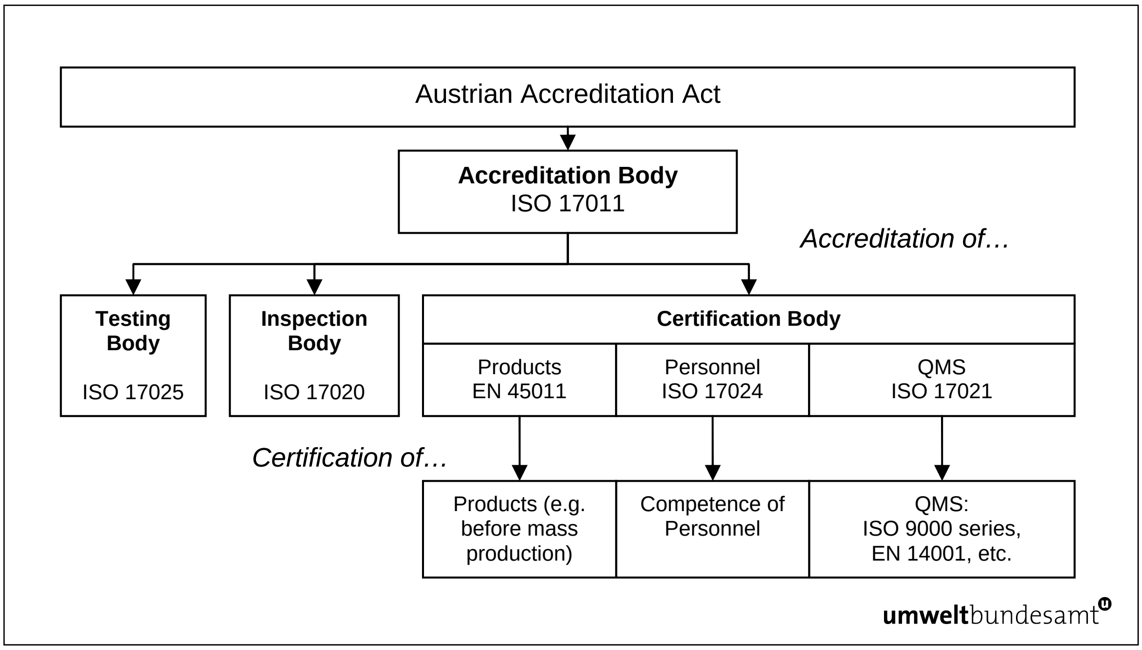

Figure 2: Inter-relationship between the Austrian Accreditation Act, the EN 45000/ISO 17000 and the ISO 9000 series.

Reports issued by an accredited body may carry the federal emblem in addition to the accreditation logo. 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).

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 3.

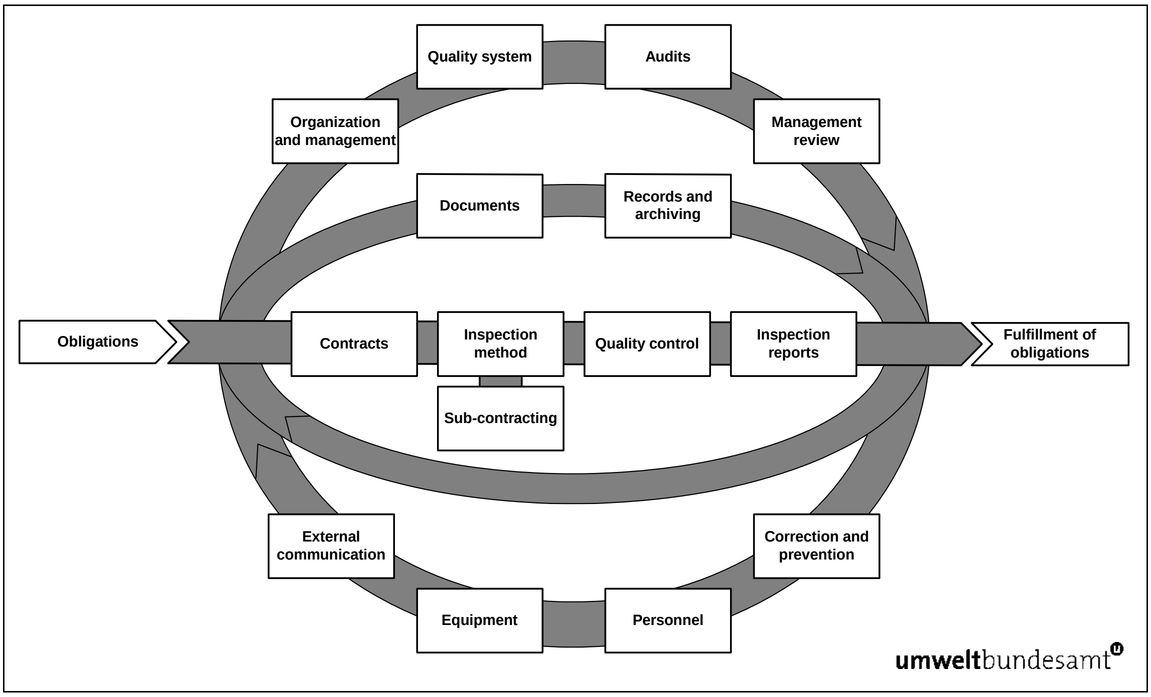

Figure 3: Process-based QMS (the outer circle corresponds to management processes, the straight line to realisation processes and the inner circle to supporting processes).

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).

ETS Testing Plan

EUROPEAN COMMISSION
DIRECTORATE-GENERAL
ENVIRONMENT
Directorate C - Climate Change & Air
ENV.C.2 - Market based instruments including Greenhouse gas emissions trading

Brussels,

ENV C2/

ETS Testing Plan

EUROPEAN COMMISSION
DIRECTORATE-GENERAL
ENVIRONMENT
Directorate C - Climate Change & Air
ENV.C.2 - Market based instruments including Greenhouse gas emissions trading

Brussels,
ENV C2/

ETS Testing Plan

Table of content

1. INTRODUCTION

1.1. Purpose

The purpose of this document is to define the Test Specifications for the verification of Member States registries applications.

This plan documents the testing activities to be conducted by the MS registry administrator or the assigned testing coordinator in order to demonstrate the ability of the registry to perform the processes required under the ETS and its good functioning in conjunction with the Community Independent Transaction Log.

The test cases are mainly based on prior work including:

- The *Commission Regulation (EC)* No 2216/2004 for a standardised ans secured system of registries pursuant to Directive 2003/87/EC of the European Parliament and of the Council and Decision 280/2004/EC of the European Parliament and of the Council. This document contains the detailed specifications of the technical aspects of the system, including the details of the WSDL and the definitions of the process flows to be tested;
- The *Data Exchange Standards for registry systems under the Kyoto Protocol - TECHNICAL SPECIFICATIONS (Version 1.1)*, document containing the description of the processes, transaction types and supplementary transaction types applicable to the EC registry system (Downloadable from https://quickplace.unfccc.int/QuickPlace/itl-rsa).

1.2. Guiding principles and Assumptions

The purpose of process testing is to verify that (i) data acceptance, processing, and retrieval is achieved properly, and (ii) both the UNFCCC Data Exchange Standards and EC Data Exchange Standards have been implemented properly.

The process testing will be achieved through the definition of test cases covering all categories of test as summarized in the table below:

Category (code)	Description
Transaction Specific Tests (“xx-yy”)	Validation of the transaction processes by performing a complete life cycle of transaction testing.
Management Tests: • clAcc • crAcc • uAcc • uVE	Registry Management Tests: • Close Account • Create Account • Update Account • Update Verified Emissions
Reconciliation Tests (“RECO”)	Validation of the reconciliation process.

Upload of Nap tests (NAP)	Validation of the Nap upload functions
Transaction Status (TXST)	Validation of the GetTransactionStatus function

Test cases will be identified by the following attributes:

- Test ID: Test case unique identifier, which will consist of a category code followed by a unique identification number;
- Test Name: Name of the test case;
- Test Description : Description of the purpose of the test case;
- Pre-Requisites: Description of the situation within the CITL before the test case has been initiated; this describes the accounts involved in the test case as well as their relation to the unit blocks before the test case has been initiated;
- Expected Results: Description of the situation within the CITL once the test case will have been completed; this describes the accounts involved in the test case as well as their relation to the unit blocks after the test case has been completed;
- Response codes: List of response codes expected from the test case;
- The parameters: Information submitted by the MS Registry to the CITL[1].

1.3. Prerequisites

- The database has to be reset so all old data is deleted.
- The XML-files for the NAP have to be created in advance

1.4. Expected result

After each test case it is expected that the balance on the accounts is equal to the balance given in the test case. The National Registry Administrator have to provide a screenshot of this after each case.

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[1] It is expected that transaction IDs and serial block IDs generated by the registry software may be different from those described in the test cases.

2. ETS REGISTRIES TEST CASES

2.1. Overview

The following table gives an overview of the processes to be tested and the related test cases

Tx ID	Process description	Test case
01-00	Issue of AAUs and RMUs	5-1
03-00	External transfer (2008-2012 onwards)	7-1, 7-2, 7-3
04-00	Cancellation (2008-2012 onwards)	8-1
05-00	Retirement	13-5
05-01	retirement of surrendered allowances	13-2
05-02	retirement of unallocated allowances	13-4
10-00	Internal transfer	6-1, 6-2, 6-3, 6-4, 6-5, 6-6, 6-7, 6-8
10-52	Allowance issue (2008-2012 onwards)	5-1
10-53	Allowance allocation	5-3, 5-4, 12-4
10-61	Conversion of surrendered allowances	13-1
10-62	Conversion of none-allocated allowances	13-3
10-02	Allowance surrender	11-2, 11-3
clAcc	Close Account	10-2
crAcc	Create Account	2-1, 2-2, 12-1
uAcc	Update Account	9-1, 9-2, 9-3
uVE	Update Verified Emissions	11-1, 11-4
RECO	Reconciliation	14-1, 14-2, 14-3, 14-4
NAP	Nap upload	3-1, 3-2, 3-3, 3-4
AddNEInstallation	Adding new entrant new installations to the national allocation plan table	12-2
IncreaseAllocation	Increasing the allocation in the national allocation plan table of existing installations that are new entrants	15-1, 15-3
RemoveNAPallocation	Removing the allocation from the national allocation plan table of installations that are closing	10-1
TXST	Transaction Status	

2.2. Test cases – Account Creation

Test case 2-1

Name	Create Party Holding Accounts
Description	Creation, in the National Registry of XX a Party Holding Account, a National Cancellation Account for Commitment Period 1, a National Retirement Account for Commitment Period 1 and a National Retirement Account for Commitment Period 2.
Pre-condition	The national registry of XX has been created. The Database is empty for data
Expected result	The follow accounts have been created Party Holding Account, type 100 Cancelation Account for CP1, type 230 Retirement Account for CP1 and CP2, Type 300
Response code	None
PARAMETRE	
Message From:	XX
Message To:	ITL/CITL
Major Version:	1
Minor Version:	1
Correlation ID:	1 - 4

Test case 2-2

Name	Create Operator and Personal Holding Accounts
Description	Creation, in the National Registry of XX of three Operator Holding Accounts, as well as their related installations and two Personal Holding Accounts
Pre-condition	The national registry of XX has been created. The Database only contains the data of the Party Holding Accounts.
Expected result	The follow accounts have been created 3 Operator Holding Accounts, type 120 3 Installations, one related to each of the OHA **The permit date have to be 01/01/2008 for the first 2 and 01/06/2009 for the third installation** 2 Personal Holding Accounts, type 121 → Set all (or at least the address and phone number of the SAR of the second OHA) to visible at the opening of the accounts

Response code	None
PARAMETRE	
Message From:	XX
Message To:	ITL/CITL
Major Version:	1
Minor Version:	1
Correlation ID:	5 – 10

2.3. Test cases – NAP Upload

Test case 3-1

<table>
<tr><td>Name</td><td>Upload NAP for CP1</td></tr>
<tr><td>Description</td><td>Upload of a National Allocation Plan from the National Registry of XX for Commitment Period 1 (2008-12). The assigned amount for the national registry of XX is set to 500000 AAU’s and the CPR to 450000</td></tr>
<tr><td>Pre-condition</td><td>The national registry of XX has been created. The Database contain the data of the Party Holding Accounts, Operator Holding Accounts including their installations and 2 Personal Holding Accounts,</td></tr>
<tr><td>Expected result</td><td>The National Allocation Plan from the National Registry of XX for Commitment Period 1 has been loaded and has allocated the amount of 105,000 allowances to the reserve and
<table>
<tr><td>Inst.</td><td>2008</td><td>2009</td><td>2010</td><td>2011</td><td>2012</td></tr>
<tr><td>#1</td><td>15000</td><td>15000</td><td>15000</td><td>15000</td><td>50000</td></tr>
<tr><td>#2</td><td>10000</td><td>10000</td><td>10000</td><td>10000</td><td>10000</td></tr>
</table>
Total amount of allowances is 265000
The assigned amount for the national registry of XX is set to 1000000 AAU’s and the CPR to 450000</td></tr>
<tr><td>Response code</td><td>None</td></tr>
<tr><td colspan="2">PARAMETRE</td></tr>
<tr><td>Originating Registry:</td><td>XX</td></tr>
<tr><td>Commitment Period:</td><td>1</td></tr>
<tr><td>Assigned amount</td><td>CPR + 500000</td></tr>
<tr><td>CPR</td><td>Given by ITL</td></tr>
<tr><td>NAP Reserve</td><td>105000</td></tr>
<tr><td>Web service</td><td>NAP XML</td></tr>
<tr><td>Action</td><td>“Add”</td></tr>
</table>

2.4. Test cases – Amendment to the NAP

Test case 4-1

<table>
<tr><td>Name</td><td>Upload an amended NAP for CP1</td></tr>
<tr><td>Description</td><td>Upload of an amended National Allocation Plan from the National Registry of XX for Commitment Period 1 (2008-12) including allocation for installation #3.</td></tr>
<tr><td>Pre-condition</td><td>The national registry of XX has been created. The Database contains the data of the Party Holding Accounts, Operator Holding Accounts including their installations and 2 Personal Holding Accounts. The initial Nap for CP1 has been loaded and the assigned amount been set.</td></tr>
<tr><td>Expected result</td><td>The National Allocation Plan from the National Registry of XX for Commitment Period 1 has been loaded and has allocated the amount of 25,000 allowances to the reserve and
<table>
<tr><td>Inst.</td><td>2008</td><td>2009</td><td>2010</td><td>2011</td><td>2012</td></tr>
<tr><td>#1</td><td>15000</td><td>15000</td><td>15000</td><td>15000</td><td>50000</td></tr>
<tr><td>#2</td><td>10000</td><td>10000</td><td>10000</td><td>10000</td><td>10000</td></tr>
<tr><td>#3</td><td></td><td>20000</td><td>20000</td><td>20000</td><td>20000</td></tr>
</table>
The assigned amount for the national registry of XX is set to 500000 AAU’s and the CPR to 450000</td></tr>
<tr><td>Response code</td><td>None</td></tr>
<tr><td colspan="2">PARAMETRE</td></tr>
<tr><td>Originating Registry:</td><td>XX</td></tr>
<tr><td>Commitment Period:</td><td>1</td></tr>
<tr><td>Assigned amount</td><td>CPR + 500000</td></tr>
<tr><td>CPR</td><td>Given by ITL</td></tr>
<tr><td>NAP Reserve</td><td>25000</td></tr>
<tr><td>Web service</td><td>AddNEInstallationtoNAP</td></tr>
<tr><td>Correlation ID</td><td>11</td></tr>
</table>

Test case 4-2

Name	Upload an amended NAP for CP1
Description	Upload of an amended National Allocation Plan from the National Registry of XX for Commitment Period 1 (2008-12) including installation 3 with amended allocation for installation 3 in year 2012
Pre-condition	The national registry of XX has been created. The Database contains the data of the Party Holding Accounts, Operator Holding Accounts including their installations and 2 Personal Holding Accounts. The initial Nap for CP1 has been loaded and the assigned amount been set.
Expected result	The National Allocation Plan from the National Registry of XX for Commitment Period 1 has been loaded and has allocated the amount of 15,000 allowances to the reserve and

<table>
<tr><td></td><td>
<table>
<tr><td>Inst.</td><td>2008</td><td>2009</td><td>2010</td><td>2011</td><td>2012</td></tr>
<tr><td>#1</td><td>15000</td><td>15000</td><td>15000</td><td>15000</td><td>50000</td></tr>
<tr><td>#2</td><td>10000</td><td>10000</td><td>10000</td><td>10000</td><td>10000</td></tr>
<tr><td>#3</td><td></td><td>20000</td><td>20000</td><td>20000</td><td>30000</td></tr>
</table>
The assigned amount for the national registry of XX is set to 500000 AAU’s and the CPR to 450000
</td></tr>
<tr><td>Response code</td><td>None</td></tr>
<tr><td colspan="2">PARAMETRE</td></tr>
<tr><td>Originating Registry:</td><td>XX</td></tr>
<tr><td>Commitment Period:</td><td>1</td></tr>
<tr><td>Assigned amount</td><td>CPR + 500000</td></tr>
<tr><td>CPR</td><td>Given by ITL</td></tr>
<tr><td>NAP Reserve</td><td>15000</td></tr>
<tr><td>Web service</td><td>IncreaseNAPallocationtoNEInstallation</td></tr>
<tr><td>Correlation ID</td><td>12</td></tr>
</table>

2.5. Test cases - Issuing and allocation

Test case 5-1

Name: **Issuance of AAU’s for Commitment Period 1 (2008-12).**

Description: **Issuance, in the National Registry of XX of 500000 AAU’s having 1 as both original and applicable Commitment Period.**

Pre-Requisites: **The NAP for CP1 has been uploaded and Operator Holding Account 10 and 11 and their Installation 1 and 2 have been created.**

The assigned amount of AAUs and Allowances has been set.

Expected Results:

Account ID	1	10	11
Type	100	120	120
Installation		1	2
Balance after	CPR+500000	0	0
Amount	CPR+500000	0	0

Response Code: **None**

Parameters

Transaction	ID	Type	Supp. Type
	XX0001	01	00

	Registry	Account type	Account ID
Transferring	XX		
Acquiring	XX	100	1

Unit	Type	Supp. Type	CP
	1	0	1

Normally the issuance is 950 000 AAUs

Here after are all balances of AAUs for the account type 100 the mentioned amount+ the CPR

Test case 5-2

Name: **Issuance of Allowances for Commitment Period 1 (2008-12).**

Description: **Issuance, in the National Registry of XX 265000 Allowances having 1 as both original and applicable Commitment Period.**

Pre-Requisites: **The NAP for CP1 has been uploaded and Operator Holding Account 10,11and 12 and their Installation 1, 2 and 3 have been created.**

The assigned amount of AAUs and Allowances has been set and there has been issued AAUs.

Expected Results:

Account ID	1	10	11	Unit type/supp. type
Type	100	120	120	
Installation		1	2	
Balance after	235000 265000	0 0	0 0	1-0 1-1
Transferred amount	265000			1-1

Response Code: **None**

Parameters

Transaction	ID	Type	Supp. Type
	XX0002	01	52

	Registry	Account type	Account ID
Transferring	XX		
Acquiring	XX	100	1

Unit	Type	Supp. Type	CP
	1	1	1

Test case 5-3

Name: **Allocation of Allowances to Operators during Commitment Period 1 (2008-12).**

Description: **Allocation for year 2008, within the National Registry XX, of 25,000 Allowances having 1 as both original and applicable commitment period, to operator holding accounts, according to the National Allocation Plan that has been uploaded for Commitment Period 1.**

Pre-Requisites: **The NAP for CP1 has been uploaded and Operator Holding Account 10 and 11 and their Installation 1 and 2 have been created.**

There has been issued AAUs and Allowances to Party Holding Account 1

Expected Results:

Account ID	1	10	11	Unit type/supp. type
Type	100	120	120	
Installation		1	2	
Balance after	235000	0	0	1-0
	240000	15000	10000	1-1
Transferred amount	-25000	15000	10000	1-1

Response Code: **None**

Parameters

Transaction	ID	Type	Supp. Type
	XX0003	10	53

	Registry	Account type	Account ID
Transferring	XX	100	1
Acquiring	XX	120	10
Acquiring	XX	120	11

Unit	Type	Supp. Type	CP
	1	1	1

Test case 5-4

Name: **Allocation of Allowances to Operators during Commitment Period 1 (2008-12).**

Description: **Allocation for year 2009, within the National Registry XX, of 25,000 Allowances having 1 as both original and applicable commitment period, to operator holding accounts, according to the National Allocation Plan that has been uploaded for Commitment Period 1.**

Pre-Requisites: **The NAP for CP1 has been uploaded and Operator Holding Account 10 and 11 and their Installation 1 and 2 have been created.**

There has been issued AAUs and Allowances to Party Holding Account 1

Expected Results:

Account ID	1	10	11	Unit type/supp. type
Type	100	120	120	
Installation		1	2	
Balance after	235000 215000	0 30000	0 20000	1-0 1-1
Transferred amount	-25000	15000	10000	1-1

Response Code: **None**

Parameters

Transaction	ID	Type	Supp. Type
	XX0004	10	53

	Registry	Account type	Account ID
Transferring	XX	100	1
Acquiring	XX	120	10
Acquiring	XX	120	11

Unit	Type	Supp. Type	CP
	1	1	1

2.6. Test cases - Internal Transaction

Test case 6-1

Name: **Internal transfer**

Description: **Internal transfer, within the National Registry of XX, from a Party Holding Account to Operator Holding Account 10 of 25,000 Allowances having 1 as both original and applicable commitment period.**

Pre-Requisites: **The NAP for CP1 has been uploaded and Operator Holding Account 10 and 11 and their Installation 1 and 2 have been created.**

There has been issued AAUs and Allowances to Party Holding Account 1, and the allocation to installation 1 and 2 have taken place.

Expected Results:

Account ID	1	10	11	Unit type/supp. type
Type	100	120	120	
Installation		1	2	
Balance after	235000 190000	0 55000	0 20000	1-0 1-1
Transferred amount	-25000	25000		1-1

Response Code: **None**

Parameters

Transaction	ID	Type	Supp. Type
	XX0005	10	

	Registry	Account type	Account ID
Transferring	XX	100	1
Acquiring	XX	120	10

Unit	Type	Supp. Type	CP
	1	1	1

Test case 6-2

Name: **Internal transfer**

Description: **Internal transfer, within the National Registry of XX, of 10,000 Allowances having 1 as both original and applicable commitment period from the operator holding account having 10 as account unique identification number to the operator holding account having 11 as unique identification number.**

Pre-Requisites: **The NAP for CP1 has been uploaded and Operator Holding Account 10 and 11 and their Installation 1 and 2 have been created.**

There has been issued AAUs and Allowances to Party Holding Account 1, and the allocation to installation 1 and 2 have taken place.

Expected Results:

Account ID	1	10	11	Unit type/supp. type
Type	100	120	120	
Installation		1	2	
Balance after	235000	0	0	1-0
	190000	45000	30000	1-1
Transferred amount		-10000	10000	1-1

Response Code: **None**

Parameters

Transaction	ID	Type	Supp. Type
	XX0006	10	

	Registry	Account type	Account ID
Transferring	XX	120	10
Acquiring	XX	120	11

Unit	Type	Supp. Type	CP
	1	1	1

Test case 6-3

Name: **Internal transfer**

Description: **Internal transfer, within the National Registry of XX, of 10,000 Allowances having 1 as both original and applicable commitment period from the operator holding account having 11 as account unique identification number to the personal holding account having 14 as unique identification number.**

Pre-Requisites: **The NAP for CP1 has been uploaded and Operator Holding Account 10 and 11 and their Installation 1 and 2 have been created.**

There has been issued AAUs and Allowances to Party Holding Account 1, and the allocation to installation 1 and 2 have taken place.

Expected Results:

Account ID	1	11	14	Unit type/supp. type
Type	100	120	121	
Installation		1		
Balance after	235000	0	0	1-0
	190000	20000	10000	1-1
Transferred amount		-10000	10000	1-1

Response Code: **None**

Parameters

Transaction	ID	Type	Supp. Type
	XX0007	10	

	Registry	Account type	Account ID
Transferring	XX	120	11
Acquiring	XX	121	14

Unit	Type	Supp. Type	CP
	1	1	1

Test case 6-4

Name: **Internal transfer**

Description: **Internal transfer, within the National Registry of XX, of 10,000 Allowances having 1 as both original and applicable commitment period from the personal holding account having 14 as account unique identification number to the Party holding account having 1 as unique identification number.**

Pre-Requisites: **The NAP for CP1 has been uploaded and Operator Holding Account 10 and 11 and their Installation 1 and 2 have been created.**

There has been issued AAUs and Allowances to Party Holding Account 1, and the allocation to installation 1 and 2 have taken place.

Expected Results:

Account ID	1	14		Unit type/supp. type
Type	100	121		
Installation		1		
Balance after	235000	0		1-0
	200000	0		1-1
Transferred amount	10000	-10000		1-1

Response Code: **None**

Parameters

Transaction	ID	Type	Supp. Type
	XX0008	10	

	Registry	Account type	Account ID
Transferring	XX	121	14
Acquiring	XX	100	11

Unit	Type	Supp. Type	CP
	1	1	1

Test case 6-5

Name: **Internal transfer**

Description: **Internal transfer, within the National Registry of XX, of 10,000 Allowances having 1 as both original and applicable commitment period from the Party holding account having 1 as account unique identification number to the operator holding account having 11 as unique identification number.**

Pre-Requisites: **The NAP for CP1 has been uploaded and Operator Holding Account 10 and 11 and their Installation 1 and 2 have been created.**

There has been issued AAUs and Allowances to Party Holding Account 1, and the allocation to installation 1 and 2 have taken place.

Expected Results:

Account ID	1	10	11	Unit type/supp. type
Type	100	120	120	
Installation		1	2	
Balance after	235000	0	0	1-0
	190000	45000	30000	1-1
Transferred amount	-10000		10000	1-1

Response Code: **None**

Parameters

Transaction	ID	Type	Supp. Type
	XX0009	10	

	Registry	Account type	Account ID
Transferring	XX	100	1
Acquiring	XX	120	11

Unit	Type	Supp. Type	CP
	1	1	1

Test case 6-6

Name: **Internal transfer**

Description: **Internal transfer, within the National Registry of XX, of 5,000 Allowances and 10000 AAUs having 1 as both original and applicable commitment period from the Party holding account having 1 as account unique identification number to the operator holding account having 10 as unique identification number.**

Pre-Requisites: **The NAP for CP1 has been uploaded and Operator Holding Account 10 and 11 and their Installation 1 and 2 have been created.**

There has been issued AAUs and Allowances to Party Holding Account 1, and the allocation to installation 1 and 2 have taken place.

Expected Results:

Account ID	1	10	11	Unit type/supp. type
Type	100	120	120	
Installation		1	2	
Balance after	225000	10000	0	1-0
	185000	50000	30000	1-1
Transferred amount	-10000	10000		1-0
	-5000	5000		1-1

Response Code: **None**

Parameters

Transaction	ID	Type	Supp. Type
	XX00010	10	

	Registry	Account type	Account ID
Transferring	XX	100	1
Acquiring	XX	120	11

Unit	Type	Supp. Type	CP
	1	1	1
	1	0	1

Test case 6-7

Name: **Internal transfer**

Description: **Internal transfer, within the National Registry of XX, of 5,000 Allowances and 10000 AAUs having 1 as both original and applicable commitment period from the Operator holding account having 10 as account unique identification number to the Personal holding account having 14 as unique identification number.**

Pre-Requisites: **The NAP for CP1 has been uploaded and Operator Holding Account 10 and 11 and their Installation 1 and 2 have been created.**

There has been issued AAUs and Allowances to Party Holding Account 1, and the allocation to installation 1 and 2 have taken place.

Expected Results:

Account ID	1	10	14	Unit type/supp. type
Type	100	120	121	
Installation		1		
Balance after	225000	0	10000	1-0
	185000	45000	5000	1-1
Transferred amount		-10000	10000	1-0
		-5000	5000	1-1

Response Code: **None**

Parameters

Transaction	ID	Type	Supp. Type
	XX00011	10	

	Registry	Account type	Account ID
Transferring	XX	120	10
Acquiring	XX	121	14

Unit	Type	Supp. Type	CP
	1	1	1
	1	0	1

Test case 6-8

Name: **Internal transfer**

Description: **Internal transfer, within the National Registry of XX, of 5,000 Allowances and 10000 AAUs having 1 as both original and applicable commitment period from the Personal holding account having 14 as account unique identification number to the Party holding account having 1 as unique identification number.**

Pre-Requisites: **The NAP for CP1 has been uploaded and Operator Holding Account 10 and 11 and their Installation 1 and 2 have been created.**

There has been issued AAUs and Allowances to Party Holding Account 1, and the allocation to installation 1 and 2 have taken place.

Expected Results:

Account ID	1	10	14	Unit type/supp. type
Type	100	120	121	
Installation		1		
Balance after	235000 190000	0 45000	0 0	1-0 1-1
Transferred amount	10000 5000		-10000 -5000	1-0 1-1

Response Code: **None**

Parameters

Transaction	ID	Type	Supp. Type
	XX00012	10	

	Registry	Account type	Account ID
Transferring	XX	121	14
Acquiring	XX	100	1

Unit	Type	Supp. Type	CP
	1	1	1
	1	0	1

2.7. Test cases - External Transactions

Test case 7-1

Name: **External transfer**

Description: **External transfer of 10000 allowances having 1 as both the original and applicable commitment period from the party holding account within the National Registry of XX having 1 as account unique identification number, to the party holding account within the national Registry of YY.**

Pre-Requisites: **The NAP for CP1 has been uploaded and Operator Holding Account 10 and 11 and their Installation 1 and 2 have been created.**

There has been issued AAUs and Allowances to Party Holding Account 1, and the allocation to installation 1 and 2 has taken place.

Expected Results:

Account ID	1	10	11	Unit type/supp. type
Type	100	120	120	
Installation		1	2	
Balance after	235000 180000	0 45000	0 30000	1-0 1-1
Transferred amount	-10000			1-1

Response Code: **None**

Parameters

Transaction	ID	Type	Supp. Type
	XX00013	03	

	Registry	Account type	Account ID
Transferring	XX	120	10
Acquiring	YY	120	11

Unit	Type	Supp. Type	CP
	1	1	1

The total amount of units in the XX registry is 490000

Test case 7-2

Name: **External transfer**

Description: **External transfer of 8000 allowances and 10000 AAUs having 1 as both the original and applicable commitment period from the Party holding account within the National Registry of XX having 1 as account unique identification number, to the party holding account within the national Registry of YY.**

Pre-Requisites: **The NAP for CP1 has been uploaded and Operator Holding Account 10 and 11 and their Installation 1 and 2 have been created.**

There has been issued AAUs and Allowances to Party Holding Account 1, and the allocation to installation 1 and 2 has taken place.

Expected Results:

Account ID	1	10	11	Unit type/supp. type
Type	100	120	120	
Installation		1	2	
Balance after	225000 172000	0 45000	0 30000	1-0 1-1
Transferred amount	-10000 _-8000			1-0 1-1

Response Code: **None**

Parameters

Transaction	ID	Type	Supp. Type
	XX00014	03	

	Registry	Account type	Account ID
Transferring	XX	100	1
Acquiring	YY		

Unit	Type	Supp. Type	CP
	1	1	1
	1	0	1

Test case 7-3

Name: **External transfer**

Description: **External transfer of 8000 allowances and 10000 AAUs having 1 as both the original and applicable commitment period from Party Holding Account in the National Registry of YY to the party holding account having 1 as account identification number within the national Registry of XX.**

Pre-Requisites: **The NAP for CP1 has been uploaded and Operator Holding Account 10 and 11 and their Installation 1 and 2 have been created.**

There has been issued AAUs and Allowances to Party Holding Account 1, and the allocation to installation 1 and 2 have taken place.

Test case 7-2 has been done

Expected Results:

Account ID	1	10	14	Unit type/supp. type
Type	100	120	121	
Installation		1		
Balance after	235000 180000	0 45000	0 30000	1-0 1-1
Transferred amount	10000 _8000			1-0 1-1

Response Code: **None**

Parameters

Transaction	ID	Type	Supp. Type
	XX00015	03	

	Registry	Account type	Account ID
Transferring	YY	100	
Acquiring	XX	100	1

Unit	Type	Supp. Type	CP
	1 1	1 0	1 1

2.8. Test cases - Cancellation

Test case 8-1

Name: **Cancellation of Allowances having 1 as both original and applicable Commitment Period from an operator holding account to an adequate cancellation account.**

Description: **Cancellation, within the National Registry of XX, of 15,000 Allowances having 1 as both original and applicable commitment period from the operator holding account having 10 as account identifier to the voluntary cancellation account having 2 as account identifier.**

Pre-Requisites: **The NAP for CP1 has been uploaded and Operator Holding Account 10 and 11 and their Installation 1 and 2 have been created.**

There has been issued AAUs and Allowances to Party Holding Account 1, and the allocation to installation 1 and 2 has taken place.

