

AUSTRIA'S NATIONAL INVENTORY REPORT 2012

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

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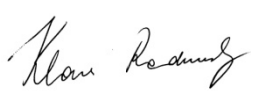
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PREFACE

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 2010. With the submission of 2010 inventory data, this report delivers 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.11¹. 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 11th version of the National Inventory Report (NIR) submitted by Austria, it is largely an update of the NIR submitted in 2011².

This report is based on data submitted to the UNFCCC in the common reporting format (CRF submission 2012). 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 2012 and as submitted to the UNFCCC in the data submission 2012 replaces all previous versions of data submissions.

The structure of the report follows the 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 secretariat³: 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 Units⁴, 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.

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 2011 – Submission under the United Nations Framework Convention of Climate Change and the Kyoto Protocol. Report REP-0308; 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 CO₂ 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 2010 as reported in the tables of the common reporting format of the data submission 2012 under the Convention and Tables for reporting emissions and removals of greenhouse gases from activities 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.

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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 2010 relate to the security measures implemented (Chapter 13). 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 13.1, 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 pursu-

ant 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 13.1.

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 84 594 Gg CO₂ equivalents in 2010 and increased by 8.2% compared to 1990. The base year for all greenhouse gases is 1990.

The most important GHG in Austria is carbon dioxide (CO₂), it contributed 85.5% to the total national GHG emissions expressed in CO₂ equivalents in 2010, followed by CH₄ (6.6%) and N₂O (6.1%). PFCs, HFCs and SF₆ amounted together to 1.9% of the overall GHG emissions in the country. The energy sector accounted for 76.0% of the total GHG emissions followed by Industrial Processes (12.6%), Agriculture (8.8%), Waste (2.1%) and Solvent (0.4%).

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

GHG	Total	CO ₂	CH ₄	N ₂ O	HFCs	PFCs	SF ₆
1990*	78 162.33	62 059.59	8 304.66	6 198.25	26.32	1 079.24	494.28
1991	82 203.00	65 643.84	8 268.14	6 529.63	29.56	1 087.08	644.74
1992	75 442.31	60 138.33	7 986.05	6 134.39	32.31	462.32	688.92
1993	75 488.13	60 516.13	7 934.59	5 960.40	243.56	52.57	780.89
1994	76 373.04	60 899.75	7 708.51	6 441.57	293.06	58.30	971.85
1995	79 806.18	63 943.97	7 618.18	6 606.82	411.88	71.27	1 154.06
1996	82 888.33	67 383.73	7 398.53	6 268.29	531.93	71.70	1 234.15
1997	82 469.57	67 180.02	7 093.97	6 299.48	651.68	105.15	1 139.26
1998	81 862.56	66 763.01	6 943.43	6 417.65	769.31	55.95	913.21
1999	80 254.13	65 344.86	6 774.34	6 392.50	876.61	78.63	787.19
2000	80 469.58	65 972.21	6 625.71	6 289.48	901.85	84.79	595.54
2001	84 343.58	70 004.86	6 490.28	6 175.35	924.89	95.91	652.28
2002	85 992.07	71 720.08	6 393.61	6 176.67	969.18	97.70	634.81
2003	91 882.00	77 758.24	6 391.35	6 099.84	949.51	116.44	566.62
2004	91 458.44	78 215.90	6 251.63	5 401.82	955.10	136.65	497.35
2005	92 879.51	79 723.89	6 094.53	5 433.59	986.36	133.82	507.33
2006	90 059.07	77 032.53	5 978.19	5 474.91	962.57	145.72	465.15
2007	87 365.67	74 362.72	5 872.33	5 504.04	1 061.91	190.12	374.54
2008	86 955.53	73 921.54	5 731.45	5 688.19	1 057.99	173.53	382.84
2009	79 739.35	67 225.70	5 663.35	5 409.51	1 056.61	35.05	349.14
2010	84 593.94	72 290.47	5 574.51	5 153.46	1 160.63	69.85	345.01

*1990 = Base Year for CO₂, CH₄ and N₂O, HFCs, PFCs and SF₆

NOTE: Emissions without LULUCF

Over the period 1990–2010 CO₂ emissions increased by 16.5%, mainly due to increased emissions from transport. Methane emissions decreased during the same period by 32.9% mainly due to lower emissions from solid waste disposal; N₂O emissions decreased by 16.9% over the same period due to lower emissions from agricultural soils and from chemical industry. In 2010 HFC emissions are 40 times higher than in the base year, whereas PFC and SF₆ emissions decreased by 93.5% and 30.2% resp. from the base year to 2010.

ES.2.2 KP-LULUCF activities

In 2010 Article 3.3 activities were a net sink in Austria: Net CO₂ removals amounted to 1 259 Gg CO₂.