Expected Results:

Account ID	1	10	11	2	Unit type/supp. type
Type	100	120	120	230	
Installation		1	2		
Balance after	235000 180000	0 30000	0 20000	15000	1-0 1-1
Transferred amount		_15000		15000	1-1

Response Code: **None**

Parameters

Transaction	ID	Type	Supp. Type
	XX00016	04	

	Registry	Account type	Account ID
Transferring	XX	120	10
Acquiring	XX	230	2

Unit	Type	Supp. Type	CP
	1	1	1

2.9. Test cases – Update Account

Test case 9-1

Name	Update Operator Holding Account
Description	Modification of information related to an operator holding account within the national registry of Greece, and its contact people. For Operator Account 10 let the person who is SAR be PAR and versa versus.
Pre-condition	The national registry of XX has been created. The Operator Holding Account 10 and 11 and their Installation 1 and 2 have been created.
Expected result	The SAR has become the PAR and the PAR has become the SAR
Response code	None
PARAMETRE	
Message From:	XX
Message To:	ITL/CITL
Major Version:	1
Minor Version:	1
Correlation ID:	13

Test case 9-2

Name	Update Operator Holding Account
Description	Modification of information related to an operator holding account within the national registry of Greece, and its contact people. For Operator Account 11 the phone number of the SAR will be changed and the address and phone information will no longer be visible
Pre-condition	The national registry of XX has been created. The Operator Holding Account 10 and 11 and their Installation 1 and 2 have been created.
Expected result	For Operator Account 11 the phone number of the SAR has been changed and the address and phone information is no longer be visible
Response code	None
PARAMETRE	
Message From:	XX
Message To:	ITL/CITL
Major Version:	1
Minor Version:	1
Correlation ID:	14

Test case 9-3

Name	Update Operator Holding Account
Description	Modification of information related to an operator holding account within the national registry of Greece, and its contact people. For Operator Account 11 the phone number of the SAR will be changed and the address information will be visible
Pre-condition	The national registry of XX has been created. The Operator Holding Account 10 and 11 and their Installation 1 and 2 have been created.
Expected result	For Operator Account 11 the phone number of the SAR has been changed and the address information is visible but not the phone number.
Response code	None
PARAMETRE	
Message From:	XX
Message To:	ITL/CITL
Major Version:	1
Minor Version:	1
Correlation ID:	15

Test case 9-4

Name	Update Operator Holding Account
Description	Modification of information related to an operator holding account within the national registry of Greece, and its contact people. If possible, for Operator Account 10 the permit number have to be updated. If not possible (due to for example national legislation), change the start date of the permit op the third installation (from 01/06/2009 to 01/08/2009). If neither of the two can be performed, skip this test case.
Pre-condition	The national registry of XX has been created. The Operator Holding Account 10 and 11 and their Installation 1 and 2 have been created.
Expected result	For Operator Account 11 the permit number, respectively start date has been changed
Response code	None
PARAMETRE	
Message From:	XX
Message To:	ITL/CITL
Major Version:	1
Minor Version:	1
Correlation ID:	16

2.10. Test cases - Close Account

Test case 10-1

<table>
<tr><td>Name</td><td>Update NAP for CP1</td></tr>
<tr><td>Description</td><td>Upload of an amended National Allocation Plan from the National Registry of XX for Commitment Period 1 (2008-12) for closing installation 3.</td></tr>
<tr><td>Pre-condition</td><td>The national registry of XX has been created. The Database contains the data of the Party Holding Accounts, Operator Holding Accounts including their installations and 2 Personal Holding Accounts. The initial Nap for CP1 has been loaded and the assigned amount been set.</td></tr>
<tr><td>Expected result</td><td>The National Allocation Plan from the National Registry of XX for Commitment Period 1 has been loaded and has allocated the amount of 105,000 allowances to the reserve and
<table>
<tr><td>Inst.</td><td>2008</td><td>2009</td><td>2010</td><td>2011</td><td>2012</td></tr>
<tr><td>#1</td><td>15000</td><td>15000</td><td>15000</td><td>15000</td><td>50000</td></tr>
<tr><td>#2</td><td>10000</td><td>10000</td><td>10000</td><td>10000</td><td>10000</td></tr>
<tr><td></td><td></td><td></td><td></td><td></td><td></td></tr>
</table>
The assigned amount for the national registry of XX is set to 500000 AAU’s and the CPR to 450000</td></tr>
<tr><td>Response code</td><td>None</td></tr>
<tr><td colspan="2">PARAMETRE</td></tr>
<tr><td>Originating Registry:</td><td>XX</td></tr>
<tr><td>Commitment Period:</td><td>1</td></tr>
<tr><td>Assigned amount</td><td>500000</td></tr>
<tr><td>CPR</td><td>450000</td></tr>
<tr><td>NAP Reserve</td><td>105000</td></tr>
<tr><td>Web service</td><td>RemoveNAPallocationofclosingInstallation</td></tr>
<tr><td>Correlation ID</td><td>17</td></tr>
</table>

Test case 10-2

Name	Closure of Account
Description	Closure of the Operator holding account within the national registry of Greece, having 12 as account unique identification number. (You have to enter 0 VEs for the year 2009 in order to avoid check 7117)
Pre-condition	The national registry of XX has been created. The Operator Holding Account 10, 11 and 12 and their Installation 1, 2 and 3 have been created.
Expected result	The Operator Account 12 is closed and can not be used
Response code	None
PARAMETRE	
Message From:	XX
Message To:	ITL/CITL
Major Version:	1
Minor Version:	1
Correlation ID:	18

2.11. Test cases - Compliance data

Test case 11-1

<table>
<tr><td>Name:</td><td>Verify Emission</td></tr>
<tr><td>Description:</td><td>Update of verified emissions table for installation 1 and 2 for year 2009.</td></tr>
<tr><td>Pre-Requisites:</td><td>The NAP for CP1 has been uploaded and Operator Holding Account 10 and 11 and their Installation 1 and 2 have been created.
There have been issued AAUs and Allowances to Party Holding Account 1, and the allocation to installation 1 and 2 has taken place.</td></tr>
<tr><td>Expected Results:</td><td>
<table>
<tr><td>Account ID</td><td>1</td><td>10</td><td>11</td><td>Unit type/supp. type</td></tr>
<tr><td>Type</td><td>100</td><td>120</td><td>120</td><td></td></tr>
<tr><td>Installation</td><td></td><td>1</td><td>2</td><td></td></tr>
<tr><td>Balance after</td><td>235000
180000</td><td>0
30000</td><td>0
20000</td><td>1-0
1-1</td></tr>
<tr><td>Verified Emission</td><td></td><td>9500</td><td>10000</td><td>1-1</td></tr>
</table>
</td></tr>
<tr><td>Response Code:</td><td>None</td></tr>
<tr><td colspan="2">PARAMETRE</td></tr>
<tr><td>Message From:</td><td>XX</td></tr>
<tr><td>Message To:</td><td>ITL/CITL</td></tr>
<tr><td>Major Version:</td><td>1</td></tr>
<tr><td>Minor Version:</td><td>1</td></tr>
<tr><td>Correlation ID:</td><td>19</td></tr>
</table>

Test case 11-2

<table>
<tr><td>Name:</td><td>Surrendering</td></tr>
<tr><td>Description:</td><td>Surrendering, within the National Registry of XX, of 8,500 Allowances having 1 as both original and applicable commitment period by transferring them from the operator holding account having 10 as account unique identification number to the party holding account having 1 as account unique identification number.</td></tr>
<tr><td>Pre-Requisites:</td><td>The NAP for CP1 has been uploaded and Operator Holding Account 10 and 11 and their Installation 1 and 2 have been created.
There have been issued AAUs and Allowances to Party Holding Account 1, and the allocation to installation 1 and 2 has taken place.</td></tr>
<tr><td>Expected Results:</td><td>
<table>
<tr><td>Account ID</td><td>1</td><td>10</td><td>11</td><td>Unit type/supp. type</td></tr>
<tr><td>Type</td><td>100</td><td>120</td><td>120</td><td></td></tr>
</table>
</td></tr>
</table>

Installation		1	2	
Balance after	235000	0	0	1-0
	188500	21500	20000	1-1
Transferred amount	8500	-8500		1-1

Response Code: **None**

Parameters

Transaction	ID	Type	Supp. Type
	XX00017	10	02

	Registry	Account type	Account ID
Transferring	XX	120	10
Acquiring	XX	100	1

Unit	Type	Supp. Type	CP
	1	1	1

Test case 11-3

Name: **Surrendering**

Description: **Surrendering, within the National Registry of XX, of 9000 Allowances having 1 as both original and applicable commitment period by transferring them from the operator holding account having 11 as account unique identification number to the party holding account having 1 as account unique identification number.**

Pre-Requisites: **The NAP for CP1 has been uploaded and Operator Holding Account 10 and 11 and their Installation 1 and 2 have been created.**

There has been issued AAUs and Allowances to Party Holding Account 1, and the allocation to installation 1 and 2 has taken place.

Expected Results:

Account ID	1	10	11	Unit type/supp. type
Type	100	120	120	
Installation		1	2	
Balance after	235000	0	0	1-0
	197500	21500	11000	1-1
Transferred amount	9000		-9000	1-1

Response Code: **None**

Parameters

Transaction	ID	Type	Supp. Type
	XX00018	10	02

	Registry	Account type	Account ID
Transferring	XX	120	11
Acquiring	XX	100	1

Unit	Type	Supp. Type	CP
	1	1	1

Test case 11-4

Name: **Update Verify Emission**

Description: **Update of verified emissions table for installation 2 for year 2009.**

Pre-Requisites: **The NAP for CP1 has been uploaded and Operator Holding Account 10 and 11 and their Installation 1 and 2 have been created.**

There have been issued AAUs and Allowances to Party Holding Account 1, and the allocation to installation 1 and 2 has taken place.

Expected Results:

Account ID	1	10	11	Unit type/supp. Type
Type	100	120	120	
Installation		1	2	
Balance after	235000 197500	0 21500	0 11000	1-0 1-1
Verified Emission before		9500	10000	1-1
Verified Emission after		9500	9000	

Response Code: **None**

PARAMETRE	
Message From:	XX
Message To:	ITL/CITL
Major Version:	1
Minor Version:	1
Correlation ID:	20

Test case 11.5

<table>
<tr><td>Name:</td><td>Upload Compliance XML</td></tr>
<tr><td>Description:</td><td>For the year 2009 the compliance status of the installations need to be updated.</td></tr>
<tr><td>Pre-Requisites:</td><td>The NAP for CP1 has been uploaded and Operator Holding Account 10 and 11 and their Installation 1 and 2 have been created.
There have been issued AAUs and Allowances to Party Holding Account 1, and the allocation to installation 1 and 2 has taken place.</td></tr>
<tr><td>Expected Results:</td><td><table>
<tr><th>Installation</th><th>VE</th><th>Computed compliance</th><th>Compliance Status</th></tr>
<tr><td>1</td><td>9500</td><td>-0</td><td>D</td></tr>
<tr><td>2</td><td>9000</td><td>-500</td><td>E</td></tr>
<tr><td>3</td><td>0</td><td>0</td><td></td></tr>
</table></td></tr>
<tr><td>Response Code:</td><td>None</td></tr>
<tr><td colspan="2">PARAMETRE</td></tr>
<tr><td>Message From:</td><td>XX</td></tr>
<tr><td>Message To:</td><td>ITL/CITL</td></tr>
<tr><td>Major Version:</td><td>1</td></tr>
<tr><td>Minor Version:</td><td>1</td></tr>
<tr><td>Correlation ID:</td><td>21</td></tr>
</table>

2.12. Test cases – New entrance

Test case 12-1

Name	Create Operator Holding Accounts
Description	Creation, in the National Registry of XX of one new Operator Holding Accounts, as well as their related **installation.**
Pre-condition	The national registry of XX has been created. The Database contains the data of the Party Holding Accounts and • 3 Operator Holding Accounts, type 120 • 3 Installations, one related to each of the OHA • 2 Personal Holding Accounts, type 121
Expected result	Operator Account No 13 has been created together with Installation 4 **→ The permit start date of installation 4 is 01/06/2009**
Response code	None
PARAMETRE	
Message From:	XX
Message To:	ITL/CITL
Major Version:	1
Minor Version:	1
Correlation ID:	22

Test case 12-2

<table>
<tr><td>Name</td><td>Upload an amended NAP for CP1</td></tr>
<tr><td>Description</td><td>Upload of an amended National Allocation Plan from the National Registry of XX for Commitment Period 1 (2008-12) including allocation for installation #4.</td></tr>
<tr><td>Pre-condition</td><td>The national registry of XX has been created. The Database contains the data of the Party Holding Accounts, Operator Holding Accounts including their installations and 2 Personal Holding Accounts. The initial Nap for CP1 has been loaded and the assigned amount been set.</td></tr>
<tr><td>Expected result</td><td>The National Allocation Plan from the National Registry of XX for Commitment Period 1 has been loaded and has allocated the amount of 45,000 allowances to the reserve and
<table>
<tr><td>Inst.</td><td>2008</td><td>2009</td><td>2010</td><td>2011</td><td>2012</td></tr>
<tr><td>#1</td><td>15000</td><td>15000</td><td>15000</td><td>15000</td><td>50000</td></tr>
<tr><td>#2</td><td>10000</td><td>10000</td><td>10000</td><td>10000</td><td>10000</td></tr>
<tr><td>#4</td><td>0</td><td>15000</td><td>15000</td><td>15000</td><td>15000</td></tr>
</table>
The assigned amount for the national registry of XX is set to 500000 AAU’s and the CPR to 450000</td></tr>
<tr><td>Response code</td><td>None</td></tr>
<tr><td colspan="2">PARAMETRE</td></tr>
</table>

Originating Registry:	XX
Commitment Period:	1
Assigned amount	500000
CPR	450000
NAP Reserve	45000
Web service	AddNEInstallationtoNAP
Correlation id	23

Test case 12-3

Name: **Allocation of Allowances to Installation 4 during Commitment Period 1 (2008-12).**

Description: **Allocation for year 2009, within the National Registry XX, of 15,000 Allowances having 1 as both original and applicable commitment period, to operator holding account13, according to the National Allocation Plan that has been uploaded for Commitment Period 1.**

Pre-Requisites: **The NAP for CP1 has been uploaded and Operator Holding Account 10, 11 and 13 and their Installation 1, 2 and 4 has been created.**

There has been issued AAUs and Allowances to Party Holding Account 1

Expected Results:

Table 2-2

Account ID	1	10	11	13	Unit type/supp. Type
Type	100	120	120	120	
Installation		1	2	4	
Balance after	235000	0	0	0	1-0
	182500	21500	21000	15000	1-1
Transferred amount	-15000			15000	1-1

Response Code: **None**

Parameters

Transaction	ID	Type	Supp. Type
	XX0019	10	53

	Registry	Account type	Account ID
Transferring	XX	100	1
Acquiring	XX	120	13

Unit	Type	Supp. Type	CP
	1	1	1

2.13. Test cases – Retirement

Test case 13-1

Name: **Conversion of surrendered allowances into AAUs for retirement**

Description: **Conversion, within the National Registry XX, of 17500 Surrendered Allowances into AAUs having 1 as both original and applicable commitment period.**

Pre-Requisites: **The surrendering for Installation 1 and 2 have taken place**

Expected Results:

Table 2-3

Account ID	1	10	11	13	Unit type/supp. Type
Type	100	120	120	120	
Installation		1	2	4	
Balance after	217500 200000	0 21500	0 21000	0 15000	1-0 1-1
Transferred amount	-17500 17500			15000	1-1 1-0

Response Code: **None**

Parameters

Transaction	ID	Type	Supp. Type
	XX0020	10	61

	Registry	Account type	Account ID
Transferring	XX	100	1
Acquiring	XX	100	1

Unit	Type	Supp. Type	CP
	1	1	1

Test case 13-2

Name: **Retirement of surrendered allowances (2008-2012 onwards)**

Description: **Retirement, within the National Registry XX, of 17500 AAUs having 1 as both original and applicable commitment period equivalent to the surrendering for 2008**

Pre-Requisites: **The surrendering for Installation 1 and 2 have taken place and allowances equivalent to the surrendering has been converted into AAUs.**

Expected Results:

Account ID	1	10	11	4	Unit type/supp. Type
Type	100	120	120	300	
Installation		1	2		
Balance after	200000 200000	0 21500	0 21000	17500	1-0 1-1
Transferred amount	-17500			17500	1-0

Response **None**

Code:

Parameters

Transaction	ID	Type	Supp. Type
	XX0021	05	01

	Registry	Account type	Account ID
Transferring	XX	100	1
Acquiring	XX	300	4

Unit	Type	Supp. Type	CP
	1	0	1

Test case 13-3

Name: **Conversion of none allocated allowances into AAUs for retirement**

Description: **Conversion, within the National Registry XX, of 165000 Allowances into AAUs having 1 as both original and applicable commitment period.**

Pre-Requisites: **The surrendering for Installation 1 and 2 have taken place**

Expected Results:

Account ID	1	10	11	13	Unit type/supp. Type
Type	100	120	120	120	
Installation		1	2	4	
Balance after	400000 0	0 21500	0 21000	0 15000	1-0 1-1
Transferred amount	-200000 200000				1-1 1-0

Response Code: **None**

Parameters

Transaction	ID	Type	Supp. Type
	XX0022	10	62

	Registry	Account type	Account ID
Transferring	XX	100	1
Acquiring	XX	100	1

Unit	Type	Supp. Type	CP
	1	1	1

Test case 13-4

Name: **Retirement of unallocated allowances (2008-2012 onwards)**

Description: **Retirement, within the National Registry XX, of 150000 AAUs having 1 as both original and applicable commitment period equivalent to the surrendering for 2008**

Pre-Requisites: **The surrendering for Installation 1 and 2 have taken place and allowances equivalent to the surrendering has been converted into AAUs.**

Expected Results:

Account ID	1	10	11	4	Unit type/supp. Type
Type	100	120	120	300	
Installation		1	2		
Balance after	200000	0 21500	0 21000	217500	1-0 1-1
Transferred amount	-200000			200000	1-0

Response Code: **None**

Parameters

Transaction	ID	Type	Supp. Type
	XX0023	05	02

	Registry	Account type	Account ID
Transferring	XX	100	1
Acquiring	XX	300	4

Unit	Type	Supp. Type	CP
	1	0	1

Test case 13-5

Name: **Retirement AAUs (2008-2012 onwards)**

Description: **Retirement, within the National Registry XX, of 6000 AAUs having 1 as both original and applicable commitment period equivalent to the surrendering for 2008**

Pre-Requisites: **The AAUs has been issued to account type 100 and account type 300 has been created**

Expected Results:

Table 2-4

Account ID	1	10	11	4	Unit type/supp. Type
Type	100	120	120	300	
Installation		1	2		
Balance after	194000	0 21500	0 21000	223500	1-0 1-1
Transferred amount	-6000			6000	1-0

Response Code: **None**

Parameters

Transaction	ID	Type	Supp. Type

	XX0024	05	

	Registry	Account type	Account ID
Transferring	XX	100	1
Acquiring	XX	300	4

Unit	Type	Supp. Type	CP
	1	0	1

2.14. Test cases – Reconciliation

Test case 14-1

Name: **Reconciliation**

Description: **Reconciliation process tested in order to check that the registry and the CITL are consistent.**

Pre-Requisites: **The national registry of XX has been created and the scenario has been performed.**

Expected Results: **Account Holdings**

Account ID	Account Type	Holdings	Unit Type/ Supp Unit Type
1	100	194500	1-0
2	230	15000	1-1
3	300	223500	1-0
10	120	21500	1-1
11	120	21000	1-1
13	120	15000	1-1

Test case 14-2

Name: **Negative Reconciliation**

Description: **Reconciliation process tested in order to check that the registry is able to handle manual intervention**

Pre-Requisites: **The national registry of XX has been created and the scenario has been performed. In the database one unit block has been moved from Operator Account 10 to Operator Account 11**

Expected Results: **STL Inconsistent Unit Blocks**

Test case 14-3

Name: **Manual Intervention**

Description: **Reconciliation process tested in order to check that the registry is able to handle manual intervention. The Reconciliation has failed and the unit block has to be moved from Operator Account 11 to Operator Account 10**

Pre-Requisites: **The Reconciliation status is STL Inconsistent Unit Blocks.**

Expected Results: **Account Holdings**

Account ID	Account Type	Holdings	Unit Type/ Supp Unit Type
1	100	194500	1-0
2	230	15000	1-1
3	300	223500	1-0
10	120	21500	1-1
11	120	21000	1-1
13	120	15000	1-1

Test case 14-4

Name: **Reconciliation**

Description: **Reconciliation process tested in order to check that the registry and the CITL are consistent.**

Pre-Requisites: **The national registry of XX has been created and the scenario has been performed.**

Expected Results: **Account Holdings**

Account ID	Account Type	Holdings	Unit Type/ Supp Unit Type
1	100	194500	1-0
2	230	15000	1-1
3	300	223500	1-0
10	120	21500	1-1
11	120	21000	1-1
13	120	15000	1-1

2.15. Test cases – Replenishment

Test case 15-1

<table>
<tr><td>Name</td><td>Update NAP for CP1</td></tr>
<tr><td>Description</td><td>Upload of an amended National Allocation Plan from the National Registry of XX for Commitment Period 1 (2008-12) increasing the numbers of allowances.</td></tr>
<tr><td>Pre-condition</td><td>The national registry of XX has been created. The Database contains the data of the Party Holding Accounts, Operator Holding Accounts including their installations and 2 Personal Holding Accounts. The initial Nap for CP1 has been loaded and the assigned amount been set.</td></tr>
<tr><td>Expected result</td><td>The National Allocation Plan from the National Registry of XX for Commitment Period 1 has been loaded and has allocated the amount of 225,000 allowances to the reserve and
<table>
<tr><td>Inst.</td><td>2008</td><td>2009</td><td>2010</td><td>2011</td><td>2012</td></tr>
<tr><td>#1</td><td>10000</td><td>10000</td><td>10000</td><td>10000</td><td>10000</td></tr>
<tr><td>#2</td><td>15000</td><td>15000</td><td>15000</td><td>15000</td><td>15000</td></tr>
<tr><td>#4</td><td>0</td><td>15000</td><td>15000</td><td>15000</td><td>15000</td></tr>
</table>
The assigned amount for the national registry of XX is set to 500000 AAU’s and the CPR to 450000</td></tr>
<tr><td>Response code</td><td>None</td></tr>
<tr><td colspan="2">PARAMETRE</td></tr>
<tr><td>Originating Registry:</td><td>XX</td></tr>
<tr><td>Commitment Period:</td><td>1</td></tr>
<tr><td>Assigned amount</td><td>500000</td></tr>
<tr><td>CPR</td><td>450000</td></tr>
<tr><td>NAP Reserve</td><td>225000</td></tr>
<tr><td>Web service</td><td></td></tr>
<tr><td>Correlation ID</td><td>14</td></tr>
</table>

Test case 15-2

Name	Update NAP for CP1
Description	Upload of an amended National Allocation Plan from the National Registry of XX for Commitment Period 1 (2008-12) increasing the numbers of allowances to installation 1 and 2.
Pre-condition	The national registry of XX has been created. The Database contains the data of the Party Holding Accounts, Operator Holding Accounts including their installations and 2 Personal Holding Accounts. The initial Nap for CP1 has been loaded and the assigned amount been set.
Expected result	The National Allocation Plan from the National Registry of XX for Commitment Period 1 has been loaded and has allocated the amount of 140,000 allowances to the reserve and <table><tr><td>Inst.</td><td>2008</td><td>2009</td><td>2010</td><td>2011</td><td>2012</td></tr><tr><td>#1</td><td>10000</td><td>10000</td><td>30000</td><td>30000</td><td>15000</td></tr><tr><td>#2</td><td>15000</td><td>25000</td><td>25000</td><td>25000</td><td>25000</td></tr><tr><td>#4</td><td>0</td><td>15000</td><td>15000</td><td>15000</td><td>15000</td></tr></table> The assigned amount for the national registry of XX is set to 500000 AAU’s and the CPR to 450000
Response code	None
PARAMETRE	
Originating Registry:	XX
Commitment Period:	1
Assigned amount	500000
CPR	450000
NAP Reserve	140000
Web service	
Correlation ID	15

Test case 15-3

Name	Update NAP for CP1
Description	Upload of an amended National Allocation Plan from the National Registry of XX for Commitment Period 1 (2008-12) decreasing the numbers of allowances.
Pre-condition	The national registry of XX has been created. The Database contains the data of the Party Holding Accounts, Operator Holding Accounts including their installations and 2 Personal Holding Accounts. The initial Nap for CP1 has been loaded and the assigned amount been set.
Expected result	The National Allocation Plan from the National Registry of XX for Commitment Period 1 has been loaded and has allocated the amount of 125,000 allowances to the reserve and

Inst.	2008	2009	2010	2011	2012
#1	10000	10000	30000	30000	15000
#2	15000	25000	25000	25000	25000
#4	0	15000	15000	15000	15000

The assigned amount for the national registry of XX is set to 500000 AAU’s and the CPR to 450000

Response code	None
PARAMETRE	
Originating Registry:	XX
Commitment Period:	1
Assigned amount	500000
CPR	450000
NAP Reserve	125000
Web service	
Correlation ID	16

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R-2 List of discrepant transactions

R- 2 List of discrepant transactions

DES Response Code	Average number of occurences per transaction (X 100.000)		Transaction Number	Proposal Date	Transaction Type	Final State	Explanation	Units involved abbreviated		
	Reported Year	Prior to the Reported Year						Serial Number	Unit Type	Quantity
4003	994,48	0								
			AT12162	30.11.2009 13:23:24	internal transfer	terminated		AT-1543995578-1543998577	AAU	3000
								AT-1544019112-1544019218	AAU	107
								AT-1548813112-1548816111	AAU	3000
								AT-1548830112-1548832997	AAU	2886
								AT-1548886112-1548889111	AAU	3000
								AT-1549068128-1549071127	AAU	3000
								AT-1549149128-1549152127	AAU	3000
								AT-1549173263-1549176262	AAU	3000
								AT-1549790129-1549793023	AAU	2895
								AT-1549991735-1549994734	AAU	3000
								AT-1550064221-1550067231	AAU	3011
								AT-1550364426-1550367425	AAU	3000
								AT-1550382426-1550385425	AAU	3000
								AT-1550522411-1550525410	AAU	3000
								AT-1555170606-1555173605	AAU	3000
								AT-1557461985-1557464900	AAU	2916
								AT-1580289120-1580291304	AAU	2185
			AT12184	30.11.2009 14:32:33	external transfer	terminated		AT-1529132698-1529136201	AAU	3504
								AT-1529139929-1529142997	AAU	3069
								AT-1529154016-1529157015	AAU	3000
								AT-1530596281-1530599738	AAU	3458
								AT-1543995578-1543998577	AAU	3000
								AT-1544019112-1544019218	AAU	107
								AT-1544019219-1544022167	AAU	2949
								AT-1548813112-1548816111	AAU	3000
								AT-1548830112-1548832997	AAU	2886
								AT-1548832998-1548836111	AAU	3114
								AT-1548865759-1548869111	AAU	3353
								AT-1548886112-1548889111	AAU	3000
								AT-1548923112-1548929111	AAU	6000
								AT-1549022022-1549028021	AAU	6000
								AT-1549028022-1549033021	AAU	5000
								AT-1549068128-1549071127	AAU	3000
								AT-1549149128-1549152127	AAU	3000
								AT-1549173263-1549176262	AAU	3000

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DES Response Code	Average number of occurences per transaction (X 100.000)		Transaction Number	Proposal Date	Transaction Type	Final State	Explanation	Units involved abbreviated		
	Reported Year	Prior to the Reported Year						Serial Number	Unit Type	Quantity
4003	994,48	0								
								AT-1549296666-1549301665	AAU	5000
								AT-1549730083-1549735082	AAU	5000
								AT-1549790129-1549793023	AAU	2895
								AT-1549985735-1549991734	AAU	6000
								AT-1549991735-1549994734	AAU	3000
								AT-1550058221-1550064220	AAU	6000
								AT-1550064221-1550067231	AAU	3011
								AT-1550320789-1550324425	AAU	3637
								AT-1550336303-1550339576	AAU	3274
								AT-1550339577-1550343028	AAU	3452
								AT-1550345621-1550348833	AAU	3213
								AT-1550360426-1550363994	AAU	3569
								AT-1550364426-1550367425	AAU	3000
								AT-1550382426-1550385425	AAU	3000
								AT-1550389789-1550393425	AAU	3637
								AT-1550423278-1550429277	AAU	6000
								AT-1550522411-1550525410	AAU	3000
								AT-1554053494-1554056655	AAU	3162
								AT-1555162606-1555169605	AAU	7000
								AT-1555170606-1555173605	AAU	3000
								AT-1557458603-1557461984	AAU	3382
								AT-1557461985-1557464900	AAU	2916
								AT-1580289120-1580291304	AAU	2185
								AT-1585034206-1585040205	AAU	6000
			AT12185	30.11.2009 14:33:40	external transfer	terminated		BE-199763137-199768136	AAU	5000
								BE-208092589-208099242	AAU	6654
								BE-208452553-208455048	AAU	2496
								BE-212497625-212500231	AAU	2607
								BE-214577712-214581711	AAU	4000
								BE-216467667-216470831	AAU	3165
								BE-216472585-216477666	AAU	5082
								BE-218441929-218444928	AAU	3000
								BE-218444929-218451910	AAU	6982
								BE-218484948-218488928	AAU	3981
								BE-218490963-218491390	AAU	428
								BE-233467837-233472645	AAU	4809
								BE-233499826-233504664	AAU	4839
								BE-240861295-240868079	AAU	6785

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DES Response Code	Average number of occurences per transaction (X 100.000)		Transaction Number	Proposal Date	Transaction Type	Final State	Explanation	Units involved abbreviated		
	Reported Year	Prior to the Reported Year						Serial Number	Unit Type	Quantity
4003	994,48	0								
								BE-242146071-242153091	AAU	7021
								BE-244563878-244567799	AAU	3922
								BE-245230696-245235919	AAU	5224
								BE-245241365-245245630	AAU	4266
								BE-246953883-246956850	AAU	2968
								BE-247767069-247772158	AAU	5090
								BE-250985312-250987238	AAU	1927
								BE-250987239-250989426	AAU	2188
								BE-250996166-250997238	AAU	1073
								BE-250997239-251001238	AAU	4000
								BE-251001239-251006548	AAU	5310
								BE-253891402-253893488	AAU	2087
								BE-375291067-375293613	AAU	2547
								BE-380349372-380354017	AAU	4646
								BE-385353417-385355416	AAU	2000
								BE-388366591-388370000	AAU	3410
								BE-390664708-390666408	AAU	1701
								BE-391313329-391315665	AAU	2337
								BE-391318211-391322910	AAU	4700
								BE-391350522-391353351	AAU	2830
								BE-391353352-391356530	AAU	3179
								BE-391565275-391565679	AAU	405
								BE-391592628-391593603	AAU	976
								BE-391604562-391605367	AAU	806
								BE-393277419-393280108	AAU	2690
								BE-393302927-393305641	AAU	2715
								BE-393309051-393309432	AAU	382
								BE-413958035-413961895	AAU	3861
								BE-414094664-414097934	AAU	3271
			AT12187	30.11.2009 14:36:06	external transfer	terminated		CZ-1189955886-1189964099	AAU	8214
								CZ-1273682038-1273685037	AAU	3000
								CZ-1291681259-1291684258	AAU	3000
								CZ-1303731586-1303732201	AAU	616
								CZ-1306862926-1306865925	AAU	3000
								CZ-1306880119-1306880554	AAU	436
								CZ-1331598733-1331603732	AAU	5000
								CZ-1359626569-1359627084	AAU	516
			AT12249	01.12.2009 10:19:50	internal transfer	terminated		DE-1545999454-1545999569	AAU	116

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DES Response Code	Average number of occurences per transaction (X 100.000)		Transaction Number	Proposal Date	Transaction Type	Final State	Explanation	Units involved abbreviated		
	Reported Year	Prior to the Reported Year						Serial Number	Unit Type	Quantity
4003	994,48	0								
								DE-1553713494-1553713689	AAU	196
								DE-1554759705-1554759835	AAU	131
								DE-1697706960-1697711959	AAU	5000
								DE-1698314206-1698317658	AAU	3453
								DE-1698411371-1698416005	AAU	4635
								DE-1708394043-1708394954	AAU	912
								DE-1874300630-1874311797	AAU	11168
								DE-2020140086-2020141085	AAU	1000
								DE-2039740038-2039740511	AAU	474
								DE-2039740512-2039740832	AAU	321
								DE-2079635992-2079636297	AAU	306
								DE-2079654286-2079654605	AAU	320
								DE-2080454536-2080460804	AAU	6269
								DE-2091040299-2091040423	AAU	125
								DE-2091066171-2091066280	AAU	110
								DE-2091152934-2091153582	AAU	649
								DE-2091155583-2091156582	AAU	1000
								DE-2092008453-2092008803	AAU	351
								DE-2092008804-2092008932	AAU	129
								DE-2150026152-2150026751	AAU	600
								DE-2194803636-2194804509	AAU	874
								DE-3560355387-3560355468	AAU	82
								DE-3566046619-3566046657	AAU	39
								DE-3568273713-3568273952	AAU	240
								DE-3602485792-3602493791	AAU	8000
								DE-3602941031-3602944530	AAU	3500
			AT12304	01.12.2009 12:15:17	external transfer	terminated		BE-228929670-228960167	AAU	30498
								BE-251122881-251122890	AAU	10
								BE-372762539-372764538	AAU	2000
								BE-391340457-391341576	AAU	1120
								BE-391345364-391345856	AAU	493
								BE-391345857-391345858	AAU	2
								BE-391348531-391350521	AAU	1991
								BE-391554015-391554124	AAU	110
								BE-391554562-391555096	AAU	535
								BE-391555097-391555336	AAU	240
								BE-391555337-391555477	AAU	141
								BE-391557562-391557920	AAU	359

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DES Response Code	Average number of occurences per transaction (X 100.000)		Transaction Number	Proposal Date	Transaction Type	Final State	Explanation	Units involved abbreviated		
	Reported Year	Prior to the Reported Year						Serial Number	Unit Type	Quantity
4003	994,48	0								
								BE-393269940-393270750	AAU	811
								BE-393406693-393406816	AAU	124
								BE-393406817-393407063	AAU	247
								BE-403614426-403616425	AAU	2000
			AT12334	01.12.2009 13:54:12	external transfer	terminated		KR-39436705-39438420	CER	1716
			AT12347	01.12.2009 14:27:57	external transfer	terminated		GB-3504765460-3504766005	AAU	546
								GB-3530619307-3530620003	AAU	697
								GB-3549146570-3549146652	AAU	83
								GB-3549156818-3549156843	AAU	26
								GB-3549177474-3549177933	AAU	460
								GB-3556743487-3556744105	AAU	619
								GB-3558058956-3558059154	AAU	199
								GB-3559569424-3559569594	AAU	171
								GB-3567092643-3567092865	AAU	223
								GB-3683008366-3683008418	AAU	53
								GB-3701056483-3701056531	AAU	49
								GB-3702124270-3702124768	AAU	499
								GB-3702182848-3702183021	AAU	174
								GB-3702244152-3702244368	AAU	217
								GB-3702461321-3702461555	AAU	235
								GB-3702550983-3702551368	AAU	386
								GB-3703898148-3703898390	AAU	243
								GB-3703899751-3703899960	AAU	210
								GB-3703903083-3703903691	AAU	609
								GB-3703903773-3703903960	AAU	188
								GB-3703954686-3703954768	AAU	83
								GB-3704151534-3704151711	AAU	178
								GB-3704152102-3704152118	AAU	17
								GB-3704428004-3704428554	AAU	551
								GB-3712706786-3712706898	AAU	113
								GB-3759717125-3759717657	AAU	533

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DES Response Code	Average number of occurences per transaction (X 100.000)		Transaction Number	Proposal Date	Transaction Type	Final State	Explanation	Units involved abbreviated		
	Reported Year	Prior to the Reported Year						Serial Number	Unit Type	Quantity
4003	994,48	0								
								GB-3765896066-3765896563	AAU	498
								GB-3770977393-3770977551	AAU	159
								GB-3771576294-3771576471	AAU	178
								GB-3771586472-3771587171	AAU	700
								GB-3774394232-3774394783	AAU	552
								GB-3774594460-3774594517	AAU	58
								GB-3774610717-3774610815	AAU	99
								GB-3774959449-3774959699	AAU	251
								GB-3775030700-3775030742	AAU	43
								GB-3777698627-3777698726	AAU	100
								GB-3793719523-3793719616	AAU	94
								GB-3833785504-3833785961	AAU	458
								GB-3834822228-3834822901	AAU	674
								GB-3835054039-3835054363	AAU	325
								GB-3901463620-3901464116	AAU	497
								GB-3901493620-3901494304	AAU	685
								GB-3917532240-3917532277	AAU	38
								GB-3984215140-3984215266	AAU	127
								GB-3987695091-3987695189	AAU	99
								GB-3989939491-3989939529	AAU	39
								GB-3994374971-3994375166	AAU	196
								GB-3994873969-3994874529	AAU	561
								GB-3995810767-3995811381	AAU	615
								GB-3995930538-3995930776	AAU	239
								GB-4000359253-4000359754	AAU	502
								GB-4003846033-4003846278	AAU	246
								GB-4003878605-4003878751	AAU	147
			AT12350	01.12.2009 14:29:18	external transfer	terminated		AT-1535329519-1535329886	AAU	368
								AT-1548733018-1548733617	AAU	600
								AT-1548804644-1548805111	AAU	468

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DES Response Code	Average number of occurences per transaction (X 100.000)		Transaction Number	Proposal Date	Transaction Type	Final State	Explanation	Units involved abbreviated		
	Reported Year	Prior to the Reported Year						Serial Number	Unit Type	Quantity
4003	994,48	0								
								AT-1549207622-1549207955	AAU	334
								AT-1549772762-1549773128	AAU	367
								AT-1549921225-1549921552	AAU	328
								AT-1549921553-1549921930	AAU	378
								AT-1549930903-1549930916	AAU	14
								AT-1550078781-1550078980	AAU	200
								AT-1550082427-1550082847	AAU	421
								AT-1550285173-1550285228	AAU	56
								AT-1550348834-1550349028	AAU	195
								AT-1550358967-1550359616	AAU	650
								AT-1550749182-1550749624	AAU	443
								AT-1553243423-1553243648	AAU	226
								AT-1553520430-1553520850	AAU	421
								AT-1554500674-1554501129	AAU	456
								AT-1554938961-1554939346	AAU	386
								AT-1554983521-1554983643	AAU	123
								AT-1555290617-1555290631	AAU	15
								AT-1555337493-1555337816	AAU	324
								AT-1555369155-1555369559	AAU	405
								AT-1557550861-1557551342	AAU	482
								AT-1559751454-1559751858	AAU	405
								AT-1573216252-1573216735	AAU	484
								AT-1574463865-1574464183	AAU	319
								AT-1583304574-1583304949	AAU	376
			AT12351	01.12.2009 14:30:12	external transaction	terminated		BE-212014027-212014117	AAU	91
								BE-219609965-219610225	AAU	261
								BE-219637147-219637586	AAU	440
								BE-219647223-219647586	AAU	364
								BE-219673855-219673910	AAU	56
								BE-233519787-233519926	AAU	140
								BE-251208295-251208670	AAU	376
								BE-251324643-251325266	AAU	624
								BE-380267733-380267760	AAU	28
			AT12352	01.12.2009 14:31:00	external transfer	terminated		CZ-1202658019-1202658019	AAU	1
								CZ-1263961403-1263961767	AAU	365
								CZ-1263968002-1263968233	AAU	232
								CZ-1264794634-1264794746	AAU	113
								CZ-1264795027-1264795426	AAU	400

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DES Response Code	Average number of occurences per transaction (X 100.000)		Transaction Number	Proposal Date	Transaction Type	Final State	Explanation	Units involved abbreviated		
	Reported Year	Prior to the Reported Year						Serial Number	Unit Type	Quantity
4003	994,48	0								
								CZ-1279302851-1279303017	AAU	167
								CZ-1279311027-1279311044	AAU	18
								CZ-1279341492-1279341898	AAU	407
								CZ-1288307939-1288307939	AAU	1
								CZ-1288676973-1288677142	AAU	170
								CZ-1291531713-1291532013	AAU	301
								CZ-1291533014-1291533631	AAU	618
								CZ-1291536818-1291536843	AAU	26
								CZ-1291567444-1291567547	AAU	104
								CZ-1291610061-1291610330	AAU	270
								CZ-1291756450-1291756738	AAU	289
								CZ-1292039975-1292040173	AAU	199
								CZ-1292046780-1292046882	AAU	103
								CZ-1292049543-1292049917	AAU	375
								CZ-1292052543-1292052545	AAU	3
								CZ-1292053590-1292053748	AAU	159
								CZ-1292060742-1292060954	AAU	213
								CZ-1295078707-1295078986	AAU	280
								CZ-1303783314-1303783512	AAU	199
								CZ-1303787670-1303788005	AAU	336
								CZ-1303849093-1303849271	AAU	179
								CZ-1303866452-1303866561	AAU	110
								CZ-1303894804-1303894950	AAU	147
								CZ-1303896368-1303896768	AAU	401
								CZ-1303899825-1303900082	AAU	258
								CZ-1303909568-1303909950	AAU	383
								CZ-1303914897-1303915089	AAU	193
								CZ-1304788731-1304788742	AAU	12
								CZ-1304818731-1304819167	AAU	437
								CZ-1306489853-1306490176	AAU	324
								CZ-1309842746-1309843031	AAU	286
								CZ-1310016201-1310016507	AAU	307
								CZ-1310030690-1310030702	AAU	13
								CZ-1310281334-1310281415	AAU	82
								CZ-1314826023-1314826363	AAU	341
								CZ-1315424274-1315424305	AAU	32
								CZ-1315424933-1315425390	AAU	458
								CZ-1315728140-1315728150	AAU	11
								CZ-1315729013-1315729265	AAU	253

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DES Response Code	Average number of occurences per transaction (X 100.000)		Transaction Number	Proposal Date	Transaction Type	Final State	Explanation	Units involved abbreviated		
	Reported Year	Prior to the Reported Year						Serial Number	Unit Type	Quantity
4003	994,48	0								
								CZ-1316579760-1316579878	AAU	119
								CZ-1316649423-1316649560	AAU	138
								CZ-1316760019-1316760636	AAU	618
								CZ-1316760800-1316761222	AAU	423
								CZ-1316775931-1316775940	AAU	10
								CZ-1317042334-1317042736	AAU	403
								CZ-1317474299-1317474335	AAU	37
								CZ-1318064130-1318064174	AAU	45
								CZ-1318190941-1318191321	AAU	381
								CZ-1318224180-1318224687	AAU	508
								CZ-1318238865-1318239170	AAU	306
								CZ-1318280165-1318280592	AAU	428
								CZ-1318336202-1318336326	AAU	125
								CZ-1320556263-1320556522	AAU	260
								CZ-1320571294-1320571679	AAU	386
								CZ-1325731541-1325731716	AAU	176
								CZ-1325787909-1325788051	AAU	143
								CZ-1325790556-1325790745	AAU	190
								CZ-1330340551-1330340695	AAU	145
								CZ-1331641672-1331642124	AAU	453
								CZ-1331661242-1331661552	AAU	311
								CZ-1331664059-1331664080	AAU	22
								CZ-1331666233-1331666744	AAU	512
								CZ-1331899696-1331899732	AAU	37
								CZ-1332220599-1332220805	AAU	207
								CZ-1332280818-1332281071	AAU	254
								CZ-1332283358-1332283378	AAU	21
								CZ-1341767729-1341768134	AAU	406
			AT12354	01.12.2009 14:33:01	external transfer	terminated		DK-1707913056-1707913140	AAU	85
								DK-1708319204-1708319703	AAU	500
								DK-1708465659-1708465986	AAU	328
								DK-1709292441-1709292812	AAU	372
								DK-1709430790-1709431490	AAU	701
								DK-1709481575-1709481924	AAU	350
								DK-1709481925-1709482175	AAU	251
								DK-1709514602-1709515062	AAU	461
								DK-1709629759-1709630177	AAU	419
								DK-1709657950-1709658293	AAU	344

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DES Response Code	Average number of occurences per transaction (X 100.000)		Transaction Number	Proposal Date	Transaction Type	Final State	Explanation	Units involved abbreviated		
	Reported Year	Prior to the Reported Year						Serial Number	Unit Type	Quantity
4003	994,48	0								
								DK-1709768481-1709768507	AAU	27
								DK-1709771762-1709772179	AAU	418
								DK-1709900491-1709900497	AAU	7
								DK-1709911984-1709912435	AAU	452
								DK-1709912436-1709912983	AAU	548
								DK-1709916984-1709917472	AAU	489
								DK-1712949585-1712949979	AAU	395
			AT12355	01.12.2009 14:34:05	externer transfer	terminated		ES-1689982776-1689983157	AAU	382
								ES-1694358695-1694359194	AAU	500
								ES-1695444767-1695445128	AAU	362
								ES-1695571117-1695571440	AAU	324
								ES-1695587213-1695587680	AAU	468
								ES-1695587681-1695588100	AAU	420
								ES-1695590213-1695590556	AAU	344
								ES-1696059699-1696060198	AAU	500
								ES-1696288995-1696289335	AAU	341
								ES-1697771534-1697771869	AAU	336
								ES-1698221729-1698222106	AAU	378
								ES-1698249664-1698250005	AAU	342
								ES-1698323303-1698323721	AAU	419
								ES-1698902221-1698902552	AAU	332
								ES-1698920343-1698920800	AAU	458
								ES-1700371541-1700371975	AAU	435
								ES-1709688939-1709689265	AAU	327
								ES-1709776931-1709777314	AAU	384
								ES-1709883160-1709883644	AAU	485
								ES-1709995566-1709995918	AAU	353
								ES-1710132640-1710132747	AAU	108
								ES-1710174768-1710175145	AAU	378
								ES-1710269678-1710269744	AAU	67
								ES-1710325414-1710325767	AAU	354
								ES-1710325768-1710325822	AAU	55
								ES-1710374117-1710374265	AAU	149
								ES-1710381106-1710381140	AAU	35
								ES-1710381535-1710381963	AAU	429
								ES-1718728587-1718729086	AAU	500
								ES-1718920084-1718920434	AAU	351
								ES-1718920435-1718920508	AAU	74

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DES Response Code	Average number of occurences per transaction (X 100.000)		Transaction Number	Proposal Date	Transaction Type	Final State	Explanation	Units involved abbreviated		
	Reported Year	Prior to the Reported Year						Serial Number	Unit Type	Quantity
4003	994,48	0								
								ES-1718957832-1718958008	AAU	177
								ES-1718958442-1718958445	AAU	4
								ES-1718975388-1718975405	AAU	18
								ES-1719008463-1719008508	AAU	46
								ES-1719058475-1719058555	AAU	81
								ES-1719059040-1719059474	AAU	435
								ES-1719087661-1719087663	AAU	3
								ES-1719116976-1719117011	AAU	36
								ES-1719472556-1719472630	AAU	75
								ES-1719653851-1719654508	AAU	658
								ES-1726735427-1726735507	AAU	81
								ES-1726904507-1726904825	AAU	319
								ES-1753036459-1753036914	AAU	456
								ES-1753044644-1753044711	AAU	68
								ES-1753073012-1753073023	AAU	12
								ES-1753150613-1753150724	AAU	112
								ES-1753310725-1753310859	AAU	135
								ES-1753310860-1753311104	AAU	245
								ES-1766514376-1766514989	AAU	614
								ES-1766567729-1766567770	AAU	42
								ES-1766655472-1766655573	AAU	102
								ES-1766730508-1766730713	AAU	206
								ES-1766852939-1766853089	AAU	151
								ES-1767038707-1767039005	AAU	299
								ES-1767299368-1767299391	AAU	24
								ES-1767315373-1767315572	AAU	200
								ES-1767318479-1767318610	AAU	132
								ES-1767320897-1767321135	AAU	239
								ES-1767321136-1767321186	AAU	51
								ES-1768120700-1768121139	AAU	440
								ES-1768133083-1768133428	AAU	346
								ES-1768137839-1768138082	AAU	244
								ES-1768158835-1768159082	AAU	248
								ES-1769901947-1769902518	AAU	572
								ES-1769904191-1769904224	AAU	34
								ES-1769906354-1769906708	AAU	355
								ES-1774138588-1774138707	AAU	120
								ES-1774233885-1774234117	AAU	233
								ES-1774336875-1774336922	AAU	48

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DES Response Code	Average number of occurences per transaction (X 100.000)		Transaction Number	Proposal Date	Transaction Type	Final State	Explanation	Units involved abbreviated		
	Reported Year	Prior to the Reported Year						Serial Number	Unit Type	Quantity
4003	994,48	0								
								ES-1774345401-1774345682	AAU	282
								ES-1774371664-1774371943	AAU	280
								ES-1776581366-1776581817	AAU	452
								ES-1776582514-1776582704	AAU	191
								ES-1777317659-1777318022	AAU	364
								ES-1778310879-1778310997	AAU	119
								ES-1778310998-1778311050	AAU	53
								ES-1778313456-1778313467	AAU	12
								ES-1778326381-1778326694	AAU	314
								ES-1778328458-1778328611	AAU	154
								ES-1778328612-1778328769	AAU	158
								ES-1778331040-1778331157	AAU	118
								ES-1778389420-1778389652	AAU	233
								ES-1778704523-1778704539	AAU	17
								ES-1779968501-1779969121	AAU	621
								ES-1779969122-1779969730	AAU	609
								ES-1779987654-1779987757	AAU	104
								ES-1781797675-1781797842	AAU	168
								ES-1781812924-1781813272	AAU	349
								ES-1781824583-1781824604	AAU	22
								ES-1781824605-1781825103	AAU	499
								ES-1783275737-1783276321	AAU	585
								ES-1789574363-1789574541	AAU	179
								ES-1789977090-1789977165	AAU	76
								ES-1791387801-1791389900	AAU	2100
								ES-1791748060-1791748194	AAU	135
								ES-1792113379-1792113673	AAU	295
								ES-1794957628-1794957896	AAU	269
								ES-1795331402-1795331714	AAU	313
								ES-1812746927-1812746929	AAU	3
								ES-1813797738-1813798077	AAU	340
								ES-1818956454-1818956864	AAU	411
								ES-1818963732-1818964150	AAU	419
								ES-1819119531-1819119746	AAU	216
								ES-1819150394-1819150483	AAU	90
								ES-1819161477-1819161504	AAU	28
								ES-1819168211-1819168476	AAU	266
								ES-1819192812-1819193233	AAU	422
								ES-1819416156-1819416754	AAU	599

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DES Response Code	Average number of occurences per transaction (X 100.000)		Transaction Number	Proposal Date	Transaction Type	Final State	Explanation	Units involved abbreviated		
	Reported Year	Prior to the Reported Year						Serial Number	Unit Type	Quantity
4003	994,48	0								
								ES-1819427082-1819427256	AAU	175
								ES-1820105480-1820105950	AAU	471
								ES-1820109951-1820110090	AAU	140
								ES-1820901248-1820901539	AAU	292
								ES-1824167535-1824167695	AAU	161
								ES-1824167696-1824167788	AAU	93
								ES-1824167789-1824167963	AAU	175
								ES-1827902788-1827902919	AAU	132
								ES-1828135221-1828135349	AAU	129
								ES-1828135717-1828135872	AAU	156
								ES-1829277103-1829277400	AAU	298
								ES-1829413623-1829413691	AAU	69
								ES-1829414533-1829414802	AAU	270
								ES-1829421564-1829421565	AAU	2
								ES-1829426369-1829426502	AAU	134
								ES-1829426503-1829426666	AAU	164
								ES-1829430575-1829430667	AAU	93
								ES-1829431760-1829431860	AAU	101
								ES-1829438075-1829438173	AAU	99
								ES-1829460624-1829460804	AAU	181
								ES-1829463877-1829463898	AAU	22
								ES-1829465200-1829465414	AAU	215
								ES-1829615369-1829615651	AAU	283
								ES-1829781632-1829782016	AAU	385
								ES-1829783369-1829783585	AAU	217
								ES-1829823154-1829823368	AAU	215
								ES-1829939896-1829940368	AAU	473
								ES-1830211626-1830211758	AAU	133
								ES-1830230924-1830230999	AAU	76
								ES-1831112429-1831112676	AAU	248
								ES-1831112677-1831112781	AAU	105
								ES-1831121299-1831121385	AAU	87
								ES-1831125267-1831125385	AAU	119
								ES-1831132089-1831132385	AAU	297
								ES-1831135055-1831135082	AAU	28
								ES-1832546153-1832546515	AAU	363
								ES-1834560719-1834560958	AAU	240
								ES-1835647763-1835648209	AAU	447
								ES-1835936424-1835937087	AAU	664

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DES Response Code	Average number of occurences per transaction (X 100.000)		Transaction Number	Proposal Date	Transaction Type	Final State	Explanation	Units involved abbreviated		
	Reported Year	Prior to the Reported Year						Serial Number	Unit Type	Quantity
4003	994,48	0								
								ES-1837047782-1837047796	AAU	15
								ES-1837450098-1837450611	AAU	514
								ES-1839831012-1839831033	AAU	22
								ES-1840652137-1840652183	AAU	47
								ES-1840662137-1840662183	AAU	47
								ES-1840680137-1840680315	AAU	179
								ES-1840713123-1840713142	AAU	20
								ES-1840715049-1840715682	AAU	634
								ES-1840719402-1840719576	AAU	175
								ES-1841001966-1841002371	AAU	406
								ES-1841013966-1841014190	AAU	225
								ES-1845048301-1845048503	AAU	203
								ES-1846807814-1846808425	AAU	612
								ES-1846808426-1846809037	AAU	612
								ES-1849488943-1849489023	AAU	81
								ES-1849905283-1849905532	AAU	250
								ES-1850420314-1850420499	AAU	186
								ES-1850420500-1850420590	AAU	91
								ES-1853109466-1853109533	AAU	68
								ES-1860729901-1860730446	AAU	546
								ES-1860811491-1860811590	AAU	100
								ES-1861195121-1861195146	AAU	26
								ES-1861201882-1861202146	AAU	265
								ES-1861222247-1861222946	AAU	700
								ES-1861345954-1861346179	AAU	226
								ES-1861357132-1861357190	AAU	59
								ES-1861507456-1861507682	AAU	227
								ES-1861507683-1861508293	AAU	611
								ES-1908412593-1908412847	AAU	255
								ES-1908476784-1908477219	AAU	436
								ES-1931865916-1931866181	AAU	266
								ES-1938654656-1938655078	AAU	423
								ES-1938655079-1938655387	AAU	309
								ES-1946669237-1946669651	AAU	415
								ES-1964049643-1964050139	AAU	497
								ES-1967313027-1967313080	AAU	54
								ES-1971772437-1971772831	AAU	395
								ES-1974480705-1974480742	AAU	38
			AT12357	01.12.2009	external transac-	terminated		SK-272690502-272690583	AAU	82

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DES Response Code	Average number of occurences per transaction (X 100.000)		Transaction Number	Proposal Date	Transaction Type	Final State	Explanation	Units involved abbreviated		
	Reported Year	Prior to the Reported Year						Serial Number	Unit Type	Quantity
4003	994,48	0								
					tion					
								SK-272692640-272693279	AAU	640
								SK-276782282-276782510	AAU	229
								SK-280766502-280766647	AAU	146
								SK-400089880-400090171	AAU	292
								SK-400105995-400106487	AAU	493
								SK-404905950-404906444	AAU	495
								SK-405335226-405335832	AAU	607
								SK-409121974-409122570	AAU	597
								SK-420882673-420882838	AAU	166
								SK-421319798-421319818	AAU	21
								SK-421319840-421320123	AAU	284
								SK-421358559-421359215	AAU	657
								SK-421366218-421366512	AAU	295
								SK-421366801-421366806	AAU	6
								SK-421410444-421410672	AAU	229
								SK-421413135-421413205	AAU	71
								SK-421437660-421437894	AAU	235
								SK-421470725-421470831	AAU	107
								SK-421473832-421473896	AAU	65
								SK-421552673-421552778	AAU	106
								SK-421657673-421657949	AAU	277
								SK-421724834-421724947	AAU	114
								SK-423770542-423771048	AAU	507
								SK-423824836-423824934	AAU	99
								SK-424605448-424605485	AAU	38
								SK-428719999-428720357	AAU	359
								SK-428806132-428806417	AAU	286
								SK-432385577-432385776	AAU	200
								SK-432485668-432485728	AAU	61
								SK-432509001-432509144	AAU	144
								SK-432541245-432541910	AAU	666
								SK-433682320-433682931	AAU	612
								SK-447346936-447347345	AAU	410
								SK-447759229-447759897	AAU	669
								SK-447760035-447760537	AAU	503
								SK-447969236-447969315	AAU	80
								SK-449265100-449265618	AAU	519
								SK-449383182-449383558	AAU	377

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DES Response Code	Average number of occurences per transaction (X 100.000)		Transaction Number	Proposal Date	Transaction Type	Final State	Explanation	Units involved abbreviated		
	Reported Year	Prior to the Reported Year						Serial Number	Unit Type	Quantity
4003	994,48	0								
								SK-449883396-449883921	AAU	526
								SK-450028716-450029062	AAU	347
								SK-451482418-451482901	AAU	484
								SK-451824350-451825039	AAU	690
			AT12359	01.12.2009 14:38:10	external transfer	terminated		FI-482216409-482216765	AAU	357
								FI-508243559-508244058	AAU	500
								FI-508953518-508953602	AAU	85
								FI-508996603-508996757	AAU	155
								FI-509276721-509310119	AAU	33399
								FI-515039181-515039837	AAU	657
			AT12430	01.12.2009 16:17:19	external transfer	terminated		NL-3220485931-3220605930	AAU	1E+05
			AT12726	15.12.2009 14:16:04	external transfer	terminated		PL-3217115423-3217139422	AAU	24000
			AT12727	15.12.2009 14:17:58	external transfer	terminated		RO-2532719563-2532730562	AAU	11000
			AT12728	15.12.2009 14:18:30	external transfer	terminated		IT-3041232541-3041238540	AAU	6000
			AT12789	16.12.2009 13:58:14	external transfer	terminated		PL-3216778423-3216779422	AAU	1000
								PL-3216821423-3216822422	AAU	1000
								PL-3216822423-3216828422	AAU	6000
								PL-3216828423-3216829422	AAU	1000
								PL-3216861423-3216869422	AAU	8000
								PL-3216869423-3216872422	AAU	3000
								PL-3216872423-3216878422	AAU	6000
								PL-3223463915-3223473914	AAU	10000
								PL-3223493915-3223498914	AAU	5000
			AT12790	16.12.2009 14:00:33	external transfer	terminated		ES-1947691432-1947695347	AAU	3916
								ES-1951568303-1951569386	AAU	1084
			AT12791	16.12.2009 14:24:59	external transfer	terminated		RO-2532463264-2532464562	AAU	1299
								RO-2532464563-2532465562	AAU	1000
								RO-2532465563-2532467562	AAU	2000
								RO-2532510862-2532512562	AAU	1701
								RO-2532699563-2532704562	AAU	5000
			AT12793	16.12.2009 14:27:18	external transfer	terminated		SE-420897692-420899691	AAU	2000
			AT12800	17.12.2009 09:36:03	external transfer	terminated		SE-420897692-420899691	AAU	2000
			AT12801	17.12.2009 09:36:43	external transfer	terminated		SE-420897692-420899691	AAU	2000
			AT12802	17.12.2009 09:37:47	external transfer	terminated		ES-1947691432-1947695347	AAU	3916

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DES Response Code	Average number of occurences per transaction (X 100.000)		Transaction Number	Proposal Date	Transaction Type	Final State	Explanation	Units involved abbreviated		
	Reported Year	Prior to the Reported Year						Serial Number	Unit Type	Quantity
4003	994,48	0								
4010	994,48	0						ES-1951568303-1951569386	AAU	1084
			AT12805	17.12.2009 09:48:00	external transfer	terminated		SE-420897692-420899691	AAU	2000
			AT12162	30.11.2009 13:23:24	internal transfer	terminated		AT-1543995578-1543998577	AAU	3000
								AT-1544019112-1544019218	AAU	107
								AT-1548813112-1548816111	AAU	3000
								AT-1548830112-1548832997	AAU	2886
								AT-1548886112-1548889111	AAU	3000
								AT-1549068128-1549071127	AAU	3000
								AT-1549149128-1549152127	AAU	3000
								AT-1549173263-1549176262	AAU	3000
								AT-1549790129-1549793023	AAU	2895
								AT-1549991735-1549994734	AAU	3000
								AT-1550064221-1550067231	AAU	3011
								AT-1550364426-1550367425	AAU	3000
								AT-1550382426-1550385425	AAU	3000
								AT-1550522411-1550525410	AAU	3000
								AT-1555170606-1555173605	AAU	3000
								AT-1557461985-1557464900	AAU	2916
								AT-1580289120-1580291304	AAU	2185
			AT12184	30.11.2009 14:32:33	external transfer	terminated		AT-1529132698-1529136201	AAU	3504
								AT-1529139929-1529142997	AAU	3069
								AT-1529154016-1529157015	AAU	3000
								AT-1530596281-1530599738	AAU	3458
								AT-1543995578-1543998577	AAU	3000
								AT-1544019112-1544019218	AAU	107
								AT-1544019219-1544022167	AAU	2949
								AT-1548813112-1548816111	AAU	3000
								AT-1548830112-1548832997	AAU	2886
								AT-1548832998-1548836111	AAU	3114
								AT-1548865759-1548869111	AAU	3353
								AT-1548886112-1548889111	AAU	3000
								AT-1548923112-1548929111	AAU	6000
								AT-1549022022-1549028021	AAU	6000
								AT-1549028022-1549033021	AAU	5000
								AT-1549068128-1549071127	AAU	3000
								AT-1549149128-1549152127	AAU	3000
								AT-1549173263-1549176262	AAU	3000

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DES Response Code	Average number of occurences per transaction (X 100.000)		Transaction Number	Proposal Date	Transaction Type	Final State	Explanation	Units involved abbreviated		
	Reported Year	Prior to the Reported Year						Serial Number	Unit Type	Quantity
4003	994,48	0								
								AT-1549296666-1549301665	AAU	5000
								AT-1549730083-1549735082	AAU	5000
								AT-1549790129-1549793023	AAU	2895
								AT-1549985735-1549991734	AAU	6000
								AT-1549991735-1549994734	AAU	3000
								AT-1550058221-1550064220	AAU	6000
								AT-1550064221-1550067231	AAU	3011
								AT-1550320789-1550324425	AAU	3637
								AT-1550336303-1550339576	AAU	3274
								AT-1550339577-1550343028	AAU	3452
								AT-1550345621-1550348833	AAU	3213
								AT-1550360426-1550363994	AAU	3569
								AT-1550364426-1550367425	AAU	3000
								AT-1550382426-1550385425	AAU	3000
								AT-1550389789-1550393425	AAU	3637
								AT-1550423278-1550429277	AAU	6000
								AT-1550522411-1550525410	AAU	3000
								AT-1554053494-1554056655	AAU	3162
								AT-1555162606-1555169605	AAU	7000
								AT-1555170606-1555173605	AAU	3000
								AT-1557458603-1557461984	AAU	3382
								AT-1557461985-1557464900	AAU	2916
								AT-1580289120-1580291304	AAU	2185
								AT-1585034206-1585040205	AAU	6000
			AT12185	30.11.2009 14:33:40	external transfer	terminated		BE-199763137-199768136	AAU	5000
								BE-208092589-208099242	AAU	6654
								BE-208452553-208455048	AAU	2496
								BE-212497625-212500231	AAU	2607
								BE-214577712-214581711	AAU	4000
								BE-216467667-216470831	AAU	3165
								BE-216472585-216477666	AAU	5082
								BE-218441929-218444928	AAU	3000
								BE-218444929-218451910	AAU	6982
								BE-218484948-218488928	AAU	3981
								BE-218490963-218491390	AAU	428
								BE-233467837-233472645	AAU	4809
								BE-233499826-233504664	AAU	4839
								BE-240861295-240868079	AAU	6785

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DES Response Code	Average number of occurences per transaction (X 100.000)		Transaction Number	Proposal Date	Transaction Type	Final State	Explanation	Units involved abbreviated		
	Reported Year	Prior to the Reported Year						Serial Number	Unit Type	Quantity
4003	994,48	0								
								BE-242146071-242153091	AAU	7021
								BE-244563878-244567799	AAU	3922
								BE-245230696-245235919	AAU	5224
								BE-245241365-245245630	AAU	4266
								BE-246953883-246956850	AAU	2968
								BE-247767069-247772158	AAU	5090
								BE-250985312-250987238	AAU	1927
								BE-250987239-250989426	AAU	2188
								BE-250996166-250997238	AAU	1073
								BE-250997239-251001238	AAU	4000
								BE-251001239-251006548	AAU	5310
								BE-253891402-253893488	AAU	2087
								BE-375291067-375293613	AAU	2547
								BE-380349372-380354017	AAU	4646
								BE-385353417-385355416	AAU	2000
								BE-388366591-388370000	AAU	3410
								BE-390664708-390666408	AAU	1701
								BE-391313329-391315665	AAU	2337
								BE-391318211-391322910	AAU	4700
								BE-391350522-391353351	AAU	2830
								BE-391353352-391356530	AAU	3179
								BE-391565275-391565679	AAU	405
								BE-391592628-391593603	AAU	976
								BE-391604562-391605367	AAU	806
								BE-393277419-393280108	AAU	2690
								BE-393302927-393305641	AAU	2715
								BE-393309051-393309432	AAU	382
								BE-413958035-413961895	AAU	3861
								BE-414094664-414097934	AAU	3271
			AT12187	30.11.2009 14:36:06	external transfer	terminated		CZ-1189955886-1189964099	AAU	8214
								CZ-1273682038-1273685037	AAU	3000
								CZ-1291681259-1291684258	AAU	3000
								CZ-1303731586-1303732201	AAU	616
								CZ-1306862926-1306865925	AAU	3000
								CZ-1306880119-1306880554	AAU	436
								CZ-1331598733-1331603732	AAU	5000
								CZ-1359626569-1359627084	AAU	516
			AT12249	01.12.2009 10:19:50	internal transfer	terminated		DE-1545999454-1545999569	AAU	116

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DES Response Code	Average number of occurences per transaction (X 100.000)		Transaction Number	Proposal Date	Transaction Type	Final State	Explanation	Units involved abbreviated		
	Reported Year	Prior to the Reported Year						Serial Number	Unit Type	Quantity
4003	994,48	0								
								DE-1553713494-1553713689	AAU	196
								DE-1554759705-1554759835	AAU	131
								DE-1697706960-1697711959	AAU	5000
								DE-1698314206-1698317658	AAU	3453
								DE-1698411371-1698416005	AAU	4635
								DE-1708394043-1708394954	AAU	912
								DE-1874300630-1874311797	AAU	11168
								DE-2020140086-2020141085	AAU	1000
								DE-2039740038-2039740511	AAU	474
								DE-2039740512-2039740832	AAU	321
								DE-2079635992-2079636297	AAU	306
								DE-2079654286-2079654605	AAU	320
								DE-2080454536-2080460804	AAU	6269
								DE-2091040299-2091040423	AAU	125
								DE-2091066171-2091066280	AAU	110
								DE-2091152934-2091153582	AAU	649
								DE-2091155583-2091156582	AAU	1000
								DE-2092008453-2092008803	AAU	351
								DE-2092008804-2092008932	AAU	129
								DE-2150026152-2150026751	AAU	600
								DE-2194803636-2194804509	AAU	874
								DE-3560355387-3560355468	AAU	82
								DE-3566046619-3566046657	AAU	39
								DE-3568273713-3568273952	AAU	240
								DE-3602485792-3602493791	AAU	8000
								DE-3602941031-3602944530	AAU	3500
			AT12304	01.12.2009 12:15:17	external transfer	terminated		BE-228929670-228960167	AAU	30498
								BE-251122881-251122890	AAU	10
								BE-372762539-372764538	AAU	2000
								BE-391340457-391341576	AAU	1120
								BE-391345364-391345856	AAU	493
								BE-391345857-391345858	AAU	2
								BE-391348531-391350521	AAU	1991
								BE-391554015-391554124	AAU	110
								BE-391554562-391555096	AAU	535
								BE-391555097-391555336	AAU	240
								BE-391555337-391555477	AAU	141
								BE-391557562-391557920	AAU	359

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DES Response Code	Average number of occurences per transaction (X 100.000)		Transaction Number	Proposal Date	Transaction Type	Final State	Explanation	Units involved abbreviated		
	Reported Year	Prior to the Reported Year						Serial Number	Unit Type	Quantity
4003	994,48	0								
								BE-393269940-393270750	AAU	811
								BE-393406693-393406816	AAU	124
								BE-393406817-393407063	AAU	247
								BE-403614426-403616425	AAU	2000
			AT12334	01.12.2009 13:54:12	external transfer	terminated		KR-39436705-39438420	CER	1716
			AT12347	01.12.2009 14:27:57	external transfer	terminated		GB-3504765460-3504766005	AAU	546
								GB-3530619307-3530620003	AAU	697
								GB-3549146570-3549146652	AAU	83
								GB-3549156818-3549156843	AAU	26
								GB-3549177474-3549177933	AAU	460
								GB-3556743487-3556744105	AAU	619
								GB-3558058956-3558059154	AAU	199
								GB-3559569424-3559569594	AAU	171
								GB-3567092643-3567092865	AAU	223
								GB-3683008366-3683008418	AAU	53
								GB-3701056483-3701056531	AAU	49
								GB-3702124270-3702124768	AAU	499
								GB-3702182848-3702183021	AAU	174
								GB-3702244152-3702244368	AAU	217
								GB-3702461321-3702461555	AAU	235
								GB-3702550983-3702551368	AAU	386
								GB-3703898148-3703898390	AAU	243
								GB-3703899751-3703899960	AAU	210
								GB-3703903083-3703903691	AAU	609
								GB-3703903773-3703903960	AAU	188
								GB-3703954686-3703954768	AAU	83
								GB-3704151534-3704151711	AAU	178
								GB-3704152102-3704152118	AAU	17
								GB-3704428004-3704428554	AAU	551
								GB-3712706786-3712706898	AAU	113
								GB-3759717125-3759717657	AAU	533

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DES Response Code	Average number of occurences per transaction (X 100.000)		Transaction Number	Proposal Date	Transaction Type	Final State	Explanation	Units involved abbreviated		
	Reported Year	Prior to the Reported Year						Serial Number	Unit Type	Quantity
4003	994,48	0								
								GB-3765896066-3765896563	AAU	498
								GB-3770977393-3770977551	AAU	159
								GB-3771576294-3771576471	AAU	178
								GB-3771586472-3771587171	AAU	700
								GB-3774394232-3774394783	AAU	552
								GB-3774594460-3774594517	AAU	58
								GB-3774610717-3774610815	AAU	99
								GB-3774959449-3774959699	AAU	251
								GB-3775030700-3775030742	AAU	43
								GB-3777698627-3777698726	AAU	100
								GB-3793719523-3793719616	AAU	94
								GB-3833785504-3833785961	AAU	458
								GB-3834822228-3834822901	AAU	674
								GB-3835054039-3835054363	AAU	325
								GB-3901463620-3901464116	AAU	497
								GB-3901493620-3901494304	AAU	685
								GB-3917532240-3917532277	AAU	38
								GB-3984215140-3984215266	AAU	127
								GB-3987695091-3987695189	AAU	99
								GB-3989939491-3989939529	AAU	39
								GB-3994374971-3994375166	AAU	196
								GB-3994873969-3994874529	AAU	561
								GB-3995810767-3995811381	AAU	615
								GB-3995930538-3995930776	AAU	239
								GB-4000359253-4000359754	AAU	502
								GB-4003846033-4003846278	AAU	246
								GB-4003878605-4003878751	AAU	147
			AT12350	01.12.2009 14:29:18	external transfer	terminated		AT-1535329519-1535329886	AAU	368
								AT-1548733018-1548733617	AAU	600
								AT-1548804644-1548805111	AAU	468

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DES Response Code	Average number of occurences per transaction (X 100.000)		Transaction Number	Proposal Date	Transaction Type	Final State	Explanation	Units involved abbreviated		
	Reported Year	Prior to the Reported Year						Serial Number	Unit Type	Quantity
4003	994,48	0								
								AT-1549207622-1549207955	AAU	334
								AT-1549772762-1549773128	AAU	367
								AT-1549921225-1549921552	AAU	328
								AT-1549921553-1549921930	AAU	378
								AT-1549930903-1549930916	AAU	14
								AT-1550078781-1550078980	AAU	200
								AT-1550082427-1550082847	AAU	421
								AT-1550285173-1550285228	AAU	56
								AT-1550348834-1550349028	AAU	195
								AT-1550358967-1550359616	AAU	650
								AT-1550749182-1550749624	AAU	443
								AT-1553243423-1553243648	AAU	226
								AT-1553520430-1553520850	AAU	421
								AT-1554500674-1554501129	AAU	456
								AT-1554938961-1554939346	AAU	386
								AT-1554983521-1554983643	AAU	123
								AT-1555290617-1555290631	AAU	15
								AT-1555337493-1555337816	AAU	324
								AT-1555369155-1555369559	AAU	405
								AT-1557550861-1557551342	AAU	482
								AT-1559751454-1559751858	AAU	405
								AT-1573216252-1573216735	AAU	484
								AT-1574463865-1574464183	AAU	319
								AT-1583304574-1583304949	AAU	376
			AT12351	01.12.2009 14:30:12	external transaction	terminated		BE-212014027-212014117	AAU	91
								BE-219609965-219610225	AAU	261
								BE-219637147-219637586	AAU	440
								BE-219647223-219647586	AAU	364
								BE-219673855-219673910	AAU	56
								BE-233519787-233519926	AAU	140
								BE-251208295-251208670	AAU	376
								BE-251324643-251325266	AAU	624
								BE-380267733-380267760	AAU	28
			AT12352	01.12.2009 14:31:00	external transfer	terminated		CZ-1202658019-1202658019	AAU	1
								CZ-1263961403-1263961767	AAU	365
								CZ-1263968002-1263968233	AAU	232
								CZ-1264794634-1264794746	AAU	113
								CZ-1264795027-1264795426	AAU	400

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DES Response Code	Average number of occurences per transaction (X 100.000)		Transaction Number	Proposal Date	Transaction Type	Final State	Explanation	Units involved abbreviated		
	Reported Year	Prior to the Reported Year						Serial Number	Unit Type	Quantity
4003	994,48	0								
								CZ-1279302851-1279303017	AAU	167
								CZ-1279311027-1279311044	AAU	18
								CZ-1279341492-1279341898	AAU	407
								CZ-1288307939-1288307939	AAU	1
								CZ-1288676973-1288677142	AAU	170
								CZ-1291531713-1291532013	AAU	301
								CZ-1291533014-1291533631	AAU	618
								CZ-1291536818-1291536843	AAU	26
								CZ-1291567444-1291567547	AAU	104
								CZ-1291610061-1291610330	AAU	270
								CZ-1291756450-1291756738	AAU	289
								CZ-1292039975-1292040173	AAU	199
								CZ-1292046780-1292046882	AAU	103
								CZ-1292049543-1292049917	AAU	375
								CZ-1292052543-1292052545	AAU	3
								CZ-1292053590-1292053748	AAU	159
								CZ-1292060742-1292060954	AAU	213
								CZ-1295078707-1295078986	AAU	280
								CZ-1303783314-1303783512	AAU	199
								CZ-1303787670-1303788005	AAU	336
								CZ-1303849093-1303849271	AAU	179
								CZ-1303866452-1303866561	AAU	110
								CZ-1303894804-1303894950	AAU	147
								CZ-1303896368-1303896768	AAU	401
								CZ-1303899825-1303900082	AAU	258
								CZ-1303909568-1303909950	AAU	383
								CZ-1303914897-1303915089	AAU	193
								CZ-1304788731-1304788742	AAU	12
								CZ-1304818731-1304819167	AAU	437
								CZ-1306489853-1306490176	AAU	324
								CZ-1309842746-1309843031	AAU	286
								CZ-1310016201-1310016507	AAU	307
								CZ-1310030690-1310030702	AAU	13
								CZ-1310281334-1310281415	AAU	82
								CZ-1314826023-1314826363	AAU	341
								CZ-1315424274-1315424305	AAU	32
								CZ-1315424933-1315425390	AAU	458
								CZ-1315728140-1315728150	AAU	11
								CZ-1315729013-1315729265	AAU	253

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DES Response Code	Average number of occurences per transaction (X 100.000)		Transaction Number	Proposal Date	Transaction Type	Final State	Explanation	Units involved abbreviated		
	Reported Year	Prior to the Reported Year						Serial Number	Unit Type	Quantity
4003	994,48	0								
								CZ-1316579760-1316579878	AAU	119
								CZ-1316649423-1316649560	AAU	138
								CZ-1316760019-1316760636	AAU	618
								CZ-1316760800-1316761222	AAU	423
								CZ-1316775931-1316775940	AAU	10
								CZ-1317042334-1317042736	AAU	403
								CZ-1317474299-1317474335	AAU	37
								CZ-1318064130-1318064174	AAU	45
								CZ-1318190941-1318191321	AAU	381
								CZ-1318224180-1318224687	AAU	508
								CZ-1318238865-1318239170	AAU	306
								CZ-1318280165-1318280592	AAU	428
								CZ-1318336202-1318336326	AAU	125
								CZ-1320556263-1320556522	AAU	260
								CZ-1320571294-1320571679	AAU	386
								CZ-1325731541-1325731716	AAU	176
								CZ-1325787909-1325788051	AAU	143
								CZ-1325790556-1325790745	AAU	190
								CZ-1330340551-1330340695	AAU	145
								CZ-1331641672-1331642124	AAU	453
								CZ-1331661242-1331661552	AAU	311
								CZ-1331664059-1331664080	AAU	22
								CZ-1331666233-1331666744	AAU	512
								CZ-1331899696-1331899732	AAU	37
								CZ-1332220599-1332220805	AAU	207
								CZ-1332280818-1332281071	AAU	254
								CZ-1332283358-1332283378	AAU	21
								CZ-1341767729-1341768134	AAU	406
			AT12354	01.12.2009 14:33:01	external transfer	terminated		DK-1707913056-1707913140	AAU	85
								DK-1708319204-1708319703	AAU	500
								DK-1708465659-1708465986	AAU	328
								DK-1709292441-1709292812	AAU	372
								DK-1709430790-1709431490	AAU	701
								DK-1709481575-1709481924	AAU	350
								DK-1709481925-1709482175	AAU	251
								DK-1709514602-1709515062	AAU	461
								DK-1709629759-1709630177	AAU	419
								DK-1709657950-1709658293	AAU	344

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DES Response Code	Average number of occurences per transaction (X 100.000)		Transaction Number	Proposal Date	Transaction Type	Final State	Explanation	Units involved abbreviated		
	Reported Year	Prior to the Reported Year						Serial Number	Unit Type	Quantity
4003	994,48	0								
								DK-1709768481-1709768507	AAU	27
								DK-1709771762-1709772179	AAU	418
								DK-1709900491-1709900497	AAU	7
								DK-1709911984-1709912435	AAU	452
								DK-1709912436-1709912983	AAU	548
								DK-1709916984-1709917472	AAU	489
								DK-1712949585-1712949979	AAU	395
			AT12355	01.12.2009 14:34:05	externer transfer	terminated		ES-1689982776-1689983157	AAU	382
								ES-1694358695-1694359194	AAU	500
								ES-1695444767-1695445128	AAU	362
								ES-1695571117-1695571440	AAU	324
								ES-1695587213-1695587680	AAU	468
								ES-1695587681-1695588100	AAU	420
								ES-1695590213-1695590556	AAU	344
								ES-1696059699-1696060198	AAU	500
								ES-1696288995-1696289335	AAU	341
								ES-1697771534-1697771869	AAU	336
								ES-1698221729-1698222106	AAU	378
								ES-1698249664-1698250005	AAU	342
								ES-1698323303-1698323721	AAU	419
								ES-1698902221-1698902552	AAU	332
								ES-1698920343-1698920800	AAU	458
								ES-1700371541-1700371975	AAU	435
								ES-1709688939-1709689265	AAU	327
								ES-1709776931-1709777314	AAU	384
								ES-1709883160-1709883644	AAU	485
								ES-1709995566-1709995918	AAU	353
								ES-1710132640-1710132747	AAU	108
								ES-1710174768-1710175145	AAU	378
								ES-1710269678-1710269744	AAU	67
								ES-1710325414-1710325767	AAU	354
								ES-1710325768-1710325822	AAU	55
								ES-1710374117-1710374265	AAU	149
								ES-1710381106-1710381140	AAU	35
								ES-1710381535-1710381963	AAU	429
								ES-1718728587-1718729086	AAU	500
								ES-1718920084-1718920434	AAU	351
								ES-1718920435-1718920508	AAU	74

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DES Response Code	Average number of occurences per transaction (X 100.000)		Transaction Number	Proposal Date	Transaction Type	Final State	Explanation	Units involved abbreviated		
	Reported Year	Prior to the Reported Year						Serial Number	Unit Type	Quantity
4003	994,48	0								
								ES-1718957832-1718958008	AAU	177
								ES-1718958442-1718958445	AAU	4
								ES-1718975388-1718975405	AAU	18
								ES-1719008463-1719008508	AAU	46
								ES-1719058475-1719058555	AAU	81
								ES-1719059040-1719059474	AAU	435
								ES-1719087661-1719087663	AAU	3
								ES-1719116976-1719117011	AAU	36
								ES-1719472556-1719472630	AAU	75
								ES-1719653851-1719654508	AAU	658
								ES-1726735427-1726735507	AAU	81
								ES-1726904507-1726904825	AAU	319
								ES-1753036459-1753036914	AAU	456
								ES-1753044644-1753044711	AAU	68
								ES-1753073012-1753073023	AAU	12
								ES-1753150613-1753150724	AAU	112
								ES-1753310725-1753310859	AAU	135
								ES-1753310860-1753311104	AAU	245
								ES-1766514376-1766514989	AAU	614
								ES-1766567729-1766567770	AAU	42
								ES-1766655472-1766655573	AAU	102
								ES-1766730508-1766730713	AAU	206
								ES-1766852939-1766853089	AAU	151
								ES-1767038707-1767039005	AAU	299
								ES-1767299368-1767299391	AAU	24
								ES-1767315373-1767315572	AAU	200
								ES-1767318479-1767318610	AAU	132
								ES-1767320897-1767321135	AAU	239
								ES-1767321136-1767321186	AAU	51
								ES-1768120700-1768121139	AAU	440
								ES-1768133083-1768133428	AAU	346
								ES-1768137839-1768138082	AAU	244
								ES-1768158835-1768159082	AAU	248
								ES-1769901947-1769902518	AAU	572
								ES-1769904191-1769904224	AAU	34
								ES-1769906354-1769906708	AAU	355
								ES-1774138588-1774138707	AAU	120
								ES-1774233885-1774234117	AAU	233
								ES-1774336875-1774336922	AAU	48

R- 2 List of discrepant transactions

DES Response Code	Average number of occurences per transaction (X 100.000)		Transaction Number	Proposal Date	Transaction Type	Final State	Explanation	Units involved abbreviated		
	Reported Year	Prior to the Reported Year						Serial Number	Unit Type	Quantity
4003	994,48	0								
								ES-1774345401-1774345682	AAU	282
								ES-1774371664-1774371943	AAU	280
								ES-1776581366-1776581817	AAU	452
								ES-1776582514-1776582704	AAU	191
								ES-1777317659-1777318022	AAU	364
								ES-1778310879-1778310997	AAU	119
								ES-1778310998-1778311050	AAU	53
								ES-1778313456-1778313467	AAU	12
								ES-1778326381-1778326694	AAU	314
								ES-1778328458-1778328611	AAU	154
								ES-1778328612-1778328769	AAU	158
								ES-1778331040-1778331157	AAU	118
								ES-1778389420-1778389652	AAU	233
								ES-1778704523-1778704539	AAU	17
								ES-1779968501-1779969121	AAU	621
								ES-1779969122-1779969730	AAU	609
								ES-1779987654-1779987757	AAU	104
								ES-1781797675-1781797842	AAU	168
								ES-1781812924-1781813272	AAU	349
								ES-1781824583-1781824604	AAU	22
								ES-1781824605-1781825103	AAU	499
								ES-1783275737-1783276321	AAU	585
								ES-1789574363-1789574541	AAU	179
								ES-1789977090-1789977165	AAU	76
								ES-1791387801-1791389900	AAU	2100
								ES-1791748060-1791748194	AAU	135
								ES-1792113379-1792113673	AAU	295
								ES-1794957628-1794957896	AAU	269
								ES-1795331402-1795331714	AAU	313
								ES-1812746927-1812746929	AAU	3
								ES-1813797738-1813798077	AAU	340
								ES-1818956454-1818956864	AAU	411
								ES-1818963732-1818964150	AAU	419
								ES-1819119531-1819119746	AAU	216
								ES-1819150394-1819150483	AAU	90
								ES-1819161477-1819161504	AAU	28
								ES-1819168211-1819168476	AAU	266
								ES-1819192812-1819193233	AAU	422
								ES-1819416156-1819416754	AAU	599

R- 2 List of discrepant transactions

DES Response Code	Average number of occurences per transaction (X 100.000)		Transaction Number	Proposal Date	Transaction Type	Final State	Explanation	Units involved abbreviated		
	Reported Year	Prior to the Reported Year						Serial Number	Unit Type	Quantity
4003	994,48	0								
								ES-1819427082-1819427256	AAU	175
								ES-1820105480-1820105950	AAU	471
								ES-1820109951-1820110090	AAU	140
								ES-1820901248-1820901539	AAU	292
								ES-1824167535-1824167695	AAU	161
								ES-1824167696-1824167788	AAU	93
								ES-1824167789-1824167963	AAU	175
								ES-1827902788-1827902919	AAU	132
								ES-1828135221-1828135349	AAU	129
								ES-1828135717-1828135872	AAU	156
								ES-1829277103-1829277400	AAU	298
								ES-1829413623-1829413691	AAU	69
								ES-1829414533-1829414802	AAU	270
								ES-1829421564-1829421565	AAU	2
								ES-1829426369-1829426502	AAU	134
								ES-1829426503-1829426666	AAU	164
								ES-1829430575-1829430667	AAU	93
								ES-1829431760-1829431860	AAU	101
								ES-1829438075-1829438173	AAU	99
								ES-1829460624-1829460804	AAU	181
								ES-1829463877-1829463898	AAU	22
								ES-1829465200-1829465414	AAU	215
								ES-1829615369-1829615651	AAU	283
								ES-1829781632-1829782016	AAU	385
								ES-1829783369-1829783585	AAU	217
								ES-1829823154-1829823368	AAU	215
								ES-1829939896-1829940368	AAU	473
								ES-1830211626-1830211758	AAU	133
								ES-1830230924-1830230999	AAU	76
								ES-1831112429-1831112676	AAU	248
								ES-1831112677-1831112781	AAU	105
								ES-1831121299-1831121385	AAU	87
								ES-1831125267-1831125385	AAU	119
								ES-1831132089-1831132385	AAU	297
								ES-1831135055-1831135082	AAU	28
								ES-1832546153-1832546515	AAU	363
								ES-1834560719-1834560958	AAU	240
								ES-1835647763-1835648209	AAU	447
								ES-1835936424-1835937087	AAU	664

R- 2 List of discrepant transactions

DES Response Code	Average number of occurences per transaction (X 100.000)		Transaction Number	Proposal Date	Transaction Type	Final State	Explanation	Units involved abbreviated		
	Reported Year	Prior to the Reported Year						Serial Number	Unit Type	Quantity
4003	994,48	0								
								ES-1837047782-1837047796	AAU	15
								ES-1837450098-1837450611	AAU	514
								ES-1839831012-1839831033	AAU	22
								ES-1840652137-1840652183	AAU	47
								ES-1840662137-1840662183	AAU	47
								ES-1840680137-1840680315	AAU	179
								ES-1840713123-1840713142	AAU	20
								ES-1840715049-1840715682	AAU	634
								ES-1840719402-1840719576	AAU	175
								ES-1841001966-1841002371	AAU	406
								ES-1841013966-1841014190	AAU	225
								ES-1845048301-1845048503	AAU	203
								ES-1846807814-1846808425	AAU	612
								ES-1846808426-1846809037	AAU	612
								ES-1849488943-1849489023	AAU	81
								ES-1849905283-1849905532	AAU	250
								ES-1850420314-1850420499	AAU	186
								ES-1850420500-1850420590	AAU	91
								ES-1853109466-1853109533	AAU	68
								ES-1860729901-1860730446	AAU	546
								ES-1860811491-1860811590	AAU	100
								ES-1861195121-1861195146	AAU	26
								ES-1861201882-1861202146	AAU	265
								ES-1861222247-1861222946	AAU	700
								ES-1861345954-1861346179	AAU	226
								ES-1861357132-1861357190	AAU	59
								ES-1861507456-1861507682	AAU	227
								ES-1861507683-1861508293	AAU	611
								ES-1908412593-1908412847	AAU	255
								ES-1908476784-1908477219	AAU	436
								ES-1931865916-1931866181	AAU	266
								ES-1938654656-1938655078	AAU	423
								ES-1938655079-1938655387	AAU	309
								ES-1946669237-1946669651	AAU	415
								ES-1964049643-1964050139	AAU	497
								ES-1967313027-1967313080	AAU	54
								ES-1971772437-1971772831	AAU	395
								ES-1974480705-1974480742	AAU	38
			AT12357	01.12.2009	external transac-	terminated		SK-272690502-272690583	AAU	82

R- 2 List of discrepant transactions										
DES Response Code	**Average number of occurences per transaction (X 100.000)**		**Transaction Number**	**Proposal Date**	**Transaction Type**	**Final State**	**Explanation**	**Units involved abbreviated**		
	Reported Year	**Prior to the Reported Year**						**Serial Number**	**Unit Type**	**Quantity**
4003	994,48	0								
					tion					
								SK-272692640-272693279	AAU	640
								SK-276782282-276782510	AAU	229
								SK-280766502-280766647	AAU	146
								SK-400089880-400090171	AAU	292
								SK-400105995-400106487	AAU	493
								SK-404905950-404906444	AAU	495
								SK-405335226-405335832	AAU	607
								SK-409121974-409122570	AAU	597
								SK-420882673-420882838	AAU	166
								SK-421319798-421319818	AAU	21
								SK-421319840-421320123	AAU	284
								SK-421358559-421359215	AAU	657
								SK-421366218-421366512	AAU	295
								SK-421366801-421366806	AAU	6
								SK-421410444-421410672	AAU	229
								SK-421413135-421413205	AAU	71
								SK-421437660-421437894	AAU	235
								SK-421470725-421470831	AAU	107
								SK-421473832-421473896	AAU	65
								SK-421552673-421552778	AAU	106
								SK-421657673-421657949	AAU	277
								SK-421724834-421724947	AAU	114
								SK-423770542-423771048	AAU	507
								SK-423824836-423824934	AAU	99
								SK-424605448-424605485	AAU	38
								SK-428719999-428720357	AAU	359
								SK-428806132-428806417	AAU	286
								SK-432385577-432385776	AAU	200
								SK-432485668-432485728	AAU	61
								SK-432509001-432509144	AAU	144
								SK-432541245-432541910	AAU	666
								SK-433682320-433682931	AAU	612
								SK-447346936-447347345	AAU	410
								SK-447759229-447759897	AAU	669
								SK-447760035-447760537	AAU	503
								SK-447969236-447969315	AAU	80
								SK-449265100-449265618	AAU	519
								SK-449383182-449383558	AAU	377

R- 2 List of discrepant transactions

DES Response Code	Average number of occurences per transaction (X 100.000)		Transaction Number	Proposal Date	Transaction Type	Final State	Explanation	Units involved abbreviated		
	Reported Year	Prior to the Reported Year						Serial Number	Unit Type	Quantity
4003	994,48	0								
								SK-449883396-449883921	AAU	526
								SK-450028716-450029062	AAU	347
								SK-451482418-451482901	AAU	484
								SK-451824350-451825039	AAU	690
			AT12359	01.12.2009 14:38:10	external transfer	terminated		FI-482216409-482216765	AAU	357
								FI-508243559-508244058	AAU	500
								FI-508953518-508953602	AAU	85
								FI-508996603-508996757	AAU	155
								FI-509276721-509310119	AAU	33399
								FI-515039181-515039837	AAU	657
			AT12430	01.12.2009 16:17:19	external transfer	terminated		NL-3220485931-3220605930	AAU	1E+05
			AT12726	15.12.2009 14:16:04	external transfer	terminated		PL-3217115423-3217139422	AAU	24000
			AT12727	15.12.2009 14:17:58	external transfer	terminated		RO-2532719563-2532730562	AAU	11000
			AT12728	15.12.2009 14:18:30	external transfer	terminated		IT-3041232541-3041238540	AAU	6000
			AT12789	16.12.2009 13:58:14	external transfer	terminated		PL-3216778423-3216779422	AAU	1000
								PL-3216821423-3216822422	AAU	1000
								PL-3216822423-3216828422	AAU	6000
								PL-3216828423-3216829422	AAU	1000
								PL-3216861423-3216869422	AAU	8000
								PL-3216869423-3216872422	AAU	3000
								PL-3216872423-3216878422	AAU	6000
								PL-3223463915-3223473914	AAU	10000
								PL-3223493915-3223498914	AAU	5000
			AT12790	16.12.2009 14:00:33	external transfer	terminated		ES-1947691432-1947695347	AAU	3916
								ES-1951568303-1951569386	AAU	1084
			AT12791	16.12.2009 14:24:59	external transfer	terminated		RO-2532463264-2532464562	AAU	1299
								RO-2532464563-2532465562	AAU	1000
								RO-2532465563-2532467562	AAU	2000
								RO-2532510862-2532512562	AAU	1701
								RO-2532699563-2532704562	AAU	5000
			AT12793	16.12.2009 14:27:18	external transfer	terminated		SE-420897692-420899691	AAU	2000
			AT12800	17.12.2009 09:36:03	external transfer	terminated		SE-420897692-420899691	AAU	2000
			AT12801	17.12.2009 09:36:43	external transfer	terminated		SE-420897692-420899691	AAU	2000
			AT12802	17.12.2009 09:37:47	external transfer	terminated		ES-1947691432-1947695347	AAU	3916

R- 2 List of discrepant transactions

DES Response Code	Average number of occurences per transaction (X 100.000)		Transaction Number	Proposal Date	Transaction Type	Final State	Explanation	Units involved abbreviated		
	Reported Year	Prior to the Reported Year						Serial Number	Unit Type	Quantity
4003	994,48	0								
								ES-1951568303-1951569386	AAU	1084
			AT12805	17.12.2009 09:48:00	external transfer	terminated		SE-420897692-420899691	AAU	2000

R-3 List of CDM notifications

There have been no CDM notifictions.

R-4 List of non-replacements

There have been no non-replacements.

R-5 List of invalid units

There have been no invalid units.

ANNEX 7: UNCERTAINTY ASSESSMENT

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.

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.

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.

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.

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.

Table A 114: Tier 1 Uncertainty Analysis (Table 6.1 GPG)

IPCC Source category	Gas	Base year emissions 1990	Year 2008 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
		Input data	Input data	Input data	Input data			Note B		Note C
		Gg CO2 equivalent	Gg CO2 equivalent	%	%	%	%	%	%	%
1.A.1.a liquid: Public Electricity and Heat Production	CO2	1 229	689	0.5	0.5	0.7	0.01	- 0.01	0.01	- 0.00445
1.A 1.a other: Public Electricity and Heat Production	CO2	118	553	10.0	20.0	22.4	0.15	0.01	0.01	0.11146
1.A 1.a solid: Public Electricity and Heat Production	CO2	6 247	4 440	0.5	0.5	0.7	0.04	- 0.03	0.06	- 0.01643
1.A 1.b liquid: Petroleum refining	CO2	1 958	2 403	0.5	0.3	0.6	0.02	0.00	0.03	0.00092
1.A.2 mobile-liquid: Manufacturing Industries and Construction	CO2	256	1 152	3.0	0.5	3.0	0.04	0.01	0.02	0.00573
1.A.2 other: Manufacturing Industries and Construction	CO2	264	686	10.0	20.0	22.4	0.18	0.01	0.01	0.10372
1.A.2 solid: Manufacturing Industries and Construction	CO2	5 016	5 454	1.0	0.5	1.1	0.07	- 0.00	0.07	- 0.00074
1.A.2 stat-liquid: Manufacturing Industries and Construction	CO2	2 884	1 924	3.0	0.5	3.0	0.07	- 0.02	0.03	- 0.00842
1.A.3.a jet kerosene: Civil Aviation	CO2	24	62	3.0	3.0	4.2	0.00	0.00	0.00	0.00138
1.A.3.b diesel oil: Road Transportation	CO2	5 341	16 018	3.0	3.0	4.2	0.81	0.13	0.21	0.39946
1.A.3.b gasoline: Road Transportation	CO2	7 942	5 393	3.0	3.0	4.2	0.27	- 0.05	0.07	- 0.13527
1.A.4 biomass: Other Sectors	CH4	316	202	10.0	50.0	51.0	0.12	- 0.00	0.00	- 0.09797
1.A.4 mobile-diesel: Other Sectors	CO2	737	798	3.0	0.5	3.0	0.03	- 0.00	0.01	- 0.00013
1.A.4 other: Other Sectors	CO2	350	253	10.0	20.0	22.4	0.07	- 0.00	0.00	- 0.03569
1.A.4 solid: Other Sectors	CO2	2 654	400	1.0	0.5	1.1	0.01	- 0.03	0.01	- 0.01680
1.A.4 stat-liquid: Other Sectors	CO2	7 319	5 786	3.0	0.5	3.0	0.21	- 0.03	0.08	- 0.01540
1.A gaseous: Fuel Combustion (stationary)	CO2	11 301	16 833	2.0	0.5	2.1	0.41	0.06	0.22	0.02831
1.B.2.b: Natural gas	CH4	98	133	3.0	5.8	6.5	0.01	0.00	0.00	0.00192
2.A.1: Cement Production	CO2	2 033	2 133	5.0	2.0	5.4	0.14	- 0.00	0.03	- 0.00325
2.A.2: Lime Production	CO2	396	621	20.0	5.0	20.6	0.15	0.00	0.01	0.01199
2.A.3: Limestone and Dolomite Use	CO2	203	281	20.0	2.0	20.1	0.07	0.00	0.00	0.00146
2.A.7.b: Sinter Production	CO2	481	332	2.0	5.0	5.4	0.02	- 0.00	0.00	- 0.01333
2.B.1: Ammonia Production	CO2	517	533	2.0	4.6	5.0	0.03	- 0.00	0.01	- 0.00247
2.B.2: Nitric Acid Production	N2O	912	326	0.0	5.0	5.0	0.02	- 0.01	0.00	- 0.04529
2.C.1: Iron and Steel Production	CO2	3 546	5 770	0.5	0.5	0.7	0.05	0.02	0.08	0.01212
2.C.3: Aluminium production	CO2	158	0	2.0	0.5	2.1	0.00	- 0.02	0.00	- 0.00769
2.C.3: Aluminium production	PFCs	1 050	0	2.0	50.0	50.0	0.00	- 0.00	0.00	- 0.11606
2.C.4: SF6 Used in Al and Mg Foundries	SF6	253	0	0.0	5.0	5.0	0.00	- 0.00	0.00	- 0.01855
2.F.1/2/3/4./5: ODS Substitutes	HFCs	24	1 058	20.0	50.0	53.9	0.68	0.01	0.01	0.68054
2.F.7: Semiconductor Manufacture	FCs	133	280	5.0	10.0	11.2	0.04	0.00	0.00	0.01741
2.F.9: Other Sources of SF6	SF6	127	250	25.0	50.0	55.9	0.17	0.00	0.00	0.07233

IPCC Source category	Gas	Base year emissions 1990	Year 2008 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
		Input data	Input data	Input data	Input data			Note B		Note C
		Gg CO2 equivalent	Gg CO2 equivalent	%	%	%	%	%	%	%
3: SOLVENT AND OTHER PRODUCT USE	CO2	279	232	5.0	10.0	11.2	0.28	0.00	0.02	0.01127
4.A.1: Cattle	CH4	3 551	3 020	10.0	20.0	22.4	7.29	0.02	0.25	0.40729
4.B.1: Cattle	N2O	759	736	10.0	100.0	100.5	7.99	0.01	0.06	1.20628
4.B.1: Cattle	CH4	282	217	10.0	50.0	51.0	1.19	- 0.00	0.02	- 0.01699
4.B.8: Swine	CH4	123	74	10.0	50.0	51.0	0.41	- 0.00	0.01	- 0.09490
4.D.1: Direct Soil Emissions	N2O	1 909	1 878	5.0	150.0	150.1	30.42	0.03	0.16	4.86699
4.D.2: Pasture, Range and Paddock Manure	N2O	169	94	5.0	150.0	150.1	1.52	- 0.00	0.01	- 0.48591
4.D.3: Indirect Emissions	N2O	1 352	1 200	5.0	150.0	150.1	19.43	0.01	0.10	1.79242
6.A: Solid Waste Disposal on Land	CH4	3 314	1 557	12.0	25.0	27.7	4.66	- 0.09	0.13	- 2.17887
6.B: Wastewater Handling	N2O	108	260	20.0	50.0	53.9	1.51	0.01	0.02	0.73947
		11 847	**9 268**				**38.04**			
		15.2%	10.7%							
National Total without LULUCF		**78 171**	**86 641**							

ANNEX 8: CRF FOR 2008

This Annex includes the CRF-tables for the year 2008 as included in Austria’s data submission 2010 to the UNFCCC.

TABLE 1 SECTORAL REPORT FOR ENERGY
(Sheet 1 of 2)

Inventory 2008

Submission 2010 v1.3

AUSTRIA

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	CO_2	CH_4	N_2O	NO_X	CO	NMVOC	SO_2
	(Gg)						
Total Energy	63 473.61	24.14	2.41	197.87	663.52	59.07	21.06
A. Fuel Combustion Activities (Sectoral Approach)	63 261.45	12.01	2.41	197.87	663.52	56.82	20.90
1. Energy Industries	13 422.88	0.28	0.32	13.44	4.12	0.63	3.16
a. Public Electricity and Heat Production	10 089.05	0.27	0.30	10.81	3.64	0.62	2.31
b. Petroleum Refining	2 806.07	IE,NO	0.02	1.20	0.39	IE	0.85
c. Manufacture of Solid Fuels and Other Energy Industries	527.76	0.01	0.00	1.43	0.10	0.00	NA
2. Manufacturing Industries and Construction	15 996.58	0.62	0.49	33.55	152.26	2.27	10.56
a. Iron and Steel	6 240.46	0.09	0.06	5.09	124.71	0.28	5.29
b. Non-Ferrous Metals	300.25	0.01	0.00	0.26	0.05	0.00	0.11
c. Chemicals	1 360.84	0.07	0.01	1.25	0.86	0.13	0.34
d. Pulp, Paper and Print	2 140.10	0.14	0.08	4.94	1.82	0.24	1.09
e. Food Processing, Beverages and Tobacco	881.87	0.02	0.00	0.88	0.14	0.02	0.38
f. Other *(as specified in table 1.A(a) sheet 2)*	5 073.07	0.29	0.33	21.13	24.68	1.61	3.35
Other non-specified	5 073.07	0.29	0.33	21.13	24.68	1.61	3.35
3. Transport	22 254.52	0.88	0.84	125.93	194.23	18.58	0.22
a. Civil Aviation	69.81	0.01	0.00	0.27	2.23	0.12	0.02
b. Road Transportation	21 410.69	0.84	0.77	121.88	188.00	17.78	0.12
c. Railways	164.68	0.01	0.06	1.90	1.68	0.29	0.07
d. Navigation	34.94	0.01	0.01	0.32	2.23	0.39	0.01
e. Other Transportation *(as specified in table 1.A(a) sheet 3)*	574.39	0.02	0.00	1.56	0.10	0.01	NA
Pipeline transport	574.39	0.02	0.00	1.56	0.10	0.01	NA

TABLE 1 SECTORAL REPORT FOR ENERGY

(Sheet 2 of 2)

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	CO_2	CH_4	N_2O	NO_X	CO	NMVOC	SO_2
	(Gg)						
4. Other Sectors	11 542.31	10.23	0.75	24.87	312.64	35.33	6.95
a. Commercial/Institutional	2 956.06	0.23	0.06	2.14	8.11	0.62	1.47
b. Residential	7 621.78	9.34	0.39	12.39	271.52	29.13	5.25
c. Agriculture/Forestry/Fisheries	964.47	0.66	0.31	10.33	33.02	5.58	0.23
5. Other *(as specified in table 1.A(a) sheet 4)*	45.17	0.00	0.00	0.08	0.27	0.02	0.01
a. Stationary	NA	NA	NA	NA	NA	NA	NA
b. Mobile	45.17	0.00	0.00	0.08	0.27	0.02	0.01
Military use	45.17	0.00	0.00	0.08	0.27	0.02	0.01
B. Fugitive Emissions from Fuels	212.16	12.13	IE,NA	IE,NA	IE,NA	2.25	0.16
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	212.16	12.13	IE,NA	IE,NA	IE,NA	2.25	0.16
a. Oil	135.00	5.78	IE,NA	NA	NA	2.23	NA
b. Natural Gas	77.16	6.35				0.02	0.16
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	2 213.42	0.04	0.08	9.18	2.76	0.97	0.70
Aviation	2 181.97	0.04	0.07	8.82	2.44	0.92	0.69
Marine	31.45	0.00	0.01	0.36	0.32	0.06	0.01
Multilateral Operations	NO	NO	NO	NO	NO	NO	NO
CO_2 Emissions from Biomass	20 878.59						

(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

Fuel Combustion Activities - Sectoral Approach

(Sheet 1 of 4)

Inventory 2008
Submission 2010 v1.3
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	1 106 748.06	NCV				63 261.45	12.01	2.41
Liquid Fuels	469 006.01	NCV	73.87	2.25	3.14	34 643.38	1.05	1.47
Solid Fuels	106 425.50	NCV	96.72	4.82	1.42	10 293.69	0.51	0.15
Gaseous Fuels	303 924.48	NCV	55.38	1.00	0.43	16 832.80	0.30	0.13
Biomass	202 181.69	NCV	103.27	48.65	3.06 [3]		9.84	0.62
Other Fuels	25 210.38	NCV	59.17	12.00	1.40	1 491.58	0.30	0.04
1.A.1. Energy Industries	243 513.87	NCV				13 422.88	0.28	0.32
Liquid Fuels	42 046.70	NCV	73.54	0.22	0.64	3 091.99	0.01	0.03
Solid Fuels	47 870.97	NCV	92.75	0.10	1.59	4 439.85	0.00	0.08
Gaseous Fuels	96 354.38	NCV	55.40	0.52	0.43	5 338.03	0.05	0.04
Biomass	47 335.40	NCV	110.40	2.07	3.35 [3]	5 225.78	0.10	0.16
Other Fuels	9 906.42	NCV	55.82	12.00	1.40	553.00	0.12	0.01
a. Public Electricity and Heat Production	193 433.19	NCV				10 089.05	0.27	0.30
Liquid Fuels	8 761.20	NCV	78.60	1.07	1.33	688.62	0.01	0.01
Solid Fuels	47 870.97	NCV	92.75	0.10	1.59	4 439.85	0.00	0.08
Gaseous Fuels	79 559.20	NCV	55.40	0.45	0.50	4 407.58	0.04	0.04
Biomass	47 335.40	NCV	110.40	2.07	3.35 [3]	5 225.78	0.10	0.16
Other Fuels	9 906.42	NCV	55.82	12.00	1.40	553.00	0.12	0.01
b. Petroleum Refining	40 554.41	NCV				2 806.07	IE,NO	0.02
Liquid Fuels	33 285.51	NCV	72.20	IE	0.46	2 403.37	IE	0.02
Solid Fuels	NO	NCV	NO	NO	NO	NO	NO	NO
Gaseous Fuels	7 268.91	NCV	55.40	IE	0.10	402.70	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	9 526.27	NCV				527.76	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	9 526.27	NCV	55.40	1.50	0.10	527.76	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.

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
Fuel Combustion Activities - Sectoral Approach
(Sheet 2 of 4)

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	287 425.80	NCV				15 996.58	0.62	0.49
Liquid Fuels	40 639.70	NCV	75.69	1.53	6.01	3 076.00	0.06	0.24
Solid Fuels	54 267.97	NCV	100.49	2.03	1.21	5 453.51	0.11	0.07
Gaseous Fuels	122 488.13	NCV	55.36	1.46	0.10	6 781.23	0.18	0.01
Biomass	57 152.26	NCV	109.01	2.01	2.61 [3]	6 230.17	0.11	0.15
Other Fuels	12 877.74	NCV	53.26	12.00	1.40	685.84	0.15	0.02
a. Iron and Steel	72 091.68	NCV				6 240.46	0.09	0.06
Liquid Fuels	10 190.66	NCV	77.98	1.54	1.00	794.69	0.02	0.01
Solid Fuels	43 035.69	NCV	102.36	1.22	1.16	4 405.25	0.05	0.05
Gaseous Fuels	18 865.33	NCV	55.16	1.22	0.10	1 040.53	0.02	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	5 190.33	NCV				300.25	0.01	0.00
Liquid Fuels	322.35	NCV	74.02	1.02	0.83	23.86	0.00	0.00
Solid Fuels	137.98	NCV	104.00	2.00	1.40	14.35	0.00	0.00
Gaseous Fuels	4 730.00	NCV	55.40	1.50	0.10	262.04	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	24 627.65	NCV				1 360.84	0.07	0.01
Liquid Fuels	570.29	NCV	77.14	0.66	0.73	43.99	0.00	0.00
Solid Fuels	752.76	NCV	93.97	5.00	1.40	70.74	0.00	0.00
Gaseous Fuels	18 588.48	NCV	55.40	1.50	0.10	1 029.80	0.03	0.00
Biomass	2 221.30	NCV	110.19	1.94	3.62 [3]	244.77	0.00	0.01
Other Fuels	2 494.82	NCV	86.70	12.00	1.40	216.31	0.03	0.00
d. Pulp, Paper and Print	70 725.79	NCV				2 140.10	0.14	0.08
Liquid Fuels	1 090.37	NCV	77.81	1.74	0.95	84.84	0.00	0.00
Solid Fuels	3 678.30	NCV	89.72	5.00	1.40	330.02	0.02	0.01
Gaseous Fuels	30 980.34	NCV	55.40	1.50	0.10	1 716.31	0.05	0.00
Biomass	34 846.33	NCV	110.01	2.06	1.89 [3]	3 833.50	0.07	0.07
Other Fuels	130.44	NCV	68.42	12.00	1.40	8.92	0.00	0.00
e. Food Processing, Beverages and Tobacco	15 381.14	NCV				881.87	0.02	0.00
Liquid Fuels	2 395.84	NCV	75.99	1.01	0.85	182.06	0.00	0.00
Solid Fuels	117.21	NCV	103.19	2.43	1.40	12.09	0.00	0.00
Gaseous Fuels	12 413.59	NCV	55.40	1.50	0.10	687.71	0.02	0.00
Biomass	454.51	NCV	110.04	1.76	2.56 [3]	50.01	0.00	0.00
Other Fuels	NO	NCV	NO	NO	NO	NO	NO	NO
f. Other *(please specify)* [4]	99 409.21	NCV				5 073.07	0.29	0.33
Other non-specified								
Liquid Fuels	26 070.18	NCV	74.67	1.59	8.84	1 946.55	0.04	0.23
Solid Fuels	6 546.03	NCV	94.88	5.35	1.40	621.07	0.04	0.01
Gaseous Fuels	36 910.39	NCV	55.40	1.50	0.10	2 044.84	0.06	0.00
Biomass	19 630.13	NCV	107.07	1.95	3.78 [3]	2 101.88	0.04	0.07
Other Fuels	10 252.48	NCV	44.93	12.00	1.40	460.61	0.12	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

Fuel Combustion Activities - Sectoral Approach

(Sheet 3 of 4)

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	322 531.87	NCV					22 254.52	0.88	0.84
Liquid Fuels	294 921.91	NCV	73.51	2.92	2.86		21 679.58	0.86	0.84
Solid Fuels	5.75	NCV	95.00	6.83	6.83		0.55	0.00	0.00
Gaseous Fuels	10 368.06	NCV	55.40	1.50	0.10		574.39	0.02	0.00
Biomass	17 236.15	NCV	70.80	IE,NO	IE,NO		1 220.32	IE,NO	IE,NO
Other Fuels	NA,NO	NCV	NA,NO	NA,NO	NA,NO	[3]	NA,NO	NA,NO	NA,NO
a. Civil Aviation	969.17	NCV					69.81	0.01	0.00
Aviation Gasoline	124.19	NCV	66.71	NO	NO		8.28	NO	NO
Jet Kerosene	844.98	NCV	72.82	6.54	4.02		61.53	0.01	0.00
b. Road Transportation	308 485.52	NCV					21 410.69	0.84	0.77
Gasoline	73 819.73	NCV	73.06	9.62	4.62		5 393.03	0.71	0.34
Diesel Oil	217 429.64	NCV	73.67	0.61	1.98		16 017.66	0.13	0.43
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	17 236.15	NCV	70.80	IE	IE	[3]	1 220.32	IE	IE
Other Fuels *(please specify)*	NA	NCV					NA	NA	NA
c. Railways	2 233.77	NCV					164.68	0.01	0.06
Liquid Fuels	2 228.02	NCV	73.67	3.16	26.55		164.13	0.01	0.06
Solid Fuels	5.75	NCV	95.00	6.83	6.83		0.55	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	475.35	NCV					34.94	0.01	0.01
Residual Oil (Residual Fuel Oil)	NO	NCV	NO	NO	NO		NO	NO	NO
Gas/Diesel Oil	354.67	NCV	73.67	3.17	26.60		26.13	0.00	0.01
Gasoline	120.69	NCV	73.06	40.68	2.90		8.82	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]	10 368.06	NCV					574.39	0.02	0.00
Pipeline transport	10 368.06	NCV					574.39	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	10 368.06	NCV	55.40	1.50	0.10		574.39	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.

TABLE 1.A(a) SECTORAL BACKGROUND DATA FOR ENERGY

Fuel Combustion Activities - Sectoral Approach

(Sheet 4 of 4)

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	252 654.28	NCV					11 542.31	10.23	0.75
Liquid Fuels	90 777.14	NCV	74.36	1.33	3.92		6 750.64	0.12	0.36
Solid Fuels	4 280.81	NCV	93.39	92.84	2.34		399.79	0.40	0.01
Gaseous Fuels	74 713.91	NCV	55.40	0.80	1.00		4 139.15	0.06	0.07
Biomass	80 456.20	NCV	101.95	119.61	3.85	[3]	8 202.20	9.62	0.31
Other Fuels	2 426.22	NCV	104.17	12.00	1.40		252.74	0.03	0.00
a. Commercial/Institutional	48 198.45	NCV					2 956.06	0.23	0.06
Liquid Fuels	17 316.15	NCV	73.91	0.34	0.99		1 279.85	0.01	0.02
Solid Fuels	727.98	NCV	93.70	90.00	2.59		68.21	0.07	0.00
Gaseous Fuels	24 463.11	NCV	55.40	0.80	1.00		1 355.26	0.02	0.02
Biomass	3 264.99	NCV	108.75	33.19	2.82	[3]	355.07	0.11	0.01
Other Fuels	2 426.22	NCV	104.17	12.00	1.40		252.74	0.03	0.00
b. Residential	182 289.19	NCV					7 621.78	9.34	0.39
Liquid Fuels	60 896.88	NCV	74.62	0.85	1.21		4 544.20	0.05	0.07
Solid Fuels	3 481.42	NCV	93.32	93.49	2.28		324.88	0.33	0.01
Gaseous Fuels	49 687.63	NCV	55.40	0.80	1.00		2 752.69	0.04	0.05
Biomass	68 223.27	NCV	101.51	130.82	3.78	[3]	6 925.46	8.93	0.26
Other Fuels	NO	NCV	NO	NO	NO		NO	NO	NO
c. Agriculture/Forestry/Fisheries	22 166.64	NCV					964.47	0.66	0.31
Liquid Fuels	12 564.12	NCV	73.75	5.02	21.11		926.58	0.06	0.27
Solid Fuels	71.40	NCV	93.79	90.00	2.68		6.70	0.01	0.00
Gaseous Fuels	563.17	NCV	55.40	0.80	1.00		31.20	0.00	0.00
Biomass	8 967.94	NCV	102.77	65.75	4.81	[3]	921.68	0.59	0.04
Other Fuels	NO	NCV	NO	NO	NO		NO	NO	NO
1.A.5 Other *(Not specified elsewhere)* [6]	622.23	NCV					45.17	0.00	0.00
a. Stationary *(please specify)* [7]	NA	NCV					NA	NA	NA
b. Mobile *(please specify)* [8]	622.23	NCV					45.17	0.00	0.00
Military use									
Liquid Fuels	620.55	NCV	72.78	2.35	5.14		45.17	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	1.68	NCV	70.80	IE	IE	[3]	0.12	IE	IE
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 th
- 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

CO_2 from Fuel Combustion Activities - Reference Approach (IPCC Worksheet 1-1)

(Sheet 1 of 1)

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	906.14	7 864.23	NO		60.61	8 709.76	42.75	NCV	372 342.19	20.00	7 446.84	NO	7 446.84	0.99	27 032.04
		Orimulsion	Gg	NO	NO	NO		NO	NO	NA	NCV	NA,NO	NA	NA,NO	NA	NA,NO	NA	NA,NO
		Natural Gas Liquids	Gg	120.09	NO	NO		NO	120.09	45.22	NCV	5 430.63	17.20	93.41	NO	93.41	0.99	339.07
	Secondary Fuels	Gasoline	Gg		718.56	656.90	NO	-10.41	72.07	44.80	NCV	3 228.72	18.90	61.02	0.00	61.02	0.99	221.51
		Jet Kerosene	Gg		252.05	1.80	672.03	-2.99	-418.78	44.59	NCV	-18 673.49	19.50	-364.13	NO	-364.13	0.99	-1 321.80
		Other Kerosene	Gg		1.71	0.21	NO	0.01	1.49	44.75	NCV	66.79	19.60	1.31	NO	1.31	0.99	4.75
		Shale Oil	Gg		NO	NO		NO	NO	NA	NCV	NA,NO	NA	NA,NO	NA	NA,NO	NA	NA,NO
		Gas / Diesel Oil	Gg		4 911.60	1 074.01	14.24	176.04	3 647.32	43.33	NCV	158 038.33	20.20	3 192.37	NO	3 192.37	0.99	11 588.32
		Residual Fuel Oil	Gg		184.36	148.01	NO	-8.42	44.76	40.19	NCV	1 799.06	21.10	37.96	NO	37.96	0.99	137.80
		Liquefied Petroleum Gas (LPG)	Gg		112.17	37.03		0.86	74.29	47.31	NCV	3 514.51	17.20	60.45	NO	60.45	0.99	219.43
		Ethane	Gg		IE	IE		IE	IE	NA	NCV	IE,NA	NA	IE,NA	NO	IE,NA,NO	NA	IE,NA,NO
		Naphtha	Gg		22.00	136.00		-5.00	-109.00	45.01	NCV	-4 906.09	20.00	-98.12	486.11	-584.23	0.99	-2 120.75
		Bitumen	Gg		271.50	215.31		-5.02	61.21	40.19	NCV	2 460.15	22.00	54.12	446.86	-392.74	0.99	-1 425.63
		Lubricants	Gg		53.75	116.53	NO	-0.87	-61.91	40.19	NCV	-2 488.08	20.00	-49.76	29.27	-79.03	0.99	-286.90
		Petroleum Coke	Gg		84.89	1.44		-3.85	87.29	31.00	NCV	2 706.10	27.50	74.42	53.40	21.02	0.99	76.29
		Refinery Feedstocks	Gg		357.94	17.67		-65.73	406.01	42.50	NCV	17 255.24	20.00	345.10	NO	345.10	0.99	1 252.73
		Other Oil	Gg		44.30	25.25		-5.99	25.04	40.19	NCV	1 006.37	20.00	20.13	40.64	-20.51	0.99	-74.46
Other Liquid Fossil												NA		NA	NA	NA		NA
Liquid Fossil Totals												541 780.42		10 875.12	1 056.28	9 818.84		35 642.39
Solid Fossil	Primary Fuels	Anthracite [(2)]	Gg	NO	4.00	1.00		NO	3.00	28.00	NCV	84.00	26.80	2.25	0.38	1.88	0.98	6.74
		Coking Coal	Gg	NO	1 931.34	NO		68.05	1 863.29	28.00	NCV	52 172.10	25.80	1 346.04	74.94	1 271.10	0.98	4 567.50
		Other Bituminous Coal	Gg	NO	2 128.00	1.00	NO	156.00	1 971.00	28.28	NCV	55 732.14	25.80	1 437.89	NO	1 437.89	0.98	5 166.81
		Sub-bituminous Coal	Gg	NO	80.00	NO	NO	NO	80.00	22.20	NCV	1 776.00	26.20	46.53	NO	46.53	0.98	167.20
		Lignite	Gg	NO	8.00	NO		1.00	7.00	20.92	NCV	146.41	27.60	4.04	NO	4.04	0.98	14.52
		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		112.94	0.41		22.36	90.16	19.30	NCV	1 740.16	25.80	44.90	NO	44.90	0.98	161.33
		Coke Oven/Gas Coke	Gg		1 464.48	5.59		152.36	1 306.53	28.20	NCV	36 844.16	29.50	1 086.90	6.31	1 080.60	0.98	3 882.95
Other Solid Fossil												NA		NA	NA	NA		NA
Solid Fossil Totals												148 499.36		3 968.68	81.62	3 887.06		13 967.50
Gaseous Fossil		Natural Gas (Dry)	TJ	55 693.18	########	#######		15 336.27	315 994.92	1.00	NCV	315 994.92	15.30	4 834.72	NO	4 834.72	1.00	17 638.68
Other Gaseous Fossil												NA		NA	NA	NA		NA
Gaseous Fossil Totals												315 994.92		4 834.72	NA,NO	4 834.72		17 638.68
Total												1 006 274.71		19 678.52	1 137.90	18 540.62		67 248.58
Biomass total												180 722.77		5 403.61	NA,NO	5 403.61		17 560.95
		Solid Biomass	TJ	165 918.72	18 343.91	#######		NO	170 332.57	1.00	NCV	170 332.57	29.90	5 092.94	NO	5 092.94	0.88	16 433.23
		Liquid Biomass	TJ	IE	IE	IE		IE	IE	NA	NCV	IE,NA	NA	IE,NA	NA	IE,NA	NA	IE,NA
		Gas Biomass	TJ	10 390.20	NO	NO		NO	10 390.20	1.00	NCV	10 390.20	29.90	310.67	NO	310.67	0.99	1 127.72

(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)

Inventory 2008

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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)	541.78	470.63	35 642.39	469.01	34 643.38	0.35	2.88
Solid Fuels (excluding international bunkers) (5)	148.50	117.07	13 967.50	106.43	10 293.69	10.00	35.69
Gaseous Fuels	315.99	304.66	17 638.68	303.92	16 832.80	0.24	4.79
Other (5)	NA	NE	NA	25.21	1 491.58	-100.00	-100.00
***Total* (5)**	***1 006.27***	***892.36***	***67 248.58***	***904.57***	***63 261.45***	***-1.35***	***6.30***

(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.

TABLE 1.A(d) SECTORAL BACKGROUND DATA FOR ENERGY
Feedstocks and Non-Energy Use of Fuels
(Sheet 1 of 1)

Additional information [a]

FUEL TYPE	ACTIVITY DATA AND RELATED INFORMATION		IMPLIED EMISSION FACTOR	ESTIMATE	CO_2 not emitted (Gg CO_2)	Subtracted from energy sector *(specify source category)*	Associated CO_2 emissions (Gg)	Allocated under *(Specify source category, e.g. Waste Incineration)*
	Fuel quantity (TJ)	Fraction of carbon stored	Carbon emission factor (t C/TJ)	Carbon stored in non-energy use of fuels (Gg C)				
Naphtha (1)	32 407.20	0.75	20.00	486.11	1 782.40	NA	NE	NE
Lubricants	2 927.31	0.50	20.00	29.27	107.33	NA	NE	NE
Bitumen	20 311.79	1.00	22.00	446.86	1 638.48	NA	NE	NE
Coal Oils and Tars (from Coking Coal)	2 210.65	0.75	45.20	74.94	274.77	NA	NE	NE
Natural Gas (1)	11 246.15	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)*				47.32				
Butane	NO	0.75	NO	NO	NO	NA	NE	NE
Coal	28.00	0.50	26.80	0.38	1.38	NA	NE	NE
Coke	30 536.11	0.01	29.50	6.31	23.12	NA	NE	NE
Gasoline	0.00	0.50	18.90	0.00	0.00	NA	NE	NE
Other petroleum products	2 709.40	0.75	20.00	40.64	149.02	NA	NE	NE

Total	1 084.50	3 976.50
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	1 124.72	4 123.97

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)

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	ACTIVITY DATA	IMPLIED EMISSION FACTORS		EMISSIONS		
	Amount of fuel produced	CH_4 (1)	CO_2	CH_4		CO_2
				Recovery/Flaring (2)	Emissions (3)	
	(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	1.41	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 2008
Submission 2010 v1.3
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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)							135.00	5.78	IE,NA
I. Exploration	*number of wells drilled*	number	699.00	IE	IE	IE	IE	IE	IE
ii. Production(4)	*Oil throughput*	Mt	0.86	156 612 529.00	6 387 471.00		135.00	5.51	
iii. Transport	*oil loaded in tankers*	number	NA	IE	IE		IE	IE	
iv. Refining / Storage	*Oil refined (SNAP 0401)*	Mt	8 709.76	NA	31.66	NA	NA	0.28	NA
v. Distribution of Oil Products	*Gasoline Consumption (SNAP*	Mt	1.84	NA	NA		NA	NA	
vi. Other	*(specify)*		NO	NO	NO		NO	NO	
1. B. 2. b. Natural Gas							77.16	6.35	
i. Exploration	*(specify)*		1 532.00	NA	IE		NA	IE	
ii. Production (4) / Processing	*Gas throughput (a)*	10^6 m^3	1 532.00	50 261.10	IE		77.00	IE	
iii. Transmission	*Pipelines length (km)*	km	6 544.65	24.50	475.10		0.16	3.11	
iv. Distribution	*Distribution network length*	km	28 348.37	NA	114.34		NA	3.24	
v. Other Leakage	*(e.g. PJ gas consumed)*	PJ	NE	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. well

(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

International Bunkers and Multilateral Operations

(Sheet 1 of 1)

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	29 965.72				2 181.97	0.04	0.07
Jet Kerosene	29 965.72	72.82	0.00	0.00	2 181.97	0.04	0.07
Gasoline	NO	NO	NO	NO	NO	NO	NO
Marine Bunkers	426.89				31.45	0.00	0.01
Gasoline	NO	NO	NO	NO	NO	NO	NO
Gas/Diesel Oil	426.89	73.67	0.00	0.03	31.45	0.00	0.01
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	3.13	96.87
Marine	52.69	47.31

[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 i
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)

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	9 912.49	0.89	1.05	1 161.70	1 058.10	428.30	173.53	0.02	0.02	1.59	24.51	4.74	1.23
A. Mineral Products	3 530.92	NA	NA							NA	9.78	IE,NA	NA
1. Cement Production	2 132.97												NA
2. Lime Production	621.13												
3. Limestone and Dolomite Use	280.74												
4. Soda Ash Production and Use	10.30												
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)*	485.79	NA	NA							NA	NA	NA	NA
Glass Production	44.07	NA	NA							NA	NA	NA	NA
Bricks and Tiles (decarbonizing)	109.69	NA	NA							NA	NA	NA	NA
Sinter Production	332.02	NA	NA							NA	NA	NA	NA
B. Chemical Industry	593.35	0.88	1.05	NO	NO	NO	NO	NO	NO	0.42	11.11	1.32	0.77
1. Ammonia Production	532.52	0.09	NA							0.22	0.05	IE	NA
2. Nitric Acid Production			1.05							0.11			
3. Adipic Acid Production	NO		NO							NO	NO	NO	
4. Carbide Production	40.69	NA,NO								NA	NA	NA	NA
5. Other *(as specified in table 2(I).A-G)*	20.14	0.80	NA,NO	NO	NA,NO	NO	NA,NO	NO	NO	0.08	11.07	1.32	0.77
Carbon Black		NO											
Ethylene	NA	0.50	NA										
Dichloroethylene		NO											
Styrene		NO											
Methanol		NO											
CO2 from nitric acid production	0.40	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
Other Chemical Industry	19.75	0.30	NA	NO	NO	NO	NO	NO	NO	0.08	11.07	1.32	0.77
C. Metal Production	5 788.22	0.00	NA	NO	NO	NO	NO	NA,NO	0.00	0.12	2.85	0.50	0.46
1. Iron and Steel Production	5 770.17	0.00								0.10	2.53	0.31	0.06
2. Ferroalloys Production	18.05	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	0.00				
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)

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									1.06	0.77	2.92	NA
1. Pulp and Paper										1.06	0.77	0.78	NA
2. Food and Drink(2)	NA											2.15	
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				1 161.70	1 058.10	428.30	173.53	0.02	0.02				
1. Refrigeration and Air Conditioning Equipment				NA	992.99	NA	6.41	NA	NA				
2. Foam Blowing				NA	24.57	NA	NO	NA	NA				
3. Fire Extinguishers				NA	10.11	NA	NO	NA	NA				
4. Aerosols/ Metered Dose Inhalers				NA	23.04	NA	NO	NA	NA				
5. Solvents				NA	NO	NA	NO	NA	NA				
6. Other applications using ODS(3) substitutes				NA	NO	NA	NO	NA	NA				
7. Semiconductor Manufacture				NA	7.39	NA	166.39	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	0.74	NA	0.01				
Double glaze windows				NA	NA,NO	NA	NO	NA	0.01				
Research and other use				NA	NA,NO	NA	0.74	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

Emissions of CO_2, CH_4 and N_2O

(Sheet 1 of 2)

Inventory 2008
Submission 2010 v1.3
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						3 530.92	IE,NO	NA	NO	NA	NO
1. Cement Production	Clinker Production [kt]	3 996.24	0.53			2 132.97	NO				
2. Lime Production	Lime Produced [kt]	847.85	0.73			621.13	NO				
3. Limestone and Dolomite Use	Limestone and Dolomite used [kt]	648.68	0.43			280.74	NO				
4. Soda Ash						10.30	IE,NO				
Soda Ash Production	Soda Ash Production	NA	IE			IE	IE				
Soda Ash Use	Soda Ash Used [kt]	24.81	0.42			10.30	NO				
5. Asphalt Roofing	Roofing Material Production [Mio m2]	27.95	IE			IE	NO				
6. Road Paving with Asphalt	Asphalt Production [kt]	1 308.12	IE			IE	NO				
7. Other *(please specify)*						485.79	NO	NA	NO	NA	NO
Glass Production	(specify)	504.21	0.09	NA	NA	44.07	NO	NA	NO	NA	NO
Bricks and Tiles (decarbonizing)	Bricks Production [kt]	2 029.95	0.05	NA	NA	109.69	NO	NA	NO	NA	NO
Sinter Production	MgCO3 sintered [kt]	648.70	0.51	NA	NA	332.02	NO	NA	NO	NA	NO
B. Chemical Industry						593.35	NO	0.88	NO	1.05	NO
1. Ammonia Production[5]	Ammonia Production [kt]	489.13	1.09	0.00	NA	532.52	NO	0.09	NO	NA	NO
2. Nitric Acid Production	Nitric Acid Production [kt]	561.75			0.00					1.05	NO
3. Adipic Acid Production	Adipic Acid Production	NO	NO		NO	NO	NO			NO	NO
4. Carbide Production	Carbide Production	31.40	1.30	NA,NO		40.69	NO	NA,NO	NO		
Silicon Carbide	Silicon Carbide Production	NO	NO	NO		NO	NO	NO	NO		
Calcium Carbide	Calcium Carbide Production	31.40	1.30	NA		40.69	NO	NA	NO		
5. Other *(please specify)*						20.14	NO	0.80	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		
CO2 from nitric acid production	(Specify)	NO	NO	NO	NO	0.40	NO	NO	NO	NO	NO
Other Chemical Industry	Other Chemical Products [kt]	NA	NA	NA	NA	19.75	NO	0.30	NO	NA	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)

Inventory 2008

Submission 2010 v1.3

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)					
C. Metal Production						5 788.22	NO	0.00	NO	NA	NO
1. Iron and Steel Production			0.33	0.00		5 770.17	NO	0.00	NO		
Steel	Steel Production [kt]	6 872.74	0.12	IE		819.54	NO	IE	NO		
Pig Iron	Iron Production [kt]	5 845.53	0.84	IE		4 893.33	NO	IE	NO		
Sinter	Sinter Production [kt]	3 527.74	IE	IE		IE	NO	IE	NO		
Coke	Coke Production [kt]	1 409.57	IE	IE		IE	NO	IE	NO		
Other *(please specify)*						57.30	NO	0.00	NO		
Electric Furnace Steel production	Electric Furnace Steel Production	757.26	0.08	0.00		57.30	NO	0.00	NO		
Foundries	Product	222.15	NA	NA		NA	NO	NA	NO		
Rolling mills	Product	6 872.74	NA	0.00		NA	NO	0.00	NO		
2. Ferroalloys Production	Ferroalloys Production [kt]	13.27	1.36	NA		18.05	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]	135.58	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]	1 514.32	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)

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	3.30	12.72	NA,NO	NA,NO	79.40	NA,NO	377.86	88.15	NA,NO	73.15	0.00	NA,NO	NA,NO	7.39		IE,NA,NO	IE,NA,NO	1.02	NA,NO	IE,NA,NO	NA,NO	NA,NO	166.39		15.96
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		0.01
Aluminium Production																NO	NO	NO	NO	NO	NO	NO	NO		
SF_6 Used in Aluminium Foundries																									0.01
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	3.30	12.72	NO	NO	79.40	NO	377.86	88.15	NO	73.15	0.00	NO	NO	7.39		IE,NO	IE,NO	1.02	NO	IE,NO	NO	NO	166.39		15.95
1. Refrigeration and Air Conditioning Equipment	2.44	12.72	NO	NO	79.40	NO	350.61	1.05	NO	73.15	NO	NO	NO	NO		NO	NO	0.92	NO	NO	NO	NO	NO		NA
2. Foam Blowing	NO	NO	NO	NO	NO	NO	9.52	87.10	NO	NO	NO	NO	NO	NO		NO	NO	NO	NO	NO	NO	NO	NO		NA
3. Fire Extinguishers	0.86	NO	NO	NO	NO	NO	NO	NO	NO	NO	0.00	NO	NO	NO		NO	NO	NO	NO	NO	NO	NO	NO		NA
4. Aerosols/Metered Dose Inhalers	NO	NO	NO	NO	NO	NO	17.73	NO	NO	NO	NO	NO	NO	NA		NO	NO	NO	NO	NO	NO	NO	NO		NA
5. Solvents	NO	NO	NO	NO	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	7.39		IE	IE	IE	NO	IE	NO	NO	166.39		4.42
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		1.06
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	0.11	NO	NO	NO	NO	NO		10.46
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		10.38
Research and other use	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NA		NO	NO	0.11	NO	NO	NO	NO	NO		0.08
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)

Inventory 2008
Submission 2010 v1.3
AUSTRIA

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]	7.89	22.80	NE,NO	NE,NO	104.09	NE,NO	296.13	80.64	NE,NO	88.64	3.48	NE,NO	NE,NO	19.91		IE,NE,NO	IE,NE,NO	0.92	IE,NE,NO	IE,NO	NO	NO	421.90		17.81
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:	7.89	22.80	NE,NO	NE,NO	104.09	NE,NO	296.13	80.64	NE,NO	88.64	3.48	NE,NO	NE,NO	19.91		IE,NO	IE,NO	0.92	NO	IE,NO	NO	NO	421.90		17.81
In bulk	7.89	22.80	NO	NO	104.09	NO	296.13	80.64	NO	88.64	3.48	NO	NO	19.91		IE	IE	0.92	NO	IE	NO	NO	421.90		17.81
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))	38.60	8.27	NA,NO	NA,NO	222.32	NA,NO	491.22	12.34	NA,NO	277.96	0.01	NA,NO	NA,NO	7.39	1 058.10	IE,NA,NO	IE,NA,NO	7.15	NA,NO	IE,NA,NO	NA,NO	NA,NO	166.39	173.53	381.44
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	0.32
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	38.60	8.27	NO	NO	222.32	NO	491.22	12.34	NO	277.96	0.01	NO	NO	7.39	1 058.10	IE,NO	IE,NO	7.15	NO	IE,NO	NO	NO	166.39	173.53	381.12
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.)	38.60	8.27	NO	NO	222.32	NO	491.22	12.34	NO	277.96	0.01	NO	NO	7.39	1 058.10	IE,NO	IE,NO	7.15	NO	IE,NO	NO	NO	166.39	173.53	381.12
Potential emissions - F(p) [8] (Gg CO_2 eq.)	92.36	14.82	NE,NO	NE,NO	291.44	NE,NO	384.96	11.29	NE,NO	336.82	10.09	NE,NO	NE,NO	19.91	1 161.70	IE,NE,NO	IE,NE,NO	6.41	IE,NE,NO	IE,NO	NO	NO	421.90	428.30	425.71
Potential/Actual emissions ratio	2.39	1.79	NE,NO	NE,NO	1.31	NE,NO	0.78	0.91	NE,NO	1.21	1 201.90	NE,NO	NE,NO	2.70	1.10	IE,NE,NO	IE,NE,NO	0.90	IE,NE,NO	IE,NO	NO	NO	2.54	2.47	1.12

[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)

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	0.01	NO
PFCs from Aluminium Production	Aluminium production	NO	NO	NO		NO	NO	NO	NO		
SF_6 used in Aluminium and Magnesium Foundries										0.01	NO
Aluminium Foundries	cast Aluminium [t]	C			C					0.01	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)

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 information
- 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)

Inventory 2008
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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	62.40	38.20	NA	0.30	30.00	NO	0.19	11.46
Commercial Refrigeration									
C3F8	NO	6.37	NO	NA	14.36	NA	NO	0.92	NO
HFC-125	56.82	375.41	20.63	0.17	13.64	30.00	0.10	51.19	6.19
HFC-134a	85.58	737.52	25.20	0.16	13.81	30.00	0.14	101.86	7.56
HFC-143a	62.64	364.64	24.35	0.17	13.71	30.00	0.11	50.01	7.31
HFC-152a	NO	4.08	NO	NA	14.37	NA	NO	0.59	NO
HFC-23	2.43	19.36	NO	0.20	12.56	NA	0.00	2.43	NO
HFC-32	3.25	36.94	NO	0.20	13.11	NA	0.01	4.84	NO
Transport Refrigeration									
HFC-125	NO	16.51	1.09	NA	29.00	30.00	NO	4.79	0.33
HFC-134a	NO	10.06	0.66	NA	29.00	30.00	NO	2.92	0.20
HFC-143a	NO	16.63	1.10	NA	29.00	30.00	NO	4.82	0.33
HFC-152a	NO	0.21	0.01	NA	29.00	30.00	NO	0.06	0.00
HFC-32	NO	2.39	0.16	NA	29.00	30.00	NO	0.69	0.05
Industrial Refrigeration									
HFC-125	8.72	71.18	6.56	0.15	7.01	30.00	0.01	4.99	1.97
HFC-134a	3.03	47.88	1.90	0.15	7.06	30.00	0.00	3.38	0.57
HFC-143a	8.19	59.39	6.73	0.15	7.05	30.00	0.01	4.19	2.02
HFC-152a	NO	NO	NO	NO	NO	NO	NO	NO	NO
HFC-32	0.95	17.76	0.33	0.15	6.97	30.00	0.00	1.24	0.10
Stationary Air-Conditioning									
HFC-125	9.17	175.94	1.48	0.06	5.34	30.00	0.01	9.39	0.44
HFC-134a	33.02	500.03	26.68	0.06	7.62	30.00	0.02	38.08	8.00
HFC-143a	4.92	54.90	1.75	0.06	6.98	30.00	0.00	3.83	0.52
HFC-152a	NO	3.68	NO	NA	10.78	NA	NO	0.40	NO
HFC-32	4.69	126.22	NO	0.05	4.59	NA	0.00	5.79	NO
Mobile Air-Conditioning									
HFC-134a	151.37	1 514.35	67.79	0.60	10.24	30.00	0.90	155.00	20.34
2. Foam Blowing[(1)]									
Hard Foam									
HFC-134a	1.01	1 593.75	NO	1.50	0.60	NA	0.02	9.51	NO
HFC-152a	79.61	7.48	NO	100.00	100.00	NA	79.61	7.48	NO
Soft Foam									
HFC-134a	NO	NO	NO	NO	NO	NO	NO	NO	NO
HFC-152a	NO	NO	NO	NO	NO	NO	NO	NO	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)

Inventory 2008
Submission 2010 v1.3
AUSTRIA

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)									
C4F10	NO	NO	NO	NO	NO	NO	NO	NO	NO
HFC-227ea	4.62	30.95	0.06	0.05	NO	1.00	0.00	NO	0.00
HFC-23	5.31	48.39	0.26	0.05	1.77	1.00	0.00	0.86	0.00
4. Aerosols (1)									
Metered Dose Inhalers									
HFC-134a	2.69	17.73	NO	1.50	100.00	NA	IE	17.73	NO
Other									
5. Solvents (1)									
HFC-43-10 mee	NO	NO	NO	NA	NA	NA	NO	NO	NO
6. Other applications using ODS(2) substitutes (1)									
7. Semiconductor Manufacture (1)									
SF6	NO	5.98	NO	NA	74.03	NA	NO	4.42	NO
Unspecified mix of HFCs	NO	19 913.40	NO	NA	37.10	NA	NO	7 388.55	NO
Unspecified mix of PFCs	NO	421 898.00	NO	NA	39.44	NA	NO	166 385.00	NO
8. Electrical Equipment(1)									
SF6	11.84	176.41	0.09	0.63	0.56	2.00	0.07	0.99	0.00
9. Other *(please specify)* (1)									
Double glaze windows									
SF6	NO	222.37	8.16	33.00	1.00	100.00	NO	2.22	8.16
Research and other use									
C3F8	NO	NO	0.11	NA	NA	100.00	NA	NA	0.11
SF6	0.01	0.77	0.15	NA	6.06	20.57	NO	0.05	0.03

(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)

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	**CO_2**	**N_2O**	**NMVOC**
	(Gg)		
Total Solvent and Other Product Use	231.86	0.51	97.11
A. Paint Application	72.49		27.26
B. Degreasing and Dry Cleaning	35.27	NA	13.34
C. Chemical Products, Manufacture and Processing	15.54		8.24
D. Other	108.56	0.51	48.27
1. Use of N_2O for Anaesthesia		0.11	
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)*	108.56	NA	48.27
Other non-specified	108.56	NA	48.27

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 2008
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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]	62.73	1.16	
B. Degreasing and Dry Cleaning	Solvents used [kt]	24.10	1.46	NA
C. Chemical Products, Manufacture and Processing	Solvents used [kt]	16.20	0.96	
D. Other				
1. Use of N_2O for Anaesthesia	Use of N2O for Anaesthesia [kt]	1.12		0.09
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]	65.28	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 2008
Submission 2010 v1.3
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GREENHOUSE GAS SOURCE AND SINK CATEGORIES	CH_4	N_2O	NO_x	CO	NMVOC
	(Gg)				
Total Agriculture	**168.98**	13.17	6.09	1.05	1.95
A. Enteric Fermentation	153.52				
1. Cattle (1)	143.80				
Option A:					
Dairy Cattle	61.29				
Non-Dairy Cattle	82.51				
Option B:					
Mature Dairy Cattle					
Mature Non-Dairy Cattle					
Young Cattle					
2. Buffalo	NO				
3. Sheep	2.67				
4. Goats	0.31				
5. Camels and Llamas	NO				
6. Horses	1.57				
7. Mules and Asses	IE				
8. Swine	4.60				
9. Poultry	0.25				
10. Other *(as specified in table 4.A)*	0.33				
Deer	0.33				
B. Manure Management	14.99	2.94			NE,NO
1. Cattle (1)	10.33				
Option A:					
Dairy Cattle	4.50				
Non-Dairy Cattle	5.82				
Option B:					
Mature Dairy Cattle					
Mature Non-Dairy Cattle					
Young Cattle					
2. Buffalo	NO				
3. Sheep	0.06				
4. Goats	0.01				
5. Camels and Llamas	NO				
6. Horses	0.11				
7. Mules and Asses	IE				
8. Swine	3.52				
9. Poultry	0.96				
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)

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		0.08			NE
13. Solid Storage and Dry Lot		2.16			NE
14. Other AWMS		0.70			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)	0.41	10.23			1.84
1. Direct Soil Emissions	0.41	6.06			1.84
2. Pasture, Range and Paddock Manure (3)		0.30			NA
3. Indirect Emissions	NA	3.87			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	1.05	0.10
1 . Cereals	0.04	0.00	0.03	0.84	0.05
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	0.21	0.05
Vine	0.02	0.00	0.00	0.21	0.05
G. Other *(please specify)*	**NA**	**NA**	**6.06**	**NA**	**NA**
NOX from Agricultural Soils	NA	NA	6.06	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.
- 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 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.

TABLE 4.A SECTORAL BACKGROUND DATA FOR AGRICULTURE
Enteric Fermentation
(Sheet 1 of 1)

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	1 997.21			72.00
Option A:				
Dairy Cattle [(4)]	530.23	293.73	6.00	115.59
Non-Dairy Cattle	1 466.98	142.93	6.00	56.25
Option B:				
Mature Dairy Cattle				
Mature Non-Dairy Cattle				
Young Cattle				
2. Buffalo	NO	NO	NO	NO
3. Sheep	333.18	20.00	6.00	8.00
4. Goats	62.49	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	3 064.23	38.00	0.60	1.50
9. Poultry	13 027.15	1.80	0.16	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	424.46				NO	NA	NA	NO	NA	NA	NA	NA		NA
Feeding situation [(c)]		Stall/Pastur	Stall/Pastu				NO	NA	NA	NO	NA	NA	NA	NA		NA
Milk yield	(kg/day)	16.60	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	16.35	0.00	0.00	0.00	NO	NA	NA	NO	NA	NA	NA	NA		NA
Digestibility of feed	(%)	70.07	72.96	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)

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	ACTIVITY DATA AND OTHER RELATED INFORMATION							IMPLIED EMISSION FACTORS (4)
		Allocation by climate region						
	Population size (1000s)	Cool	Temperate	Warm	Typical animal mass (average) (kg)	VS(2) daily excretion (average) (kg dm/head/day)	CH_4 producing potential (Bo)(2) (average) (m^3 CH_4/kg VS)	CH_4 (kg CH_4/head/yr)
		(%)						
1. Cattle	1 997.21							5.17
Option A:								
Dairy Cattle (3)	530.23	100.00	NO	NO	700.00	4.24	0.24	8.49
Non-Dairy Cattle	1 466.98	0.00	NO	NO	424.46	1.95	0.17	3.97
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	333.18	0.00	NO	NO	43.00	0.40	0.19	0.19
4. Goats	62.49	0.00	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	0.00	NO	NO	238.00	1.72	0.33	1.24
7. Mules and Asses	IE	IE	NO	NO	IE	IE	IE	IE
8. Swine	3 064.23	0.00	NO	NO	82.00	0.36	0.45	1.15
9. Poultry	13 027.15	0.00	NO	NO	1.10	0.10	0.32	0.07
10. Other livestock *(please specify)*								
Deer	41.19	NA	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 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.

TABLE 4.B(a) SECTORAL BACKGROUND DATA FOR AGRICULTURE
CH_4 Emissions from Manure Management
(Sheet 2 of 2)

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	30,13	NO	49,02	NO	2,91	17,93
		Temperate	NO	NO	NO	NO	NO	NO	NO
		Warm	NO	NO	NO	NO	NO	NO	NO
	MCF[(b)]	Cool	NA	8,63	NA	1.00	NO	1.00	1,9
		Temperate	NO	NO	NO	NO	NO	NO	NO
		Warm	NO	NO	NO	NO	NO	NO	NO
Non-Dairy Cattle	Allocation (%)	Cool	NO	20,73	NO	44,27	NO	4,91	30,09
		Temperate	NO	NO	NO	NO	NO	NO	NO
		Warm	NO	NO	NO	NO	NO	NO	NO
	MCF[(b)]	Cool	NA	8,28	NA	1.00	NO	1.00	10,09
		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	IE	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	IE	IE	IE
		Temperate	NO	NO	NO	NO	NO	NO	NO
		Warm	NO	NO	NO	NO	NO	NO	NO
Swine	Allocation (%)	Cool	NO	78,42	NO	2,89	NO	NO	18,68
		Temperate	NO	NO	NO	NO	NO	NO	NO
		Warm	NO	NO	NO	NO	NO	NO	NO
	MCF[(b)]	Cool	NA	3,39	NO	1.00	NO	1.00	9,47
		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
N_2O Emissions from Manure Management
(Sheet 1 of 1)

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	1 997.21		NO	30 615 542.30	NO	54 548 578.91	5 933 512.97	28 627 064.36
Option A:								
Dairy Cattle	530.23	97.03	NO	15 503 460.69	NO	25 222 520.92	1 497 219.48	9 227 640.16
Non-Dairy Cattle	1 466.98	46.54	NO	15 112 081.62	NO	29 326 057.99	4 436 293.49	19 399 424.20
Option B:								
Mature Dairy Cattle								
Mature Non-Dairy Cattle								
Young Cattle								
Sheep	333.18	13.10	NO	NO	NO	2 182 335.55	2 182 335.55	NO
Swine	3 064.23	12.71	NO	21 529 402.04	NO	1 827 128.66	NO	6 152 743.10
Poultry	13 027.15	0.55	NO	247 840.99	NO	6 493 424.86	NO	423 066.01
Buffalo	NO	NO	NO	NO	NO	NO	NO	NO
Goats	62.49	12.30	NO	NO	NO	384 313.50	384 313.50	NO
Camels and Llamas	NO	NO	NO	NO	NO	NO	NO	NO
Horses	87.07	47.90	NO	NO	NO	2 885 463.38	834 149.76	451 135.66
Mules and Asses	IE	IE	IE	IE	IE	IE	IE	IE
Other livestock *(please specify)*								
Deer	41.19	13.10	NO	NO	NO	269 794.50	269 794.50	NO
Total per AWMS			IE,NO	52 392 785.33	IE,NO	68 591 039.37	9 604 106.28	35 654 009.13

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	0.01

(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

TABLE 4.C SECTORAL BACKGROUND DATA FOR AGRICULTURE

Rice Cultivation

(Sheet 1 of 1)

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 2008

Submission 2010 v1.3

AUSTRIA

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**			6.06
1. Synthetic Fertilizers	Nitrogen input from application of synthetic fertilizers	114 747 030.00	0.01	2.25
2. Animal Manure Applied to Soils	Nitrogen input from manure applied to soils	110 605 245.97	0.01	2.17
3. N-fixing Crops	Nitrogen fixed by N-fixing crops	21 165 005.20	0.01	0.42
4. Crop Residue	Nitrogen in crop residues returned to soils	60 657 661.66	0.01	1.19
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)	1 285 723.42	0.01	0.03
2. Pasture, Range and Paddock Manure	**N excretion on pasture range and paddock**	9 604 106.28	0.02	0.30
3. Indirect Emissions				3.87
1. Atmospheric Deposition	Volatized N from fertilizers, animal manures and other	49 331 662.92	0.01	0.78
2. Nitrogen Leaching and Run-off	N from fertilizers, animal manures and other that is lost through leaching and run-off	78 766 694.79	0.02	3.09
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 2008

Agricultural Soils[1]

Submission 2010 v1.3

(Sheet 2 of 2)

AUSTRIA

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	0.03
$Frac_{GASM}$	Fraction of livestock N excretion that volatilizes as NH_3 and NOx	0.27
$Frac_{GRAZ}$	Fraction of livestock N excreted and deposited onto soil during grazing	0.06
$Frac_{LEACH}$	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
Prescribed Burning of Savannas
(Sheet 1 of 1)

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

Field Burning of Agricultural Residues

(Sheet 1 of 1)

Inventory 2008
Submission 2010 v1.3
AUSTRIA

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	ACTIVITY DATA AND OTHER RELATED INFORMATION								IMPLIED EMISSION FACTORS		EMISSIONS	
	Crop production	Residue/ Crop ratio	Dry matter (dm) fraction of residue	Fraction burned in fields	Fraction oxidized	Total biomass burned	C fraction of residue	N-C ratio in biomass residues	CH_4	N_2O	CH_4	N_2O
	(t)					(Gg dm)			(kg/t dm)		(Gg)	
1. Cereals											0.04	0.00
Wheat	5 714 313.74	1.30	0.86	0.00	0.90	13.73	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	0.80	NA	NA	2.99	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)

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	**-17 655.21**	**0.00**	**1.03**	**IE,NA,NE**	**IE,NA,NE**	**NA,NE**
A. Forest Land	**-19 512.08**	**0.00**	**0.15**	**NE**	**NE**	**NE**
1. Forest Land remaining Forest Land	-16 974.32	0.00	0.15	NE	NE	NE
2. Land converted to Forest Land	-2 537.76	NO	NO	NE	NE	NE
B. Cropland	**1 789.46**	**NA,NO**	**0.88**	**IE**	**IE**	**NE**
1. Cropland remaining Cropland	1.87	NA	NA	IE	IE	NE
2. Land converted to Cropland	1 787.59	NO	0.88	IE	IE	NE
C. Grassland	**-1 283.77**	**NO**	**NO**	**IE**	**IE**	**NE**
1. Grassland remaining Grassland	46.57	NO	NO	IE	IE	NE
2. Land converted to Grassland	-1 330.34	NO	NO	IE	IE	NE
D. Wetlands	**376.97**	**NO**	**NO**	**NA**	**NA**	**NA**
1. Wetlands remaining Wetlands [(3)]	NE,NO	NO	NO	NA	NA	NA
2. Land converted to Wetlands	376.97	NO	NO	NA	NA	NA
E. Settlements	**517.46**	**NA,NO**	**NA,NO**	**NA**	**NA**	**NA**
1. Settlements remaining Settlements [(3)]	NE,NO	NA	NA	NA	NA	NA
2. Land converted to Settlements	517.46	NA	NA	NA	NA	NA
F. Other Land	**456.74**	**NA,NO**	**NA,NO**	**NA**	**NA**	**NA**
1. Other Land remaining Other Land [(4)]						
2. Land converted to Other Land	456.74	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	1 252.31	NA	NA	NA	NA	NA
Grassland converted to other Land-Use Categories	947.85	NE	0.88	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)

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		3 994.00	NA,NO	2.71	-1.54	1.17	0.04	0.12	NO	10 839.93	-6 154.85	4 685.08	163.95	472.45	NO	-19 512.08
1. Forest Land remaining Forest Land		3 769.32	NA,NO	2.81	-1.62	1.18	0.04	NO	NO	10 575.70	-6 110.30	4 465.41	163.95	NO	NO	-16 974.32
	Coniferous	2 495.68	NA	3.15	-1.97	1.17	0.05	NO	NO	7 850.30	-4 924.17	2 926.13	124.51	NO	NO	-11 185.70
	Deciduous	886.00	NA	3.08	-1.34	1.74	0.04	NO	NO	2 725.40	-1 186.13	1 539.28	39.44	NO	NO	-5 788.61
	Unmanaged forest	387.63	NO	NA	NA	NA	NA	NO	NO	NA	NA	NA	NA	NO	NO	NA,NO
2. Land converted to Forest Land(10)		224.68	NO	1.18	-0.20	0.98	IE	2.10	NO	264.23	-44.56	219.67	IE	472.45	NO	-2 537.76
2.1 Cropland converted to Forest Land		35.95	NO	1.18	IE	1.18	IE	3.02	NO	42.28	IE	42.28	IE	108.41	NO	-552.53
	Total	35.95	NO	1.18	IE	1.18	IE	3.02	NO	42.28	IE	42.28	IE	108.41	NO	-552.53
2.2 Grassland converted to Forest Land		132.56	NO	1.18	IE	1.18	IE	0.97	NO	155.89	IE	155.89	IE	128.51	NO	-1 042.81
	Total	132.56	NO	1.18	IE	1.18	IE	0.97	NO	155.89	IE	155.89	IE	128.51	NO	-1 042.81
2.3 Wetlands converted to Forest Land		11.23	NO	1.18	IE	1.18	IE	4.55	NO	13.21	IE	13.21	IE	51.16	NO	-236.04
	Total	11.23	NO	1.18	IE	1.18	IE	4.55	NO	13.21	IE	13.21	IE	51.16	NO	-236.04
2.4 Settlements converted to Forest Land		31.46	NO	1.18	-1.42	-0.24	IE	3.91	NO	36.99	-44.56	-7.56	IE	122.86	NO	-422.75
	Total	31.46	NO	1.18	-1.42	-0.24	IE	3.91	NO	36.99	-44.56	-7.56	IE	122.86	NO	-422.75
2.5 Other Land converted to Forest Land		13.48	NO	1.18	IE	1.18	IE	4.56	NO	15.85	IE	15.85	IE	61.50	NO	-283.63
	Total	13.48	NO	1.18	IE	1.18	IE	4.56	NO	15.85	IE	15.85	IE	61.50	NO	-283.63

(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
Cropland
(Sheet 1 of 1)

Inventory 2008
Submission 2010 v1.3
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		1 443.74	NO	0.05	-0.03	0.02	IE,NO	-0.34	NO	71.05	-44.66	26.40	IE,NO	-490.36	NO	1 701.18
1. Cropland remaining Cropland		899.93	NO	IE	-0.04	-0.04	NO	0.07	NO	IE	-39.48	-39.48	NO	63.04	NO	-86.41
	Annual converted t	12.47	NO	IE	-0.19	-0.19	NO	0.35	NO	IE	-2.41	-2.41	NO	4.36	NO	-7.17
	Annual remaining a	878.21	NO	IE	-0.03	-0.03	NO	0.07	NO	IE	-24.94	-24.94	NO	61.91	NO	-135.58
	Perennial converted	9.24	NO	IE	-1.31	-1.31	NO	-0.35	NO	IE	-12.13	-12.13	NO	-3.24	NO	56.34
2. Land converted to Cropland(12)		543.81	NO	0.13	-0.01	0.12	IE,NO	-1.02	NO	71.05	-5.18	65.88	IE,NO	-553.40	NO	1 787.59
2.1 Forest Land converted to Cropland		5.28	NO	IE	-0.91	-0.91	IE	-2.94	NO	IE	-4.81	-4.81	IE	-15.53	NO	74.59
	Total	5.28	NO	IE	-0.91	-0.91	IE	-2.94	NO	IE	-4.81	-4.81	IE	-15.53	NO	74.59
2.2 Grassland converted to Cropland		538.53	NO	0.13	0.00	0.13	NO	-1.00	NO	71.05	-0.37	70.69	NO	-537.87	NO	1 713.00
	Grassland converte	536.65	NO	0.13	IE	0.13	NO	-1.00	NO	71.05	IE	71.05	NO	-536.65	NO	1 707.19
	Grassland converte	1.88	NO	IE	-0.19	-0.19	NO	-0.65	NO	IE	-0.37	-0.37	NO	-1.22	NO	5.82
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

Grassland

(Sheet 1 of 1)

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		1 796.17	IE,NO	IE,NO	-0.04	-0.04	IE,NO	0.23	IE,NO	IE,NO	-65.95	-65.95	IE,NO	416.07	IE,NO	-1 283.77
1. Grassland remaining Grassland		1 262.69	IE	NO	NO	NO	NO	-0.01	IE	NO	NO	NO	NO	-12.70	IE	46.57
	Total	1 262.69	IE	NO	NO	NO	NO	-0.01	IE	NO	NO	NO	NO	-12.70	IE	46.57
2. Land converted to Grassland(12)		533.48	NO	IE,NO	-0.12	-0.12	IE,NO	0.80	NO	IE,NO	-65.95	-65.95	IE,NO	428.77	NO	-1 330.34
2.1 Forest Land converted to Grassland		56.00	NO	IE	-0.91	-0.91	IE	-0.85	NO	IE	-51.02	-51.02	IE	-47.77	NO	362.22
	Total	56.00	NO	IE	-0.91	-0.91	IE	-0.85	NO	IE	-51.02	-51.02	IE	-47.77	NO	362.22
2.2 Cropland converted to Grassland		477.48	NO	IE	-0.03	-0.03	NO	1.00	NO	IE	-14.93	-14.93	NO	476.54	NO	-1 692.56
	Annual cropland co	474.80	NO	IE	-0.03	-0.03	NO	1.00	NO	IE	-12.53	-12.53	NO	474.80	NO	-1 694.97
	Perennial cropland	2.68	NO	IE	-0.90	-0.90	NO	0.65	NO	IE	-2.40	-2.40	NO	1.74	NO	2.41
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)

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		144.26	IE,NE,NO	-0.11	-0.11	IE,NE,NO	-0.61	IE,NE,NO	-15.30	-15.30	IE,NE,NO	-87.51	376.97
1. Wetlands remaining Wetlands(7)		121.66	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE
	Total	121.66	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE
2. Land converted to Wetlands (8)		22.60	IE,NO	-0.68	-0.68	IE,NO	-3.87	IE,NO	-15.30	-15.30	IE,NO	-87.51	376.97
2.1 Forest Land converted to Wetlands		3.17	IE	-0.91	-0.91	IE	-6.05	IE	-2.89	-2.89	IE	-19.18	80.91
	Total	3.17	IE	-0.91	-0.91	IE	-6.05	IE	-2.89	-2.89	IE	-19.18	80.91
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		14.22	NO	NO	NO	NO	-3.50	NO	NO	NO	NO	-49.78	182.53
	Total	14.22	NO	NO	NO	NO	-3.50	NO	NO	NO	NO	-49.78	182.53
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		5.21	IE	-2.38	-2.38	NO	-3.56	IE	-12.41	-12.41	NO	-18.55	113.53
	Total	5.21	IE	-2.38	-2.38	NO	-3.56	IE	-12.41	-12.41	NO	-18.55	113.53

(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

Settlements

(Sheet 1 of 1)

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		513.02	0.22	-0.15	0.07	IE,NO	-0.35	112.70	-74.79	37.92	IE,NO	-179.04	517.46
1. Settlements remaining Settlements(8)		338.54	NE	NE	NE	NO	NE	NE	NE	NE	NO	NE	NE,NO
	Total	338.54	NE	NE	NE	NO	NE	NE	NE	NE	NO	NE	NE,NO
2. Land converted to Settlements (9)		174.48	0.65	-0.43	0.22	IE,NO	-1.03	112.70	-74.79	37.92	IE,NO	-179.04	517.46
2.1 Forest Land converted to Settlements		15.85	0.58	-0.91	-0.33	IE	-4.45	9.23	-14.44	-5.21	IE	-70.57	277.85
	Total	15.85	0.58	-0.91	-0.33	IE	-4.45	9.23	-14.44	-5.21	IE	-70.57	277.85
2.2 Cropland converted to Settlements		52.92	0.78	-1.14	-0.36	NO	NO	41.09	-60.35	-19.26	NO	NO	70.62
	Total	52.92	0.78	-1.14	-0.36	NO	NO	41.09	-60.35	-19.26	NO	NO	70.62
2.3 Grassland converted to Settlements		61.13	0.58	NO	0.58	NO	-1.00	35.18	NO	35.18	NO	-61.13	95.12
	Total	61.13	0.58	NO	0.58	NO	-1.00	35.18	NO	35.18	NO	-61.13	95.12
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		44.58	0.61	NO	0.61	NO	-1.06	27.20	NO	27.20	NO	-47.35	73.88
	Total	44.58	0.61	NO	0.61	NO	-1.06	27.20	NO	27.20	NO	-47.35	73.88

(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)

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		495.81	IE,NO	-0.05	-0.05	IE,NO	-0.20	IE,NO	-23.10	-23.10	IE,NO	-101.46	456.74
1. Other Land remaining Other Land[7]		470.45											
2. Land converted to Other Land [8]		25.36	IE,NO	-0.91	-0.91	IE,NO	-4.00	IE,NO	-23.10	-23.10	IE,NO	-101.46	456.74
2.1 Forest Land converted to Other Land		25.36	IE	-0.91	-0.91	IE	-4.00	IE	-23.10	-23.10	IE	-101.46	456.74
	Total	25.36	IE	-0.91	-0.91	IE	-4.00	IE	-23.10	-23.10	IE	-101.46	456.74
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

Direct N_2O emissions from N fertilization(1) of Forest Land and Other

(Sheet 1 of 1)

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 sep

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

Non-CO_2 emissions from drainage of soils and wetlands[1]

(Sheet 1 of 1)

Inventory 2008
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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	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 differe

[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 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 2008

N_2O emissions from disturbance associated with land-use conversion to cropland (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]	**538.53**	**1.04**	**0.88**
B. Cropland	**538.53**	**1.04**	**0.88**
2. Lands converted to Cropland [6]	538.53	1.04	0.88
Organic Soils	NO	NO	NO
Mineral Soils	538.53	1.04	0.88
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	538.53	1.04	0.88
Organic Soils	NO	NO	NO
Mineral Soils	538.53	1.04	0.88
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

CO_2 emissions from agricultural lime application (1)

(Sheet 1 of 1)

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)	**200 626.32**	**0.12**	**88.28**
B. Cropland (6) (7)	**200 626.32**	**0.12**	**88.28**
Limestone $CaCO_3$	200 626.32	0.12	88.28
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 cat

(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 2008

Biomass Burning [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	**Area burned**	**ha**	**50.00**	**IE,NA,NO**	**0.00**	**2.91**	**IE,NA,NO**	**0.00**	**0.15**
A. Forest Land			**50.00**	**IE,NO**	**0.00**	**2.91**	**IE,NO**	**0.00**	**0.15**
1. Forest land remaining Forest Land			50.00	IE,NO	0.00	2.91	IE,NO	0.00	0.15
Controlled Burning	(specify)	ha	NO	NO	NO	NO	NO	NO	NO
Wildfires	(specify)	ha	50.00	IE	0.00	2.91	IE	0.00	0.15
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	**Area burned**		**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	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
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	**Area burned**	**ha**	**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	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
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	**Area burned**	**ha**	**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	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
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)

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	**CO_2[(1)]**	**CH_4**	**N_2O**	**NO_x**	**CO**	**NMVOC**	**SO_2**
	(Gg)						
Total Waste	**12.26**	**78.21**	**1.19**	**0.05**	**5.23**	**0.07**	**0.06**
A. Solid Waste Disposal on Land	**NA,NO**	**74.16**		**NA,NO**	**5.22**	**0.07**	
1. Managed Waste Disposal on Land	NA	74.16		NA	5.22	0.07	
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		**1.50**	**0.84**	**NA**	**NA**	**NA**	
1. Industrial Wastewater		IE,NA	0.18	NA	NA	NA	
2. Domestic and Commercial Waste Water		1.50	0.66	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**	**2.55**	**0.35**	**NA**	**NA**	**NA**	**NA**
Compost production	NA	2.55	0.35	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)

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	449.25	1.00	16.17	0.20	NA	74.16	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)]	**8 336.55**
Urban population (1000s)[(a)]	5 412.23
Waste generation rate (kg/capita/day)	0.15
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)]	59.00

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	IMPLIED EMISSION FACTOR			EMISSIONS		
	Amount of incinerated wastes	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
Hospital waste	3.10	836.00	0.10	0.01	2.59	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

[(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
Waste Water Handling
(Sheet 1 of 2)

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	ACTIVITY DATA AND RELATED INFORMATION(1)	IMPLIED EMISSION FACTOR		EMISSIONS		
				CH_4		
	Total organic product	CH_4 (2)	N_2O(3)	Emissions (4)	Recovery (5)	N_2O (3)
	(Gg DC(1)/yr)	(kg/kg DC)		(Gg)		
1. Industrial Waste Water				IE,NA	NA	0.18
a. Waste Water	510.00	NA	0.00	NA	NA	0.18
b. Sludge	NA	IE	NA	IE	NA	IE
2. Domestic and Commercial Wastewater				1.50	NA	0.66
a. Waste Water	334.71	0.00	NA	1.50	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)	8 336.55	39.06	0.16	0.01	0.66

(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
Waste Water Handling
(Sheet 2 of 2)

Additional information

	Domestic	Industrial
Total waste water (m^3):	1 061 381 000.00	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	NA	NA
Fertilizers	NA	NA
Food and beverage	NA	NA
Paper and pulp	NA	NA
Organic chemicals	NA	NA
Other (please specify)	NA	NA
Chemical		
Dairy Processing		
Electricity, steam, water production		
Fuels		
Iron and steel		
Leather and Skins		
Leather industry		
Machinery and equipment		
Meat industry		
Mining and quarrying		
Other agricultural		
Poultry		
Rubber		
Textile		
Wood and wood production		
Wool Scouring		
	DC (kg BOD/1000 person/yr)	
Domestic and Commercial	NA	
Other (please specify)		

Handling systems:	Industrial waste water treated (%)	Industrial sludge treated (%)	Domestic waste water treated (%)	Domestic sludge treated (%)
Aerobic	0.00	NA	0.00	NA
Anaerobic	100.00	NA	100.00	NA
Other (please specify)	0.00	NA	0.00	NA

SUMMARY 1.A SUMMARY REPORT FOR NATIONAL GREENHOUSE GAS INVENTORIES (IPCC TABLE 7A)
(Sheet 1 of 3)

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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	**55 975.01**	**272.22**	**19.35**	**1 161.70**	**1 058.10**	**428.30**	**173.53**	**0.02**	**0.02**	**205.61**	**694.32**	**162.94**	**22.35**
1. Energy	**63 473.61**	**24.14**	**2.41**							**197.87**	**663.52**	**59.07**	**21.06**
A. Fuel Combustion — Reference Approach (2)	67 248.58												
Sectoral Approach (2)	63 261.45	12.01	2.41							197.87	663.52	56.82	20.90
1. Energy Industries	13 422.88	0.28	0.32							13.44	4.12	0.63	3.16
2. Manufacturing Industries and Construction	15 996.58	0.62	0.49							33.55	152.26	2.27	10.56
3. Transport	22 254.52	0.88	0.84							125.93	194.23	18.58	0.22
4. Other Sectors	11 542.31	10.23	0.75							24.87	312.64	35.33	6.95
5. Other	45.17	0.00	0.00							0.08	0.27	0.02	0.01
B. Fugitive Emissions from Fuels	212.16	12.13	IE,NA							IE,NA	IE,NA	2.25	0.16
1. Solid Fuels	IE,NA,NO	IE,NA,NO	IE,NA							IE,NA	IE,NA	IE,NA	IE,NA
2. Oil and Natural Gas	212.16	12.13	IE,NA							IE,NA	IE,NA	2.25	0.16
2. Industrial Processes	**9 912.49**	**0.89**	**1.05**	**1 161.70**	**1 058.10**	**428.30**	**173.53**	**0.02**	**0.02**	**1.59**	**24.51**	**4.74**	**1.23**
A. Mineral Products	3 530.92	NA	NA							NA	9.78	IE,NA	NA
B. Chemical Industry	593.35	0.88	1.05	NO	NO	NO	NO	NO	NO	0.42	11.11	1.32	0.77
C. Metal Production	5 788.22	0.00	NA				NO		0.00	0.12	2.85	0.50	0.46
D. Other Production (3)	NA									1.06	0.77	2.92	NA
E. Production of Halocarbons and SF_6					NA		NA		NA				
F. Consumption of Halocarbons and SF_6				1 161.70	1 058.10	428.30	173.53	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)

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	**231.86**		**0.51**							**NA**	**NA**	**97.11**	**NA**
4. Agriculture		**168.98**	**13.17**							**6.09**	**1.05**	**1.95**	**0.00**
A. Enteric Fermentation		153.52											
B. Manure Management		14.99	2.94									NE,NO	
C. Rice Cultivation		NO										NO	
D. Agricultural Soils(4)		0.41	10.23									1.84	
E. Prescribed Burning of Savannas		NO	NO							NO	NO	NO	
F. Field Burning of Agricultural Residues		0.06	0.00							0.03	1.05	0.10	
G. Other		NA	NA							6.06	NA	NA	0.00
5. Land Use, Land-Use Change and Forestry	(5) **-17 655.21**	**0.00**	**1.03**							**IE,NA,NE**	**IE,NA,NE**	**NA,NE**	**NA**
A. Forest Land	(5) -19 512.08	0.00	0.15							NE	NE	NE	
B. Cropland	(5) 1 789.46	NA,NO	0.88							IE	IE	NE	
C. Grassland	(5) -1 283.77	NO	NO							IE	IE	NE	
D. Wetlands	(5) 376.97	NO	NO							NA	NA	NA	
E. Settlements	(5) 517.46	NA,NO	NA,NO							NA	NA	NA	
F. Other Land	(5) 456.74	NA,NO	NA,NO							NA	NA	NA	
G. Other	(5) NE	NA	NA							NA	NA	NA	NA
6. Waste	**12.26**	**78.21**	**1.19**							**0.05**	**5.23**	**0.07**	**0.06**
A. Solid Waste Disposal on Land	(6) NA,NO	74.16								NA,NO	5.22	0.07	
B. Waste-water Handling		1.50	0.84							NA	NA	NA	
C. Waste Incineration	(6) 12.26	0.00	0.00							0.05	0.01	0.00	0.06
D. Other	NA	2.55	0.35							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)

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	**2 213.42**	**0.04**	**0.08**							**9.18**	**2.76**	**0.97**	**0.70**
Aviation	2 181.97	0.04	0.07							8.82	2.44	0.92	0.69
Marine	31.45	0.00	0.01							0.36	0.32	0.06	0.01
Multilateral Operations	**NO**	**NO**	**NO**							**NO**	**NO**	**NO**	**NO**
CO_2 Emissions from Biomass	**20 878.59**												

[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)

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GREENHOUSE GAS SOURCE AND SINK CATEGORIES		Net CO_2 emisions/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		**55 975.01**	**272.22**	**19.35**	**1 161.70**	**1 058.10**	**428.30**	**173.53**	**0.02**	**0.02**	**205.61**	**694.32**	**162.94**	**22.35**
1. Energy		**63 473.61**	**24.14**	**2.41**							**197.87**	**663.52**	**59.07**	**21.06**
A. Fuel Combustion	Reference Approach(2)	67 248.58												
	Sectoral Approach(2)	63 261.45	12.01	2.41							197.87	663.52	56.82	20.90
B. Fugitive Emissions from Fuels		212.16	12.13	IE,NA							IE,NA	IE,NA	2.25	0.16
2. Industrial Processes		**9 912.49**	**0.89**	**1.05**	**1 161.70**	**1 058.10**	**428.30**	**173.53**	**0.02**	**0.02**	**1.59**	**24.51**	**4.74**	**1.23**
3. Solvent and Other Product Use		**231.86**		**0.51**							**NA**	**NA**	**97.11**	**NA**
4. Agriculture (3)			**168.98**	**13.17**							**6.09**	**1.05**	**1.95**	**0.00**
5. Land Use, Land-Use Change and Forestry		(4) **-17 655.21**	**0.00**	**1.03**							**IE,NA,NE**	**IE,NA,NE**	**NA,NE**	**NA**
6. Waste		**12.26**	**78.21**	**1.19**							**0.05**	**5.23**	**0.07**	**0.06**
7. Other		**NA**	**NA**	**NA**	**NA**	**NA**	**NA**	**NA**	**NA**	**NA**	**NA**	**NA**	**NA**	**NA**
Memo Items: (5)														
International Bunkers		**2 213.42**	**0.04**	**0.08**							**9.18**	**2.76**	**0.97**	**0.70**
Aviation		2 181.97	0.04	0.07							8.82	2.44	0.92	0.69
Marine		31.45	0.00	0.01							0.36	0.32	0.06	0.01
Multilateral Operations		**NO**	**NO**	**NO**							**NO**	**NO**	**NO**	**NO**
CO_2 Emissions from Biomass		**20 878.59**												

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)

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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)	**55 975.01**	**5 716.63**	**5 999.34**	**1 058.10**	**173.53**	**381.44**	**69 304.05**
1. Energy	**63 473.61**	**506.98**	**746.47**				**64 727.07**
A. Fuel Combustion (Sectoral Approach)	63 261.45	252.20	746.47				64 260.13
1. Energy Industries	13 422.88	5.90	98.26				13 527.04
2. Manufacturing Industries and Construction	15 996.58	13.03	151.66				16 161.27
3. Transport	22 254.52	18.40	261.81				22 534.73
4. Other Sectors	11 542.31	214.84	233.75				11 990.90
5. Other	45.17	0.03	0.99				46.19
B. Fugitive Emissions from Fuels	212.16	254.78	IE,NA				466.94
1. Solid Fuels	IE,NA,NO	IE,NA,NO	IE,NA				IE,NA,NO
2. Oil and Natural Gas	212.16	254.78	IE,NA				466.94
2. Industrial Processes	**9 912.49**	**18.63**	**325.81**	**1 058.10**	**173.53**	**381.44**	**11 870.01**
A. Mineral Products	3 530.92	NA	NA				3 530.92
B. Chemical Industry	593.35	18.54	325.81	NO	NO	NO	937.70
C. Metal Production	5 788.22	0.09	NA	NO	NO	0.32	5 788.63
D. Other Production	NA						NA
E. Production of Halocarbons and SF_6				NA	NA	NA	NA
F. Consumption of Halocarbons and SF_6 (2)				1 058.10	173.53	381.12	1 612.75
G. Other	NA	NA	NA	NA	NA	NA	NA
3. Solvent and Other Product Use	**231.86**		**156.55**				**388.41**
4. Agriculture		**3 548.60**	**4 082.73**				**7 631.33**
A. Enteric Fermentation		3 223.99					3 223.99
B. Manure Management		314.82	910.96				1 225.79
C. Rice Cultivation		NO					NO
D. Agricultural Soils(3)		8.57	3 171.46				3 180.03
E. Prescribed Burning of Savannas		NO	NO				NO
F. Field Burning of Agricultural Residues		1.22	0.30				1.52
G. Other		NA	NA				NA
5. Land Use, Land-Use Change and Forestry(1)	**-17 655.21**	**0.00**	**318.05**				**-17 337.16**
A. Forest Land	-19 512.08	0.00	45.11				-19 466.96
B. Cropland	1 789.46	NA,NO	272.94				2 062.40
C. Grassland	-1 283.77	NO	NO				-1 283.77
D. Wetlands	376.97	NO	NO				376.97
E. Settlements	517.46	NA,NO	NA,NO				517.46
F. Other Land	456.74	NA,NO	NA,NO				456.74
G. Other	NE	NA	NA				NA,NE
6. Waste	**12.26**	**1 642.41**	**369.73**				**2 024.40**
A. Solid Waste Disposal on Land	NA,NO	1 557.46					1 557.46
B. Waste-water Handling		31.40	260.05				291.45
C. Waste Incineration	12.26	0.01	0.03				12.30
D. Other	NA	53.55	109.64				163.19
7. Other *(as specified in Summary 1.A)*	**NA**	**NA**	**NA**	**NA**	**NA**	**NA**	**NA**

Memo Items: (4)							
International Bunkers	2 213.42	0.94	26.19				2 240.55
Aviation	2 181.97	0.92	22.67				2 205.55
Marine	31.45	0.03	3.52				35.00
Multilateral Operations	**NO**	**NO**	**NO**				**NO**
CO_2 Emissions from Biomass	**20 878.59**						**20 878.59**

Total CO_2 Equivalent Emissions without Land Use, Land-Use Change and Forestry	86 641.21
Total CO_2 Equivalent Emissions with Land Use, Land-Use Change and Forestry	69 304.05

(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)

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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,T3**	**CS**						
A. Fuel Combustion	CS,M,T2,T3	CS,PS	CS,M,T2,T3	CS	CS,M,T2,T3	CS						
1. Energy Industries	T2	CS,PS	T2	CS	T2	CS						
2. Manufacturing Industries and Construction	T2,T3	CS,PS	T2,T3	CS	T2,T3	CS						
3. Transport	CS,M,T2	CS	CS,M,T2	CS	CS,M,T2	CS						
4. Other Sectors	T2,T3	CS	T2,T3	CS	T2,T3	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,T1**	**CS,D**
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	T1	D
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)

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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**
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)

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	x	
1 A 2 mobile, liquid	CO2	x	x		x	x	
1 A 2 other	CO2	x	x		x	x	
1 A 2 solid	CO2	x	x		x	x	
1 A 2 stationary, liquid	CO2	x	x		x	x	
1 A 3 a jet kerosene	CO2			x			
1 A 3 b diesel oil	CO2	x	x		x	x	
1 A 3 b gasoline	CO2	x	x		x	x	
1 A 4 mobile, diesel	CO2	x			x	x	
1 A 4 other	CO2	x	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	
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			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	
4 D 1 Direct Soil Emissions	N2O	x	x		x	x	
4 D 2 Pasture, Range and Paddock Manure	N2O			x			
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	
5 C 2 Land converted to grassland	CO2	x	x			x	
5 D 2 Land converted to wetland	CO2	x				x	
5 E 2 Land converted to settlements	CO2	x	x			x	
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		

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 LULUC

(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 2008
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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			**55 975.01**						5 716.63						5 999.34				
1. Energy			**63 473.61**						506.98						746.47				
1.A.	Fuel Combustion Activities		63 261.45						252.20						746.47				
1.A.1.	Energy Industries		13 422.88						5.90						98.26				
1.A.2.	Manufacturing Industries and Construction		15 996.58						13.03						151.66				
1.A.3.	Transport		22 254.52						18.40						261.81				
1.A.4.	Other Sectors		11 542.31						214.84						233.75				
1.A.5.	Other		45.17						0.03						0.99				
1.B.	Fugitive Emissions from Fuels		212.16						254.78						IE,NA				
1.B.1.	Solid fuel		IE,NA,NO						IE,NA,NO						IE,NA				
1.B.2.	Oil and Natural Gas		212.16						254.78						IE,NA				
2. Industrial Processes			**9 912.49**						**18.63**						**325.81**				
2.A.	Mineral Products		3 530.92						NA						NA				
2.B.	Chemical Industry		593.35						18.54						325.81				
2.C.	Metal Production		5 788.22						0.09						NA				
2.D.	Other Production		NA																
2.G.	Other		NA						NA						NA				
3. Solvent and Other Product Use			**231.86**												**156.55**				
4. Agriculture									**3 548.60**						**4 082.73**				
4.A.	Enteric Fermentation								3 223.99										
4.B.	Manure Management								314.82						910.96				
4.C.	Rice Cultivation								NO										
4.D.	Agricultural Soils [(4)]								8.57						3 171.46				
4.E.	Prescribed Burning of Savannas								NO						NO				
4.F.	Field Burning of Agricultural Residues								1.22						0.30				
4.G.	Other								NA						NA				
5. Land Use, Land-Use Change and Forestry (net) [(5)]			**-17 655.21**						0.00						318.05				
5.A.	Forest Land		-19 512.08						0.00						45.11				
5.B.	Cropland		1 789.46						NA,NO						272.94				
5.C.	Grassland		-1 283.77						NO						NO				
5.D.	Wetlands		376.97						NO						NO				
5.E.	Settlements		517.46						NA,NO						NA,NO				
5.F.	Other Land		456.74						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 2008
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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**						1 642.41						369.73				
6.A. Solid Waste Disposal on Land		NA,NO						1 557.46										
6.B. Waste-water Handling								31.40						260.05				
6.C. Waste Incineration		12.26						0.01						0.03				
6.D. Other		NA						53.55						109.64				
7. Other ***(as specified in Summary 1.A)***		NA						NA						NA				
Memo Items:																		
International Bunkers		**2 213.42**						**0.94**						**26.19**				
Multilateral Operations		**NO**						**NO**						**NO**				
CO_2 Emissions from Biomass		**20 878.59**																

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		**1 058.10**						**173.53**						**381.44**				
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		1 058.10						173.53						381.12				
2.G. Other		NA						NA						NA				
Potential Emissions from Consumption of HFCs/PFCs and SF_6		**1 161.70**						**428.30**						**425.71**				

	Previous submission	Latest submission	Difference	Difference[1]
	CO_2 equivalent (Gg)			(%)
Total CO_2 Equivalent Emissions with Land Use, Land-Use Change and Forestry		69 304.05		
Total CO_2 Equivalent Emissions without Land Use, Land-Use Change and Forest		86 641.21		

[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)

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)

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Sources and sinks not estimated (NE) [(1)]			
GHG	Sector[(2)]	Source/sink category [(2)]	Explanation
Carbo	5 LULUCF	5.D.1 Total	no sufficient data for estimates.
Carbo	5 LULUCF	5.E.1 Total	no sufficient data for estimates.
Carbo	5 LULUCF	5.D.1 Total	no sufficient data for estimates.
Carbo	5 LULUCF	5.E.1 Total	no sufficient data for estimates.
Carbo	5 LULUCF	5.D.1 Total	no sufficient data for estimates.
Carbo	5 LULUCF	5.D.1 Total	no sufficient data for estimates.
Carbo	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.P4 Destroyed amount	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
Carbo	erennial converted to annual	Increase	Decrease	only net figures are reported.
Carbo	Total	Increase	Decrease	only net figures are reported.
Carbo	verted to perennial cropland	Gains	Losses	only net figures are reported.
Carbo	Total	Increase	Decrease	only net figures are reported.
Carbo	pland converted to grassland	Increase	Decrease	only net figures are reported.
Carbo	Total	Increase	Decrease	only net figures are reported.
Carbo	Total	Increase	Decrease	Only net figures are reported.
Carbo	Total	Increase	Decrease	only net figures are reported.
Carbo	erennial remaining perennial	Increase	Decrease	only net figures are reported.
Carbo	nnual converted to perennial	Increase	Decrease	only net figures are reported.
Carbo	pland converted to grassland	Gains	Losses	only net figures are reported.
Carbo	Total	5 A 2 1 Cropland converted to Forest Land -Total - Decrease	verted to Forest Land -Total - Increase	only net figures are reported.
Carbo	Total	5 A 2 2 Grassland converted to Forest Land -Total - Decrease	verted to Forest Land -Total - Increase	only net figures are reported.
Carbo	Total	5 A 2 3 Wetlands converted to Forest Land -Total - Decrease	verted to Forest Land -Total - Increase	only net figures are reported.
Carbo	Total	5 A 2 5 Other Land converted to Forest Land -Total - Decrease	verted to Forest Land -Total - Increase	only net figures are reported.
Carbo	converted to annual cropland	Losses	Gains	only net figures are reported.
Carbo	Total		Net carbon stock change in dead wood' is included in 'biomass'. 'Litter' is included in 'soils'	
Carbo	Total		Net carbon stock change in dead wood' is included in 'biomass'. 'Litter' is included in 'soils'	
Carbo	Total		Net carbon stock change in dead wood' is included in 'biomass'. 'Litter' is included in 'soils'	
Carbo	Total		Net carbon stock change in dead wood' is included in 'biomass'. 'Litter' is included in 'soils'	
Carbo	Total		'Net carbon stock change in dead wood' is included in 'biomass'. 'Litter' is included in 'soils'.	
Carbo	Total		Net carbon stock change in dead wood' is included in 'biomass'. 'Litter' is included in 'soils'	
Carbo	Total		Net carbon stock change in dead wood' is included in 'biomass'. 'Litter' is included in 'soils'	
Carbo	Total		Net carbon stock change in dead wood' is included in 'biomass'. 'Litter' is included in 'soils'	
Carbo	Total		Net carbon stock change in dead wood' is included in 'biomass'. 'Litter' is included in 'soils'	
Carbo	Total		Net carbon stock change in dead wood' is included in 'biomass'. 'Litter' is included in 'soils'	
Carbo	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	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	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	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	fields are reported here (total figures are reported from the Association of Oil Industry
CH4	.B.2 Production / Processing	1 B 2 A 3 Oil Transport	1 B 2 A 2 Oil Production	fields are reported here (total figures are reported from the Association of Oil Industry
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.2.1 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.C.1.1 Steel	2 C 1 1 Steel	1 A 2 a Iron and Steel	ll 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	ll 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	ll 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	ll 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	1 Industrial Wastewater / Wastewater	Emissions from sludge are reported together with emissions from wastewater
CH4	nercial (w/o human sewage)	6 B 2 Dometic and Commercial Wastewater / Sludge	Commercial Wastewater / Wastewater	Emissions from sludge are reported together with emissions from wastewater
CH4	.AA.1.B Petroleum Refining	1 A 1 b Petroleum Refining / Liquid Fuels.	1 B 2 fugitive Emissions from fuels	missions from fuel combustion are a minor source of total CH4 emisions from refinery
CH4	.AA.1.B Petroleum Refining	1 A 1 b Petroleum Refining / Gaseous Fuels.	1 B 2 fugitive Emissions from fuels	missions from fuel combustion are a minor source of total CH4 emisions from refinery
CH4	AA.3.B Road Transportation		Included in 1.A.3.b diesel and gasoline.	
CH4	Military use		Included in 1.A.3.b diesel and gasoline.	
CO2	A.2.2 Post-Mining Activities	1 B 1 A 2 Coal Surface Mines/ Post Mining Activities	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	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	fields are reported here (total figures are reported from the Association of Oil Industry
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.2.1 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	.A.4.1 Soda Ash Production	2 A 4 1 Soda Ash Production	1 A 2 c Chemicals	ategory 1 A 2 c), that's why CO2 emissions of soda ash production is reported as "IE".
CO2	.A.4.1 Soda Ash Production	2 A 4 1 Soda Ash Production	1 A 2 c Chemicals	ategory 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	Asphalt Roofing and 2A6 Road Paving with Asphalt are included in the Solvent Secto
CO2	.6 Road Paving with Asphalt	2 A 6 Road Paving	3 Solvent Use	Asphalt Roofing and 2A6 Road Paving with Asphalt are included in the Solvent Secto
CO2	2.C.1.3 Sinter	2 C 1 3 Sinter	1 A 2 a Iron and Steel	ll 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	ll activities of integrated iron and steel plants are reported under 1 A 2 a Iron and Steel.
CO2	Land remaining Forest Land	5 A 1 Widfires	Forest Land remaining Forest land	k change due to wildfires at forest land is included in figures of table 5.A Sektor 5.A.1.
CO2	ropland remaining Cropland	5 B Cropland / lime application / Dolomite	Cropland / lime application / Limestone	Emissions from dolomite liming include emissions from limestone liming
CO2	assland remaining Grassland	5 C Grassland / lime application	Cropland / lime application / Limestone	Emissions from cropland dolomite liming include emissions from grassland liming.
CO2	assland remaining Grassland	5 C Grassland / lime application	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	fields are reported here (total figures are reported from the Association of Oil Industry
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	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	1 Industrial Wastewater / Wastewater	Emissions from sludge are reported together with emissions from wastewater
N2O	nercial (w/o human sewage)	6 B 2 Dometic and Commercial Wastewater / Sludge	Commercial Wastewater / Wastewater	Emissions from sludge are reported together with emissions from wastewater
N2O	AA.3.B Road Transportation		Included in 1.A.3.b diesel and gasoline.	
N2O	Military use		Included in 1.A.3.b diesel and gasoline.	
SF6	2.F.P2.2 In products	2 F P 2 2 Import in Products	2 F P 2 1 Import in Bulk	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	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	is based on consumption data of halocarbons and SF6 or products (net import/export).

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(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

(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

TABLE 9(b) COMPLETENESS - INFORMATION ON ADDITIONAL GREENHOUSE GAS
(Sheet 1 of 1)

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	950.00	2.14	anel on Climate Change	CHF2CH2CF3
HFC-365mfc	Hard Foam	0.00	890.00	2.03	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 2008
Submission 2010 v1.3
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	**54 177.69**	**57 969.39**	**53 071.59**	**53 472.46**	**53 544.55**	**56 362.22**	**60 122.04**	**59 307.12**	**59 255.93**	**58 011.83**
A. Fuel Combustion (Sectoral Approach)	54 075.60	57 858.30	52 951.46	53 360.33	53 416.92	56 235.07	60 050.90	59 186.50	59 113.99	57 841.18
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	12 648.52
2. Manufacturing Industries and Construction	12 685.23	13 074.16	11 781.85	12 247.63	13 235.01	13 487.01	13 700.70	15 229.33	13 990.37	13 186.65
3. Transport	13 751.71	15 214.06	15 187.03	15 319.69	15 370.62	15 653.22	17 203.40	16 227.41	18 325.28	17 795.64
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	14 168.80
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	102.09	111.09	120.13	112.13	127.64	127.15	71.14	120.63	141.94	170.65
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	102.09	111.09	120.13	112.13	127.64	127.15	71.14	120.63	141.94	170.65
2. Industrial Processes	**7 584.25**	**7 429.75**	**6 943.95**	**6 858.90**	**7 188.91**	**7 388.04**	**7 087.10**	**7 677.19**	**7 321.26**	**7 168.71**
A. Mineral Products	3 274.18	3 131.72	3 152.67	3 087.49	3 201.88	2 862.55	2 775.17	2 975.07	2 821.92	2 807.37
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)	**-13 570.90**	**-19 483.98**	**-14 432.88**	**-18 327.61**	**-16 984.83**	**-16 403.21**	**-11 362.59**	**-20 298.96**	**-18 429.86**	**-22 815.98**
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	1 595.29	1 593.20	1 616.59	1 639.01	1 639.00	1 661.92	1 668.92	1 680.58	1 684.76	1 690.20
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	759.10	843.62	762.67	776.31	845.77	674.69	779.01	743.53	588.02	605.88
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	**48 497.23**	**46 172.03**	**45 778.67**	**42 200.33**	**43 930.04**	**47 547.97**	**56 031.01**	**46 888.85**	**48 333.10**	**42 536.57**
Total CO_2 emissions excluding net CO_2 from LULUCF	**62 068.13**	**65 656.02**	**60 211.55**	**60 527.94**	**60 914.87**	**63 951.18**	**67 393.60**	**67 187.80**	**66 762.96**	**65 352.56**
Memo Items:										
International Bunkers	**904.54**	**1 013.55**	**1 097.60**	**1 160.61**	**1 205.87**	**1 347.25**	**1 485.85**	**1 544.62**	**1 596.89**	**1 560.13**
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	18.57	19.67	20.16	20.63	20.22	19.83	19.44	19.05	18.68	18.46
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	13 172.43

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)

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	2000	2001	2002	2003	2004	2005	2006	2007	2008	Change from base to latest reported year
	(Gg)	(Gg)	(Gg)	(Gg)	(Gg)	(Gg)	(Gg)	(Gg)	(Gg)	%
1. Energy	**57 820.48**	**62 274.16**	**63 534.09**	**69 383.20**	**69 342.80**	**70 839.63**	**67 309.58**	**64 183.12**	**63 473.61**	**17.16**
A. Fuel Combustion (Sectoral Approach)	57 655.83	62 091.31	63 366.94	69 150.05	69 132.65	70 634.48	67 077.43	63 945.97	63 261.45	16.99
1. Energy Industries	12 206.88	13 777.04	13 644.56	16 087.17	16 150.38	16 097.58	15 482.09	13 918.37	13 422.88	-2.68
2. Manufacturing Industries and Construction	13 722.60	13 620.70	14 048.71	14 453.79	14 425.28	15 988.40	15 943.17	15 971.21	15 996.58	26.10
3. Transport	18 788.69	20 036.55	21 957.16	23 803.59	24 280.06	24 626.62	23 338.43	23 519.97	22 254.52	61.83
4. Other Sectors	12 896.86	14 615.67	13 674.60	14 763.02	14 233.90	13 878.31	12 269.68	10 491.81	11 542.31	-16.43
5. Other	40.80	41.36	41.91	42.47	43.03	43.56	44.06	44.61	45.17	29.03
B. Fugitive Emissions from Fuels	164.65	182.85	167.15	233.15	210.15	205.15	232.16	237.16	212.16	107.82
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	0.00
2. Oil and Natural Gas	164.65	182.85	167.15	233.15	210.15	205.15	232.16	237.16	212.16	107.82
2. Industrial Processes	**7 773.68**	**7 700.46**	**8 268.26**	**8 213.54**	**8 169.33**	**8 710.01**	**9 117.55**	**9 549.94**	**9 912.49**	**30.70**
A. Mineral Products	2 965.71	2 983.49	3 093.10	3 081.21	3 178.18	3 132.87	3 306.72	3 517.56	3 530.92	7.84
B. Chemical Industry	587.27	539.50	551.22	592.50	528.09	563.47	599.25	530.62	593.35	1.41
C. Metal Production	4 220.70	4 177.48	4 623.93	4 539.83	4 463.06	5 013.66	5 211.58	5 501.76	5 788.22	55.39
D. Other Production	NA	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	NA	0.00
3. Solvent and Other Product Use	192.62	204.10	225.85	231.32	198.72	211.05	247.67	226.96	231.86	-16.99
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)	**-17 440.44**	**-20 155.54**	**-16 347.17**	**-17 789.85**	**-17 791.29**	**-17 611.60**	**-17 634.00**	**-17 677.76**	**-17 655.21**	**30.10**
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	-19 512.08	22.61
B. Cropland	1 680.25	1 658.78	1 732.83	1 731.37	1 748.06	1 766.04	1 757.82	1 729.69	1 789.46	12.17
C. Grassland	-1 220.98	-1 207.83	-1 268.54	-1 259.15	-1 291.15	-1 265.56	-1 288.27	-1 264.41	-1 283.77	25.67
D. Wetlands	293.40	301.63	309.87	318.10	326.65	318.79	337.67	371.78	376.97	88.74
E. Settlements	568.23	545.18	530.98	541.92	533.88	664.52	640.83	553.87	517.46	-31.83
F. Other Land	578.31	560.63	542.95	525.26	511.56	497.85	484.15	470.44	456.74	-43.61
G. Other	NE	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**	**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	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	12.26	-54.39
D. Other	NA	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**	**NA**	**0.00**
Total CO_2 emissions including net CO_2 from LULUCF	**48 358.61**	**50 035.44**	**55 693.28**	**60 050.46**	**59 931.82**	**62 161.35**	**59 053.07**	**56 294.53**	**55 975.01**	**15.42**
Total CO_2 emissions excluding net CO_2 from LULUCF	**65 799.05**	**70 190.98**	**72 040.46**	**77 840.32**	**77 723.12**	**79 772.95**	**76 687.06**	**73 972.29**	**73 630.23**	**18.63**
Memo Items:										
International Bunkers	**1 715.80**	**1 671.50**	**1 564.80**	**1 470.24**	**1 784.90**	**2 024.37**	**2 091.30**	**2 211.93**	**2 213.42**	**144.70**
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	2 181.97	146.28
Marine	20.22	20.22	23.95	17.27	59.97	64.54	42.42	36.13	31.45	69.33
Multilateral Operations	NO	NO	NO	NO	NO	NO	NO	NO	NO	0.00
CO_2 Emissions from Biomass	12 445.30	13 320.46	12 747.95	13 293.16	13 774.96	16 787.54	18 087.09	19 711.59	20 878.59	112.98

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)

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	31.94	33.71	32.71	32.48	30.37	31.15	31.85	27.35	26.54	26.06
A. Fuel Combustion (Sectoral Approach)	21.96	23.82	22.00	21.67	19.96	20.41	21.17	16.60	15.98	16.05
1. Energy Industries	0.16	0.18	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	0.42
3. Transport	3.06	3.36	3.36	3.37	3.32	3.10	2.81	2.53	2.44	2.15
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	9.98	9.89	10.72	10.81	10.41	10.74	10.69	10.75	10.56	10.01
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	9.46	9.44	10.34	10.45	10.12	10.46	10.45	10.51	10.32	9.76
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	NA	NA	NA	NA	NA	NA	NA	NA	NA	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	**199.66**	**196.70**	**188.76**	**188.92**	**188.77**	**192.01**	**188.77**	**185.48**	**184.07**	**181.86**
A. Enteric Fermentation	178.73	176.11	168.77	168.70	168.90	172.08	169.32	166.32	165.07	163.65
B. Manure Management	20.53	20.19	19.61	19.69	19.40	19.43	18.94	18.64	18.48	17.69
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	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**
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	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	**163.20**	**162.81**	**158.50**	**156.25**	**147.84**	**139.67**	**131.87**	**125.24**	**120.30**	**115.01**
A. Solid Waste Disposal on Land	157.82	157.43	153.14	150.88	142.48	134.42	126.91	120.63	115.99	110.91
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	**395.50**	**393.92**	**380.64**	**378.36**	**367.70**	**363.51**	**353.18**	**338.77**	**331.65**	**323.63**
Total CH_4 emissions excluding CH_4 from LULUCF	**395.50**	**393.92**	**380.64**	**378.36**	**367.70**	**363.51**	**353.18**	**338.77**	**331.65**	**323.63**
Memo Items:										
International Bunkers	0.02	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	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
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 2008
Submission 2010 v1.3
AUSTRIA

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	2000	2001	2002	2003	2004	2005	2006	2007	2008	Change from base to latest reported year
	(Gg)	(Gg)	(Gg)	(Gg)	(Gg)	(Gg)	(Gg)	(Gg)	(Gg)	%
1. Energy	25.21	25.41	24.30	24.32	24.20	25.40	24.20	24.34	24.14	-24.42
A. Fuel Combustion (Sectoral Approach)	15.10	15.41	14.35	14.28	13.28	14.24	12.59	12.33	12.01	-45.31
1. Energy Industries	0.16	0.19	0.20	0.24	0.27	0.25	0.30	0.30	0.28	74.49
2. Manufacturing Industries and Construction	0.44	0.45	0.46	0.52	0.57	0.60	0.62	0.61	0.62	83.85
3. Transport	1.96	1.81	1.73	1.61	1.44	1.29	1.13	1.01	0.88	-71.39
4. Other Sectors	12.54	12.95	11.95	11.91	11.00	12.10	10.54	10.41	10.23	-44.39
5. Other	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	23.81
B. Fugitive Emissions from Fuels	10.11	10.00	9.95	10.04	10.92	11.16	11.61	12.00	12.13	21.52
1. Solid Fuels	0.27	0.26	0.30	0.25	0.05	0.00	0.00	IE,NA,NO	IE,NA,NO	-100.00
2. Oil and Natural Gas	9.84	9.75	9.65	9.80	10.87	11.16	11.61	12.00	12.13	28.25
2. Industrial Processes	**0.70**	**0.67**	**0.71**	**0.70**	**0.70**	**0.75**	**0.92**	**0.91**	**0.89**	**25.61**
A. Mineral Products	NA	NA	NA	NA	NA	NA	NA	NA	NA	0.00
B. Chemical Industry	0.70	0.67	0.70	0.69	0.70	0.75	0.92	0.90	0.88	25.37
C. Metal Production	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	99.48
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	0.00
3. Solvent and Other Product Use										
4. Agriculture	**180.38**	**177.98**	**174.08**	**172.25**	**171.85**	**169.73**	**169.04**	**169.70**	**168.98**	**-15.37**
A. Enteric Fermentation	162.71	160.48	157.20	155.71	155.69	153.74	153.23	153.84	153.52	-14.10
B. Manure Management	17.16	17.00	16.44	16.07	15.70	15.56	15.34	15.38	14.99	-26.98
C. Rice Cultivation	NO	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	0.41	24.29
E. Prescribed Burning of Savannas	NO	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	0.06	-15.75
G. Other	NA	NA	NA	NA	NA	NA	NA	NA	NA	0.00
5. Land Use, Land-Use Change and Forestry	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**-75.00**
A. Forest Land	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	-75.00
B. Cropland	NA,NO	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	NO	0.00
D. Wetlands	NO	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	NA,NO	0.00
F. Other Land	NA,NO	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	NA	0.00
6. Waste	**109.92**	**105.75**	**103.75**	**105.76**	**99.43**	**93.91**	**89.44**	**84.15**	**78.21**	**-52.08**
A. Solid Waste Disposal on Land	106.01	101.91	99.99	102.08	95.31	89.60	85.51	80.14	74.16	-53.01
B. Waste-water Handling	2.68	2.43	2.18	1.95	1.96	1.97	1.48	1.49	1.50	-69.17
C. Waste Incineration	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	-90.13
D. Other	1.24	1.41	1.58	1.74	2.16	2.33	2.44	2.52	2.55	390.05
7. Other *(as specified in Summary 1.A)*	**NA**	**NA**	**NA**	**NA**	**NA**	**NA**	**NA**	**NA**	**NA**	**0.00**
Total CH_4 emissions including CH_4 from LULUCF	**316.22**	**309.82**	**302.84**	**303.03**	**296.18**	**289.80**	**283.60**	**279.10**	**272.22**	**-31.17**
Total CH_4 emissions excluding CH_4 from LULUCF	**316.22**	**309.82**	**302.84**	**303.03**	**296.18**	**289.80**	**283.60**	**279.10**	**272.22**	**-31.17**
Memo Items:										
International Bunkers	0.03	0.03	0.04	0.04	0.05	0.04	0.04	0.04	0.04	191.29
Aviation	0.03	0.03	0.03	0.04	0.04	0.04	0.04	0.04	0.04	200.38
Marine	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	47.56
Multilateral Operations	NO	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)

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	**1.79**	**2.01**	**1.97**	**2.03**	**2.04**	**2.11**	**2.21**	**2.18**	**2.31**	**2.33**
A. Fuel Combustion (Sectoral Approach)	1.79	2.01	1.97	2.03	2.04	2.11	2.21	2.18	2.31	2.33
1. Energy Industries	0.15	0.17	0.14	0.14	0.14	0.16	0.15	0.15	0.17	0.16
2. Manufacturing Industries and Construction	0.26	0.28	0.27	0.29	0.30	0.31	0.34	0.36	0.38	0.41
3. Transport	0.63	0.75	0.77	0.80	0.85	0.86	0.87	0.86	0.97	0.94
4. Other Sectors	0.76	0.81	0.79	0.79	0.75	0.78	0.83	0.81	0.79	0.81
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	NA	NA	NA	NA	NA	NA	NA	NA	NA	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	**14.08**	**14.89**	**13.94**	**13.17**	**14.81**	**15.12**	**13.81**	**13.95**	**14.06**	**13.81**
A. Enteric Fermentation										
B. Manure Management	3.02	3.02	2.93	2.97	2.99	3.08	3.04	3.04	3.04	3.03
C. Rice Cultivation										
D. Agricultural Soils	11.06	11.88	11.00	10.21	11.82	12.04	10.76	10.91	11.01	10.78
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	**1.39**	**0.96**	**1.19**	**1.13**	**0.97**	**0.90**	**0.89**	**0.86**	**1.07**	**0.83**
A. Forest Land	0.58	0.15	0.38	0.33	0.17	0.09	0.08	0.06	0.27	0.02
B. Cropland	0.81	0.81	0.81	0.81	0.81	0.80	0.80	0.80	0.80	0.80
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**	**0.67**	**0.72**
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	0.56
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	**21.38**	**22.04**	**20.97**	**20.34**	**21.73**	**22.19**	**21.07**	**21.16**	**21.75**	**21.41**
Total N_2O emissions excluding N_2O from LULUCF	**19.99**	**21.07**	**19.78**	**19.21**	**20.76**	**21.29**	**20.19**	**20.29**	**20.68**	**20.58**
Memo Items:										
International Bunkers	**0.04**	**0.04**	**0.05**	**0.05**	**0.05**	**0.05**	**0.06**	**0.06**	**0.06**	**0.06**
Aviation	0.03	0.03	0.04	0.04	0.04	0.05	0.05	0.05	0.06	0.05
Marine	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01
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 2008
Submission 2010 v1.3
AUSTRIA

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	2000	2001	2002	2003	2004	2005	2006	2007	2008	Change from base to latest reported year
	(Gg)	(Gg)	(Gg)	(Gg)	(Gg)	(Gg)	(Gg)	(Gg)	(Gg)	%
1. Energy	**2.34**	**2.45**	**2.48**	**2.56**	**2.52**	**2.61**	**2.54**	**2.48**	**2.41**	**34.39**
A. Fuel Combustion (Sectoral Approach)	2.34	2.45	2.48	2.56	2.52	2.61	2.54	2.48	2.41	34.39
1. Energy Industries	0.16	0.19	0.19	0.22	0.24	0.26	0.29	0.31	0.32	113.15
2. Manufacturing Industries and Construction	0.43	0.42	0.40	0.40	0.40	0.46	0.49	0.50	0.49	89.58
3. Transport	0.97	1.00	1.09	1.12	1.08	1.06	0.99	0.94	0.84	34.71
4. Other Sectors	0.78	0.83	0.80	0.81	0.80	0.83	0.77	0.73	0.75	-0.16
5. Other	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	13.45
B. Fugitive Emissions from Fuels	IE,NA	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	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	IE,NA	0.00
2. Industrial Processes	**3.07**	**2.54**	**2.60**	**2.85**	**0.91**	**0.88**	**0.90**	**0.87**	**1.05**	**-64.28**
A. Mineral Products	NA	NA	NA	NA	NA	NA	NA	NA	NA	0.00
B. Chemical Industry	3.07	2.54	2.60	2.85	0.91	0.88	0.90	0.87	1.05	-64.28
C. Metal Production	NA	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	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	0.51	-32.67
4. Agriculture	**13.28**	**13.28**	**13.21**	**12.67**	**12.35**	**12.37**	**12.53**	**12.69**	**13.17**	**-6.47**
A. Enteric Fermentation										
B. Manure Management	2.98	2.97	2.93	2.93	2.94	2.91	2.92	2.94	2.94	-2.59
C. Rice Cultivation										
D. Agricultural Soils	10.30	10.31	10.28	9.73	9.41	9.46	9.61	9.75	10.23	-7.53
E. Prescribed Burning of Savannas	NO	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	0.00	-15.94
G. Other	NA	NA	NA	NA	NA	NA	NA	NA	NA	0.00
5. Land Use, Land-Use Change and Forestry	**0.93**	**0.88**	**1.37**	**1.34**	**0.86**	**0.90**	**1.02**	**0.94**	**1.03**	**-26.29**
A. Forest Land	0.12	0.07	0.56	0.53	0.05	0.09	0.22	0.11	0.15	-75.00
B. Cropland	0.80	0.81	0.81	0.81	0.81	0.81	0.81	0.83	0.88	8.72
C. Grassland	NO	NO	NO	NO	NO	NO	NO	NO	NO	0.00
D. Wetlands	NO	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	NA,NO	0.00
F. Other Land	NA,NO	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	NA	0.00
6. Waste	**0.80**	**0.90**	**0.92**	**0.95**	**1.02**	**1.09**	**1.15**	**1.18**	**1.19**	**179.64**
A. Solid Waste Disposal on Land										
B. Waste-water Handling	0.63	0.71	0.71	0.71	0.72	0.77	0.81	0.83	0.84	139.82
C. Waste Incineration	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	-74.43
D. Other	0.17	0.19	0.22	0.24	0.30	0.32	0.34	0.35	0.35	363.66
7. Other *(as specified in Summary 1.A)*	**NA**	**NA**	**NA**	**NA**	**NA**	**NA**	**NA**	**NA**	**NA**	**0.00**
Total N_2O emissions including N_2O from LULUCF	**21.17**	**20.76**	**21.27**	**21.00**	**18.26**	**18.42**	**18.67**	**18.67**	**19.35**	**-9.50**
Total N_2O emissions excluding N_2O from LULUCF	**20.24**	**19.88**	**19.90**	**19.66**	**17.40**	**17.52**	**17.65**	**17.73**	**18.33**	**-8.33**
Memo Items:										
International Bunkers	**0.06**	**0.06**	**0.06**	**0.05**	**0.08**	**0.09**	**0.08**	**0.09**	**0.08**	**126.05**
Aviation	0.06	0.06	0.05	0.05	0.06	0.07	0.07	0.07	0.07	136.67
Marine	0.01	0.01	0.01	0.01	0.02	0.02	0.02	0.01	0.01	75.39
Multilateral Operations	NO	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)

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)	**26.32**	**29.56**	**32.31**	**243.56**	**293.06**	**411.89**	**531.94**	**651.70**	**769.33**	**876.64**
HFC-23	NA,NO	NA,NO	NA,NO	0.00	0.00	0.00	0.00	0.00	0.00	0.00
HFC-32	NA,NO	NA,NO	NA,NO	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	NA,NO	NA,NO	NA,NO	NA,NO	0.00	0.01	0.01	0.02	0.03	0.03
HFC-134	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO
HFC-134a	0.02	0.02	0.02	0.17	0.21	0.28	0.33	0.38	0.44	0.48
HFC-152a	NA,NO	NA,NO	NA,NO	0.07	0.08	0.08	0.09	0.10	0.10	0.11
HFC-143	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO
HFC-143a	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	0.00	0.01	0.02	0.03	0.03
HFC-227ea	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,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)	1.93	3.07	4.44	5.81	7.18	8.53	9.74	9.43	2.96	3.23
Emissions of PFCs(3) - (Gg CO_2 equivalent)	**1 079.24**	**1 087.08**	**462.32**	**52.57**	**58.30**	**71.27**	**71.70**	**105.15**	**55.95**	**78.63**
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	0.00	0.00	0.00	0.00	0.00
C_4F_{10}	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO
$c-C_4F_8$	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)	**494.28**	**644.74**	**688.92**	**780.89**	**971.85**	**1 154.06**	**1 234.15**	**1 139.26**	**913.21**	**787.19**
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 2008

Submission 2010 v1.3

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GREENHOUSE GAS SOURCE AND SINK CATEGORIES	2000	2001	2002	2003	2004	2005	2006	2007	2008	Change from base to latest reported year
	(Gg)	(Gg)	(Gg)	(Gg)	(Gg)	(Gg)	(Gg)	(Gg)	(Gg)	%
Emissions of HFCs(3) - (Gg CO_2 equivalent)	**901.88**	**924.92**	**969.22**	**949.55**	**955.14**	**986.41**	**962.62**	**1 061.99**	**1 058.10**	**3 920.01**
HFC-23	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	100.00
HFC-32	0.00	0.01	0.01	0.01	0.01	0.01	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	NA,NO	0.00
HFC-43-10mee	0.00	0.00	0.00	0.00	0.00	NA,NO	NA,NO	NA,NO	NA,NO	-100.00
HFC-125	0.04	0.05	0.05	0.05	0.05	0.06	0.07	0.08	0.08	100.00
HFC-134	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	0.00
HFC-134a	0.40	0.40	0.40	0.42	0.42	0.40	0.36	0.37	0.38	1 952.74
HFC-152a	0.60	0.61	0.95	0.64	0.43	0.21	0.25	0.25	0.09	100.00
HFC-143	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	0.00
HFC-143a	0.04	0.04	0.04	0.05	0.05	0.06	0.06	0.07	0.07	100.00
HFC-227ea	0.00	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	NA,NO	0.00
HFC-245ca	NA,NO	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)	3.85	4.14	4.05	3.88	4.06	3.98	5.03	7.07	7.39	283.42
Emissions of PFCs(3) - (Gg CO_2 equivalent)	**84.79**	**95.91**	**97.70**	**116.44**	**136.65**	**133.82**	**145.72**	**190.12**	**173.53**	**-83.92**
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	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	IE,NA,NO	-100.00
C_3F_8	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	100.00
C_4F_{10}	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	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	0.00
C_5F_{12}	NA,NO	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	NA,NO	0.00
Unspecified mix of listed PFCs(4) - (Gg CO_2 equivalent)	67.46	81.67	83.46	102.20	125.49	125.04	135.50	182.55	166.39	472.73
Emissions of SF6(3) - (Gg CO_2 equivalent)	**595.54**	**652.28**	**634.81**	**566.62**	**497.35**	**507.33**	**465.15**	**374.54**	**381.44**	**-22.83**
SF_6	0.02	0.03	0.03	0.02	0.02	0.02	0.02	0.02	0.02	-22.83

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 2008
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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	48 497.23	46 172.03	45 778.67	42 200.33	43 930.04	47 547.97	56 031.01	46 888.85	48 333.10	42 536.57
CO_2 emissions excluding net CO_2 from LULUCF	62 068.13	65 656.02	60 211.55	60 527.94	60 914.87	63 951.18	67 393.60	67 187.80	66 762.96	65 352.56
CH_4 emissions including CH_4 from LULUCF	8 305.60	8 272.24	7 993.50	7 945.51	7 721.63	7 633.77	7 416.88	7 114.22	6 964.58	6 796.19
CH_4 emissions excluding CH_4 from LULUCF	8 305.59	8 272.24	7 993.50	7 945.51	7 721.63	7 633.77	7 416.88	7 114.22	6 964.58	6 796.19
N_2O emissions including N_2O from LULUCF	6 628.86	6 831.40	6 502.12	6 306.93	6 736.72	6 877.94	6 533.22	6 558.29	6 743.75	6 636.62
N_2O emissions excluding N_2O from LULUCF	6 197.36	6 532.88	6 132.73	5 955.79	6 434.51	6 599.54	6 257.64	6 290.91	6 410.77	6 380.26
HFCs	26.32	29.56	32.31	243.56	293.06	411.89	531.94	651.70	769.33	876.64
PFCs	1 079.24	1 087.08	462.32	52.57	58.30	71.27	71.70	105.15	55.95	78.63
SF_6	494.28	644.74	688.92	780.89	971.85	1 154.06	1 234.15	1 139.26	913.21	787.19
Total (including LULUCF)	**65 031.53**	**63 037.06**	**61 457.84**	**57 529.78**	**59 711.61**	**63 696.90**	**71 818.90**	**62 457.46**	**63 779.91**	**57 711.85**
Total (excluding LULUCF)	**78 170.92**	**82 222.52**	**75 521.32**	**75 506.24**	**76 394.22**	**79 821.72**	**82 905.91**	**82 489.04**	**81 876.79**	**80 271.46**

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	55 403.93	59 301.11	54 369.50	54 782.71	54 816.14	57 671.32	61 475.43	60 555.92	60 528.76	59 280.18
2. Industrial Processes	10 110.94	10 133.05	8 978.97	8 829.32	9 352.32	9 896.87	9 813.74	10 450.73	9 971.94	9 849.23
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	8 558.03	8 747.46	8 284.53	8 050.63	8 555.15	8 718.84	8 244.26	8 220.97	8 223.45	8 098.73
5. Land Use, Land-Use Change and Forestry(5)	-13 139.39	-19 185.46	-14 063.48	-17 976.46	-16 682.61	-16 124.81	-11 087.01	-20 031.57	-18 096.88	-22 559.62
6. Waste	3 586.22	3 574.92	3 470.69	3 425.09	3 267.35	3 112.23	2 966.81	2 837.04	2 746.32	2 651.07
7. Other	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Total (including LULUCF)(5)	**65 031.53**	**63 037.06**	**61 457.84**	**57 529.78**	**59 711.61**	**63 696.90**	**71 818.90**	**62 457.46**	**63 779.91**	**57 711.85**

(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 2008
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GREENHOUSE GAS EMISSIONS	2000	2001	2002	2003	2004	2005	2006	2007	2008	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 equivalent (Gg)	(%)
CO_2 emissions including net CO_2 from LULUCF	48 358.61	50 035.44	55 693.28	60 050.46	59 931.82	62 161.35	59 053.07	56 294.53	55 975.01	15.42
CO_2 emissions excluding net CO_2 from LULUCF	65 799.05	70 190.98	72 040.46	77 840.32	77 723.12	79 772.95	76 687.06	73 972.29	73 630.23	18.63
CH_4 emissions including CH_4 from LULUCF	6 640.53	6 506.20	6 359.63	6 363.69	6 219.86	6 085.71	5 955.58	5 861.10	5 716.63	-31.17
CH_4 emissions excluding CH_4 from LULUCF	6 640.53	6 506.19	6 359.63	6 363.68	6 219.86	6 085.71	5 955.58	5 861.10	5 716.62	-31.17
N_2O emissions including N_2O from LULUCF	6 561.59	6 436.19	6 592.92	6 509.50	5 661.49	5 709.78	5 788.40	5 787.18	5 999.34	-9.50
N_2O emissions excluding N_2O from LULUCF	6 274.65	6 162.45	6 168.32	6 094.35	5 394.06	5 429.69	5 471.40	5 497.31	5 681.28	-8.33
HFCs	901.88	924.92	969.22	949.55	955.14	986.41	962.62	1 061.99	1 058.10	3 920.01
PFCs	84.79	95.91	97.70	116.44	136.65	133.82	145.72	190.12	173.53	-83.92
SF_6	595.54	652.28	634.81	566.62	497.35	507.33	465.15	374.54	381.44	-22.83
Total (including LULUCF)	**63 142.93**	**64 650.95**	**70 347.58**	**74 556.27**	**73 402.31**	**75 584.39**	**72 370.54**	**69 569.46**	**69 304.05**	**6.57**
Total (excluding LULUCF)	**80 296.44**	**84 532.75**	**86 270.14**	**91 930.97**	**90 926.17**	**92 915.91**	**89 687.53**	**86 957.35**	**86 641.21**	**10.84**

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	2000	2001	2002	2003	2004	2005	2006	2007	2008	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 equivalent (Gg)	(%)
1. Energy	59 076.02	63 566.65	64 814.11	70 687.24	70 633.66	72 182.73	68 604.68	65 463.08	64 727.07	16.83
2. Industrial Processes	10 322.18	10 174.17	10 792.03	10 744.18	10 054.07	10 627.52	10 990.48	11 465.65	11 870.01	17.40
3. Solvent and Other Product Use	425.12	424.82	434.79	428.48	384.10	384.65	411.97	387.23	388.41	-24.11
4. Agriculture	7 904.40	7 855.62	7 751.63	7 543.49	7 438.55	7 398.79	7 432.89	7 497.40	7 631.33	-10.83
5. Land Use, Land-Use Change and Forestry(5)	-17 153.51	-19 881.80	-15 922.57	-17 374.70	-17 523.86	-17 331.51	-17 316.99	-17 387.89	-17 337.16	31.95
6. Waste	2 568.72	2 511.49	2 477.59	2 527.58	2 415.79	2 322.22	2 247.51	2 143.99	2 024.40	-43.55
7. Other	NA	NA	NA	NA	NA	NA	NA	NA	NA	0.00
Total (including LULUCF)(5)	**63 142.93**	**64 650.95**	**70 347.58**	**74 556.27**	**73 402.31**	**75 584.39**	**72 370.54**	**69 569.46**	**69 304.05**	**6.57**

(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 this
- Use the documentation box to provide explanations if potential emissions are reported.

ANNEX 9: CRF TABLES ART. 3.3 KP ACTIVITIES FOR 2008

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 2008.

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

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	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 %	30.00
Minimum height	2 - 5 m	2.00

Table NIR 2. LAND TRANSITION MATRIX

Areas and changes in areas between the previous and the current inventory year (1), (2), (3)

From previous inventory year / To current inventory		Article 3.3 activities		Article 3.4 activities				Other (5)	Total area at the beginning of the current inventory (6)
		Afforestation and Reforestation	Deforestation	Forest Management (if elected)	Cropland Management (if elected)	Grazing Land Management	Revegetation (if elected)		
		(kha)							
Article 3.3 activities	Afforestation and Reforestation	200.25	NO						200.25
	Deforestation		94.12						94.12
Article 3.4 activities	Forest Management (if elected)		NA	NA					NA
	Cropland Management(4) (if elected)	NA	NA		NA	NA	NA		NA
	Grazing Land Management(4) (if	NA	NA		NA	NA	NA		NA
	Revegetation(4) (if elected)	NA			NA	NA	NA		NA
Other (5)		9.76	4.55	NA	NA	NA	NA	NA	14.31
Total area at the end of the current inventory year		210.02	98.66	NA	NA	NA	NA	NA	308.68

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(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 preceding the inventory year,

(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

(5) “Other” includes the total area of the country that has not been reported under an Article 3.3 or an elected Article 3.4 activity.

(6) The value in the cell of row “Total area at the end of the current inventory year” corresponds to the total land area of a country and is constant for all years.

TABLE NIR 3. SUMMARY OVERVIEW FOR KEY CATEGORIES FOR LAND USE, LAND-USE CHANGE AND FORESTRY ACTIVITIES UNDER THE KYOTO PROTOCOL

KEY CATEGORIES OF EMISSIONS AND REMOVALS	GAS	CRITERIA USED FOR KEY CATEGORY IDENTIFICATION			COMMENTS [3]
		Associated category in UNFCCC inventory[1] is key (indicate which category)	Category contribution is greater than the smallest category considered key in the UNFCCC inventory [1], [4] (including LULUCF)	Other [2]	
Specify key categories according to the national level of disaggregation used[1]					
Afforestation and Reforestation	CO2	Conversion to forest land	Yes	NA	NA
Deforestation	CO2	Conversion to cropland, Conversion to grassland, Conversion to wetland, Conversion to settlements, Conversion to other land	Yes	NA	key category analysis is not only based on emissions/removals from deforestation areas but also from LUC between other categories (e.g.

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[1] See section 5.4 of the IPCC good practice guidance for LULUCF.

[2] This should include qualitative consideration as per section 5.4.3 of the IPCC good practice guidance for LULUCF or any other criteria.

[3] Describe the criteria identifying the category as key.

[4] If the emissions or removals of the category exceed the emissions of the smallest category identified as key in the UNFCCC inventory (including LULUCF), Parties should indicate YES. If not, Parties should indicate NO.

TABLE 5(KP). REPORT OF SUPPLEMENTARY INFORMATION FOR LAND USE, LAND-USE CHANGE AND FORESTRY ACTIVITIES UNDER THE KYOTO PROTOCOL[1], [2]

AUSTRIA
Inventory 2008
Submission 2010 v1.3

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
	(Gg)			
A. Article 3.3 activities				**-1 307.07**
A.1. Afforestation and Reforestation [7]	-2 530.67	NO	NO	-2 530.67
A.1.1. Units of land not harvested since the beginning of the commitment period	-2 530.67	NO	NO	-2 530.67
A.1.2. Units of land harvested since the beginning of the commitment period	NO	NO	NO	NO
A.2. Deforestation	1 223.61	NO	NO	1 223.61
B. Article 3.4 activities				**NA,NO**
B.1. Forest Management (if elected)	NA,NO	NO	NA,NO	NA,NO
B.2. Cropland Management (if elected)	NA,NO	NO	NA,NO	NA,NO
B.3. Grazing Land Management (if elected)	NA,NO	NO	NO	NA,NO
B.4. Revegetation (if elected)	NA,NO	NO	NO	NA,NO

Information item:				
A.1.2. Units of land harvested since the beginning of the commitment period	NO	NO	NO	NO
Austria	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] 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 CRF 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

[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

[7] As both Afforestation and Reforestation under Article 3.3 are subject to the same provisions specified in the annex to decision 16/CMP.1, they can be reported together.

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

Article 3.3 activities: Afforestation and Reforestation [(1), (2)]

Units of land not harvested since the beginning of the commitment period

AUSTRIA
Inventory 2008
Submission 2010 v1.3

GEOGRAPHICAL LOCATION [(3)]	ACTIVITY DATA			IMPLIED CARBON STOCK CHANGE FACTORS [(7)]										Implied emission/ removal factor per area[(9)]	CHANGE IN CARBON STOCK [(7)]										Net CO_2 emissions/ removals [(9)]
Identification code	Subdivision[(4)]	Area subject to the activity	Area of organic soils[(8)]	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			Mineral soils	Organic soils		Gains	Losses	Net change	Gains	Losses	Net change			Mineral soils	Organic soils [(10)]	
		(kha)	(kha)	(Mg C/ha)										(Mg CO_2/ha)	(Gg C)										(Gg CO_2)
Total for activity A.1.1		**210.02**	**NO**	**1.00**	**IE**	**1.00**	**0.18**	**IE**	**0.18**	**IE**	**NO**	**2.10**	**NO**	**-12.05**	**210.83**	**IE**	**210.83**	**37.75**	**IE**	**37.75**	**IE**	**NO**	**441.61**	**NO**	**-2 530.67**
Austria		210.02	NO	1.00	IE	1.00	0.18	IE	0.18	IE	NO	2.10	NO	-12.05	210.83	IE	210.83	37.75	IE	37.75	IE	NO	441.61	NO	-2 530.67
	converted to Forest Land	33.60	NO	1.00	IE	1.00	0.18	IE	0.18	IE	NO	3.02	NO	-15.40	33.73	IE	33.73	6.04	IE	6.04	IE	NO	101.34	NO	-517.40
	converted to Forest Land	123.91	NO	1.00	IE	1.00	0.18	IE	0.18	IE	NO	0.97	NO	-7.89	124.39	IE	124.39	22.27	IE	22.27	IE	NO	120.12	NO	-978.20
	converted to Forest land	12.60	NO	1.00	IE	1.00	0.18	IE	0.18	IE	NO	4.56	NO	-21.07	12.65	IE	12.65	2.26	IE	2.26	IE	NO	57.48	NO	-265.46
	converted to Forest Land	29.40	NO	1.00	IE	1.00	0.18	IE	0.18	IE	NO	3.91	NO	-18.66	29.52	IE	29.52	5.28	IE	5.28	IE	NO	114.84	NO	-548.68
	converted to Forest Land	10.50	NO	1.00	IE	1.00	0.18	IE	0.18	IE	NO	4.55	NO	-21.04	10.54	IE	10.54	1.89	IE	1.89	IE	NO	47.82	NO	-220.93

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 decision 16/CMP.1, 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)] 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. In that case, net gains should be reported in the "Gains"

[(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)] This information is needed for the calculation of the net carbon stock changes in soils per area.

[(9)] 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 (+).

[(10)] The value reported here is an emission and not a carbon stock change.

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
Inventory 2008
Submission 2010 v1.3

GEOGRAPHICAL LOCATION [3]	ACTIVITY DATA			IMPLIED CARBON STOCK CHANGE FACTORS [7]										Implied emission/ removal factor per area[9]	CHANGE IN CARBON STOCK [7]										Net CO_2 emissions/ removals[9]
Identification code	Subdivision[4]	Area subject to the activity	Area of organic soils[8]	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			Mineral soils	Organic soils		Gains	Losses	Net change	Gains	Losses	Net change			Mineral soils	Organic soils [10]	
		(kha)	(kha)	(Mg C/ha)										($Mg CO_2/ha$)	(Gg C)										($Gg CO_2$)
Total for activity A.1.2		**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**
Austria		NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
	D-Area	NO	NO	NO	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.

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[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

[2] As both Afforestation and Reforestation under Article 3.3 are subject to the same provisions specified in the annex to draft decision 16/CMP.1, 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] 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. In that case, net gains should be reported in the "Gains"

[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] This information is needed for the calculation of the net carbon stock changes in soils per area.

[9] 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 (+).

[10] The value reported here is an emission and not a carbon stock change.

TABLE 5(KP-I)A.1.3. SUPPLEMENTARY BACKGROUND FOR LAND USE, LAND-USE CHANGE AND FORESTRY ACTIVITIES UNDER THE KYOTO PROTOCOL

AUSTRIA

Article 3.3 activities: Afforestation and Reforestation (1), (2)

Inventory 2008

Units of land otherwise subject to elected activities under Article 3.4 (information item)

Submission 2010 v1.3

GEOGRAPHICAL LOCATION(3)	ACTIVITY DATA	
Identification code	**Subdivision(4)**	**Area subject to the activity (kha)**
Total for activity A.1.3		**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.

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(1) Units of land subject to Afforestation or Reforestation under Article 3.3 otherwise subject to elected activities under Article 3.4 are implicitly included under A.1.1 or A.1.2. They are reported here for transparency and to fulfil the requirement of paragraph 6 (b) (ii) of the annex to decision 15/CMP.1.

(2) As both Afforestation and Reforestation under Article 3.3 are subject to the same provisions specified in the annex to decision 16/CMP.1, 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, which would otherwise be included in land subject to elected activities under Article 3.4.

(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.

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
Inventory 2008
Submission 2010 v1.3

GEOGRAPHICAL LOCATION (2)	ACTIVITY DATA			IMPLIED CARBON STOCK CHANGE FACTORS (6)										Implied emission/ removal factor per area (8)	CHANGE IN CARBON STOCK (6)										Net CO_2 emissions/ removals (8)
Identification code	Subdivision (3)	Area subject to the activity	Area of organic soils (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)		
				Gains	Losses	Net change	Gains	Losses	Net change			Mineral soils	Organic soils		Gains	Losses	Net change	Gains	Losses	Net change			Mineral soils	Organic soils (9)	
		(kha)	(kha)	(Mg C/ha)										(Mg CO_2/ha)	(Gg C)										(Gg CO_2)
Total for activity A.2.		**98.66**	**NO**	**NO**	**-0.77**	**-0.77**	**NO**	**-0.20**	**-0.20**	**IE**	**IE**	**-2.41**	**NO**	**12.40**	**NO**	**-76.42**	**-76.42**	**NO**	**-19.65**	**-19.65**	**IE**	**IE**	**-237.65**	**NO**	**1 223.61**
Austria		98.66	NO	NO	-0.77	-0.77	NO	-0.20	-0.20	IE	IE	-2.41	NO	12.40	NO	-76.42	-76.42	NO	-19.65	-19.65	IE	IE	-237.65	NO	1 223.61
	converted to Cropland	4.93	NO	NO	-0.77	-0.77	NO	-0.20	-0.20	IE	IE	-2.94	NO	14.35	NO	-3.82	-3.82	NO	-0.98	-0.98	IE	IE	-14.50	NO	70.78
	converted to Grassland	52.29	NO	NO	-0.77	-0.77	NO	-0.20	-0.20	IE	IE	-0.85	NO	6.70	NO	-40.50	-40.50	NO	-10.41	-10.41	IE	IE	-44.61	NO	350.23
	converted to Other Land	23.68	NO	NO	-0.77	-0.77	NO	-0.20	-0.20	IE	IE	-4.00	NO	18.24	NO	-18.34	-18.34	NO	-4.71	-4.71	IE	IE	-94.74	NO	431.92
	converted to Settlement	14.80	NO	NO	-0.77	-0.77	NO	-0.20	-0.20	IE	IE	-4.45	NO	19.90	NO	-11.46	-11.46	NO	-2.95	-2.95	IE	IE	-65.90	NO	294.45
	converted to Wetland	2.96	NO	NO	-0.77	-0.77	NO	-0.20	-0.20	IE	IE	-6.05	NO	25.75	NO	-2.29	-2.29	NO	-0.59	-0.59	IE	IE	-17.91	NO	76.23

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 subdivisi

(4) The signs for estimates of gains in carbon stocks are positive (+) and of losses in carbon stocks are negative (-).

(5) 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. In that case, net gains should be reported in the "Gains" column and net losses should

(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) This information is needed for the calculation of the net carbon stock changes in soils per area.

(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 (+).

(9) The value reported here is an emission and not a carbon stock change.

TABLE 5(KP-I)A.2.1. SUPPLEMENTARY BACKGROUND DATA FOR LAND USE, LAND-USE CHANGE AND FORESTRY ACTIVITIES UNDER THE KYOTO PROTOCOL

AUSTRIA
Inventory 2008
Submission 2010 v1.3

Article 3.3 activities: Deforestation [1]

Units of land otherwise subject to elected activities under Article 3.4 (information item)

GEOGRAPHICAL LOCATION[2]	ACTIVITY DATA	
Identification code	Subdivision[3]	Area subject to the activity (kha)
Total for activity A.2.1.		**NA**
Austria		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] Units of lands 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 decision 15/CMP.1.

[2] Geographical location refers to the boundaries of the areas that encompass units of land subject to Deforestation which would otherwise be included in land subject to elected activities under Article 3.4.

[3] Activity data may be further subdivided according to climate zone, management system, soil type, vegetation type, tree species, ecological zone, national lanc classification or other criteria. Complete one row for each subdivision.

TABLE 5(KP-I)B.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

Elected Article 3.4 activities: Forest Management [1]

GEOGRAPHICAL	ACTIVITY DATA			IMPLIED CARBON STOCK CHANGE FACTORS [6]										Implied emission/ removal factor per area[8]	CHANGE IN CARBON STOCK [6]										Net CO$_2$ emissions/ removals[8]
Identification code	Subdivision[3]	Area subject to the activity	Area of organic soils[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]		
				Gains	Losses	Net change	Gains	Losses	Net change			Mineral soils	Organic soils		Gains	Losses	Net change	Gains	Losses	Net change			Mineral soils	Organic soils [9]	
		(kha)	(kha)	(Mg C/ha)										(Mg CO$_2$/ha)	(Gg C)										(Gg CO$_2$)
Total for activity B.1		**NA**	**NA**	**NA**	**NA**	**NA**	**NA**	**NA**	**NA**	**NA**	**NA**	**NA**	**NA**	**NA**	**NA**	**NA**	**NA**	**NA**	**NA**	**NA**	**NA**	**NA**	**NA**	**NA**	**NA**
Austria		NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	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.

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(1) If Forest Management has been elected, report here information on anthropogenic carbon stock change for the inventory year for all geographical locations that encor

(2) Geographical location refers to the boundaries of the areas that encompass land subject to Forest Management (if elected).

(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) 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. In that case, net gains should be reported in the “Gains”

(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) This information is needed for the calculation of the net carbon stock changes in soils per area.

(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

(9) The value reported here is an emission and not a carbon stock change.

TABLE 5(KP-I)B.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

Elected Article 3.4 activities: Cropland Management (1), (2)

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GEOGRAPHICAL LOCATION(3)	ACTIVITY DATA			IMPLIED CARBON STOCK CHANGE FACTORS (7)										Implied emission/ removal factor per area(10)	CHANGE IN CARBON STOCK (7)										Net CO$_2$ emissions/ removals(10)
Identification code	Subdivision(4)	Area subject to the activity	Area of organic soils(9)	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			Mineral soils	Organic soils		Gains	Losses	Net change	Gains	Losses	Net change			Mineral soils	Organic soils(8)	
		(kha)	(kha)	(Mg C/ha)										(Mg CO$_2$/ha)	(Gg C)										(Gg CO$_2$)
Total for activity B.2		**NA**	**NA**	**NA**	**NA**	**NA**	**NA**	**NA**	**NA**	**NA**	**NA**	**NA**	**NA**	**NA**	**NA**	**NA**	**NA**	**NA**	**NA**	**NA**	**NA**	**NA**	**NA**	**NA**	**NA**
Austria		NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	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) If Cropland Management has been elected, report here information on anthropogenic carbon stock change for the inventory year for all geographical locations that encompass land subject to Cropland Management under Article 3.

(2) If Cropland Management has been elected, this table and all relevant CRF tables should also be reported for the base year for Cropland Management.

(3) Geographical location refers to the boundaries of the areas that encompass land subject to Cropland Management (if elected).

(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) 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. In that case, net gains should be reported in the “Gains” column and

(7) Note that net change corresponds to increase / decrease of carbon stock (see table 4.2.6b of the IPCC good practice guidance for LULUCF).

(8) The value reported here is an emission and not a carbon stock change.

(9) This information is needed for the calculation of the net carbon stock changes in soils per area.

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)B.3. 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

Elected Article 3.4 activities: Grazing Land Management [1], [2]

GEOGRAPHICAL LOCATION[3]	ACTIVITY DATA			IMPLIED CARBON STOCK CHANGE FACTORS [7]											CHANGE IN CARBON STOCK [7]										
Identification code	Subdivision[4]	Area subject to the activity	Area of organic soils[9]	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]		Implied emission/ removal factor per area[10]	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]		Net CO_2 emissions/ removals[10]
				Gains	Losses	Net change	Gains	Losses	Net change			Mineral soils	Organic soils		Gains	Losses	Net change	Gains	Losses	Net change			Mineral soils	Organic soils[8]	
		(kha)	(kha)	(Mg C/ha)										(Mg CO_2/ha)	(Gg C)										(Gg CO_2)
Total for activity B.3		**NA**	**NA**	**NA**	**NA**	**NA**	**NA**	**NA**	**NA**	**NA**	**NA**	**NA**	**NA**	**NA**	**NA**	**NA**	**NA**	**NA**	**NA**	**NA**	**NA**	**NA**	**NA**	**NA**	**NA**
Austria		NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	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 i any additional details are needed to understand the content of this table.

[1] If Grazing Land Management has been elected, report here information on anthropogenic carbon stock change for the inventory year for all geographical locations that encompass land subject to Grazing Land Management under Article 3.4.

[2] If Grazing Land Management has been elected, this table and all relevant CRF tables should also be reported for the base year for Grazing Land Management.

[3] Geographical location refers to the boundaries of the areas that encompass land subject to Grazing Land Management (if elected).

[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] 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. In that case, net gains should be reported in the "Gains" column and net

[7] Note that net change corresponds to increase / decrease of carbon stock (see table 4.2.6b of the IPCC good practice guidance for LULUCF).

[8] The value reported here is an emission and not a carbon stock change.

[9] This information is needed for the calculation of the net carbon stock changes in soils per area.

[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 CO2 removals to be negative (-) and for net CO2 emissions to be positive (+).

TABLE 5(KP-I)B.4. 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

Elected Article 3.4 activities: Revegetation [(1), (2)]

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GEOGRAPHICAL LOCATION[(3)]	ACTIVITY DATA			IMPLIED CARBON STOCK CHANGE FACTORS[(7)]										Implied emission/ removal factor per area [(10)]	CHANGE IN CARBON STOCK[(7)]										Net CO_2 emissions/ removals[(10)]
Identification code	Subdivision[(4)]	Area subject to the activity	Area of organic soils [(9)]	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			Mineral soils	Organic soils		Gains	Losses	Net change	Gains	Losses	Net change			Mineral soils	Organic soils[(8)]	
		(kha)	(kha)	(Mg C/ha)										(Mg CO_2/ha)	(Gg C)										(Gg CO_2)
Total for activity B.4		**NA**	**NA**	**NA**	**NA**	**NA**	**NA**	**NA**	**NA**	**NA**	**NA**	**NA**	**NA**	**NA**	**NA**	**NA**	**NA**	**NA**	**NA**	**NA**	**NA**	**NA**	**NA**	**NA**	**NA**
Austria		NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	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.

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(1) If Revegetation has been elected, report here information on anthropogenic carbon stock change for the inventory year for all geographical locations that encompass land subject to Revegetation under Article 3.

(2) If Revegetation has been elected, this table and all relevant CRF tables should also be reported for the base year for Revegetation.

(3) Geographical location refers to the boundaries of the areas that encompass land subject to Revegetation (if elected).

(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) 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. In that case, net gains should be reported in the “Gains” column and net losses should be

(7) Note that net change corresponds to increase / decrease of carbon stock (see table 4.2.6b of the IPCC good practice guidance for LULUCF).

(8) The value reported here is an emission and not a carbon stock change.

(9) This information is needed for the calculation of the net carbon stock changes in soils per area.

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 (+).

Direct N_2O emissions from N fertilization (1), (2)

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]	**NA**	**NA**	**NA**
Austria	NA	NA	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) 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. 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 N_2O 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 N_2O 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)2. SUPPLEMENTARY BACKGROUND DATA FOR LAND USE, LAND-USE CHANGE AND FORESTRY ACTIVITIES UNDER THE KYOTO PROTOCOL

AUSTRIA
Inventory 2008
Submission 2010 v1.3

Elected Article 3.4 activities: Forest Management

N_2O emissions from drainage of soils (1), (2)

Identification code of geographical location[3]	**ACTIVITY DATA** **Area of drained soils (kha)**	**IMPLIED EMISSION FACTOR** **N_2O-N per area drained (kg N_2O-N/ha)[4]**	**EMISSIONS** **N_2O (Gg)**
B.1. Forest Management (if elected)	**NA,NO**	**NA,NO**	**NA,NO**
Total for organic soils	NO	NO	NO
Total for mineral soils	NA	NA	NA
Austria	NA,NO	NA,NO	NA,NO
Organic soils	NO	NO	NO
Mineral soils	NA	NA	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 estimating N_2O emissions from drainage of soils are not addressed in the Revised 1996 IPCC Guidelines, but Appendix 3a.2 of the IPCC good practice guidance for LULUCF provides methodologies for consideration.

(2) N_2O emissions from drainage of soils include those resulting from Forest Management. N_2O emissions from drained Cropland and Grassland soils are

(3) Geographical location refers to the boundaries of the areas that encompass land subject to Forest Management (if elected).

(4) In the calculation of the implied emission factor, N_2O emissions are converted to N_2O-N by multiplying by 28/44.

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)

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Identification code of geographical location	ACTIVITY DATA	IMPLIED EMISSION	EMISSIONS
	Land area converted (kha)	N_2O-N per area converted (5) (kg N_2O-N/ha)	N_2O (Gg)
A.2. Deforestation (3), (6)	**NO**	**NO**	**NO**
Total organic soils	NO	NO	NO
Total mineral soils	NO	NO	NO
Austria	NO	NO	NO
Organic soils (7), (10)	NO	NO	NO
Mineral soils (7)	NO	NO	NO
B.2. Cropland Management (if elected) (4), (8)	**NA,NO**	**NA,NO**	**NA,NO**
Total organic soils	NO	NO	NO
Total mineral soils	NA	NA	NA
Austria	NA,NO	NA,NO	NA,NO
Organic soils (7), (10)	NO	NO	NO
Mineral soils (7)	NA	NA	NA
Information items (9)			
A.2.1. Deforestation: units of land otherwise	**NO**		
Total organic soils	NO		
Total mineral soils	NO		
Austria	NO		
Organic soils (7), (10)	NO		
Mineral soils (7)	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) 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. N_2O 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 the Agriculture sector under Cultivation of

(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

(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

(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 decision 15/CMP.1.

(10) N_2O emissions from Cropland are included in the Agriculture sector.

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 applicatior [(1)]

AUSTRIA
Inventory 2008
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Identification code of geographical location	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)]	**NO**	**NO**	**NO**
Total for limestone	NO	NO	NO
Total for dolomite	NO	NO	NO
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)]	**NO**	**NO**	**NO**
Total for limestone	NO	NO	NO
Total for dolomite	NO	NO	NO
Austria	NO	NO	NO
Limestone ($CaCO_3$)	NO	NO	NO
Dolomite ($CaMg(CO_3)_2$)	NO	NO	NO
A.2. Deforestation [(3), (8), (9)]	**NO**	**NO**	**NO**
Total for limestone	NO	NO	NO
Total for dolomite	NO	NO	NO
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)]	**NA**	**NA**	**NA**
Total for limestone	NA	NA	NA
Total for dolomite	NA	NA	NA
Austria	NA	NA	NA
Limestone ($CaCO_3$)	NA	NA	NA
Dolomite ($CaMg(CO_3)_2$)	NA	NA	NA
B.2. Cropland Management (if elected)[(5), (8), (9)]	**NA**	**NA**	**NA**
Total for limestone	NA	NA	NA
Total for dolomite	NA	NA	NA
Austria	NA	NA	NA
Limestone ($CaCO_3$)	NA	NA	NA
Dolomite ($CaMg(CO_3)_2$)	NA	NA	NA
B.3. Grazing Land Management (if elected) [(6), (8), (9)]	**NA**	**NA**	**NA**
Total for limestone	NA	NA	NA
Total for dolomite	NA	NA	NA
Austria	NA	NA	NA
Limestone ($CaCO_3$)	NA	NA	NA
Dolomite ($CaMg(CO_3)_2$)	NA	NA	NA
B.4. Revegetation (if elected) [(7), (8), (9)]	**NA**	**NA**	**NA**
Total for limestone	NA	NA	NA
Total for dolomite	NA	NA	NA
Austria	NA	NA	NA
Limestone ($CaCO_3$)	NA	NA	NA
Dolomite ($CaMg(CO_3)_2$)	NA	NA	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)] Carbon emissions from agricultural lime application are addressed in sections 3.3.1.2.1.1 and 3.3.2.2.1.1 of the IPCC good practice guidance for LULUCF
[(2)] Geographical location refers to the boundaries of the areas that encompass units of land subject to Afforestation and Reforestation.
[(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 Forest Management, if elected
[(5)] Geographical location refers to the boundaries of the areas that encompass land subject to Cropland Management, if elected
[(6)] Geographical location refers to the boundaries of the areas that encompass land subject to Grazing Land Management, if elected
[(7)] Geographical location 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

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Inventory 2008
Submission 2010 v1.3

Identification code of geographical location	ACTIVITY DATA			IMPLIED EMISSION			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)		
since the beginning of the commitment perio(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.1.2. Afforestation/Reforestation: units of land harvested	**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)			**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**
Total for controlled burning			NO	NO	NO	NO	NO	NO	NO
Total for wildfires			NO	NO	NO	NO	NO	NO	NO
Austria			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
B.2. Cropland Management (if elected) (4), (9), (10)			**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**
Total for controlled burning			NO	NO	NO	NO	NO	NO	NO
Total for wildfires			NO	NO	NO	NO	NO	NO	NO
Austria			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
B.3. Grazing Land Management (if elected) (5), (9), (11)			**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**
Total for controlled burning			NO	NO	NO	NO	NO	NO	NO
Total for wildfires			NO	NO	NO	NO	NO	NO	NO
Austria			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
B.4. Revegetation (if elected) (6), (9)			**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**
Total for controlled burning			NO	NO	NO	NO	NO	NO	NO
Total for wildfires			NO	NO	NO	NO	NO	NO	NO
Austria			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

Documentation box
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.

(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 CO_2 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.

INFORMATION TABLE ON ACCOUNTING FOR ACTIVITIES UNDER ARTICLES 3.3 AND 3.4 OF THE KYOTO PROTOCOL

AUSTRIA
Inventory 2008
Submission 2010 v1.3

☐**Commitment period accounting: YES**
☐**Annual accounting: NO**

Number of the reported year in the commitment period: 1

GREENHOUSE GAS SOURCE AND SINK ACTIVITIES	**BY(5)**	**Net emissions/removals(1)**		**Accounting Parameters[7]**	**Accounting Quantity [8]**
		2008	**Total[6]**		
	(Gg CO_2 equivalent)				
A. Article 3.3 activities					
A.1. Afforestation and Reforestation					-2 530.67
A.1.1. Units of land not harvested since the beginning of the commitment period[2]		-2 530.67	-2 530.67		-2 530.67
A.1.2. Units of land harvested since the beginning of the commitment period[2]					NO
Austria		NO	NO		NO
A.2. Deforestation		1 223.61	1 223.61		1 223.61
B. Article 3.4 activities					
B.1. Forest Management (if elected)		NA,NO	NA,NO		NA,NO
3.3 offset[3]				0.00	NA,NO
FM cap[4]				11 550.00	NA,NO
B.2. Cropland Management (if elected)	0.00	NA,NO	NA,NO	0.00	0.00
B.3. Grazing Land Management (if elected)	0.00	NA,NO	NA,NO	0.00	0.00
B.4. Revegetation (if elected)	0.00	NA,NO	NA,NO	0.00	0.00

[1] All values are reported in table 5(KP) of the CRF for the relevant inventory year as reported in the current submission and are automatically entered in this tabl

[2] In accordance with paragraph 4 of the annex to decision 16/CMP.1, debits resulting from harvesting during the first commitment period following Afforestation and Reforestation since 1990 shall not be greater than credits accounted for on that unit of land.

[3] In accordance with paragraph 10 of the annex to decision 16/CMP.1, for the first commitment period, a Party included in Annex I that incurs a net source of emissions under the provisions of Article 3.3 may account for anthropogenic greenhouse gas emissions by sources and removals by sinks in areas under Forest Management under Article 3.4, up to a level that is equal to the net source of emissions under the provisions of Article 3.3, but not greater than 9.0 megatonnes of carbon times five, if the total anthropogenic greenhouse gas emissions by sources and removals by sinks in the managed forest since 1990 is equal to, or larger than, the net source of emissions incurred under Article 3.3.

[4] In accordance with paragraph 11 of the annex to decision 16/CMP.1, for the first commitment period only, additions to and subtractions from the assigned amount of a Party resulting from Forest Management under Article 3.4, after the application of paragraph 10 of the annex to decision 16/CMP.1 and resulting from Forest Management project activities undertaken under Article 6, shall not exceed the value inscribed in the appendix of the annex to decision 16/CMP.1, times five.

[5] Net emissions and removals in the Party’s base year, as established by decision 9/CP.2

[6] Cumulative net emissions and removals for all years of the commitment period reported in the current submission.

[7] The values in the cells "3.3 offset" and "FM cap" are absolute value:

[8] The accounting quantity is the total quantity of units to be added to or subtracted from a Party's assigned amount for a particular activity in accordance with the provisions of Article 7.4 of the Kyoto Protocol.