Removals from Afforestation/Reforestation (AR) amounted to 2 621 Gg CO₂. 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 37% of these removals occurred on AR areas from grassland, 18% on AR areas from other land, 17% from settlement, 16% from cropland and 12 % from wetlands.

In the same year, emissions from deforestation amounted to 1 362 Gg CO₂. 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 30% of these losses occurred on D areas to grassland, 28% to settlement. 25% to other land and the rest at D areas to cropland and wetlands.

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 (76.0%), followed by Industrial Processes (12.6%).

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*	68 139.78	78 162.33	55 396.89	10 108.40	511.80	8 557.96	-10 022.56	3 587.28
1991	66 462.78	82 203.00	59 290.61	10 126.98	465.98	8 747.51	-15 740.22	3 571.93
1992	64 500.27	75 442.31	54 363.89	8 912.12	417.65	8 284.72	-10 942.04	3 463.94
1993	64 109.74	75 488.13	54 779.83	8 824.00	418.48	8 050.88	-11 378.39	3 414.94
1994	66 126.83	76 373.04	54 815.08	9 343.79	403.26	8 556.67	-10 246.21	3 254.24
1995	68 208.78	79 806.18	57 669.86	9 896.75	422.45	8 720.66	-11 597.40	3 096.47
1996	74 395.94	82 888.33	61 474.07	9 813.62	405.66	8 246.32	-8 492.38	2 948.66
1997	65 312.59	82 469.57	60 554.13	10 450.56	424.37	8 223.84	-17 156.97	2 816.67
1998	66 600.99	81 862.56	60 531.37	9 971.69	406.32	8 227.12	-15 261.56	2 726.05
1999	62 117.78	80 254.13	59 274.55	9 851.69	392.26	8 104.16	-18 136.35	2 631.47
2000	65 433.72	80 469.58	59 250.78	10 324.58	425.12	7 910.93	-15 035.87	2 558.17

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
2001	67 420.12	84 343.58	63 374.21	10 176.58	424.82	7 863.86	-16 923.46	2 504.11
2002	75 013.73	85 992.07	64 487.54	10 794.43	427.08	7 761.32	-10 978.34	2 521.70
2003	90 950.80	91 882.00	70 596.35	10 746.65	418.42	7 554.56	-931.20	2 566.02
2004	85 469.71	91 458.44	71 070.90	10 115.55	374.23	7 450.57	-5 988.73	2 447.19
2005	85 484.08	92 879.51	72 112.85	10 623.26	386.59	7 412.12	-7 395.44	2 344.70
2006	88 475.99	90 059.07	68 943.92	10 984.18	415.03	7 447.12	-1 583.08	2 268.81
2007	86 847.10	87 365.67	65 845.55	11 460.03	388.34	7 512.44	-518.57	2 159.30
2008	87 340.55	86 955.53	65 000.43	11 910.82	367.24	7 647.15	385.02	2 029.90
2009	76 094.87	79 739.35	60 219.86	9 675.39	299.16	7 631.63	-3 644.48	1 913.30
2010	80 983.22	84 593.94	64 327.66	10 680.47	327.12	7 452.64	-3 610.72	1 806.05

* 1990 = Base Year for CO₂, CH₄ and N₂O, HFCs, PFCs and SF₆

In 2010, 64 328 Gg CO₂ equivalents, that is 76.0% of total national emissions, arose from the energy sector; 99.2% of these emissions arose from fuel combustion activities. The most important fuel combustion sub-sector was transport with a share of 35.2% (2010). From 1990 to 2010, GHG emissions from the energy sector increased by 16.1%.

Industrial processes was the second largest sector in Austria with 12.6% of total GHG emissions in 2010 (10 680 Gg CO₂ equivalents). The main source of greenhouse gas emissions from industrial processes was metal production, which caused 51.3% of the emissions from this sector in 2010. From the base year to 2010, emissions from industrial processes increased by 5.7%.

In 2010, 0.4% of total GHG emissions in Austria (327 Gg CO₂ equivalent) arose from solvent and other product use. From 1990 to 2010, emissions from this category decreased by 36.1%.

Emissions from agriculture amounted to 7 453 Gg CO₂ equivalent in 2010, which corresponded to 8.8% of total national emissions. In 2010 the most important sub-sector enteric fermentation contributed with 43.7% to total greenhouse gas emissions from the agriculture sector. In 2010 emissions from this category were 12.9% below the level of the base year.

In 2010 greenhouse gas emissions from the waste sector amounted to 1 806 Gg CO₂ equivalents, which corresponded to 2.1% of the total national emissions. The main source of greenhouse gas emissions in this sector is solid waste disposal on land, which caused 74.8% of the sectoral emissions. In 2010 emissions from this sector were 49.7% below the level of the base year.

ES.3.1 KP-LULUCF activities

In 2010 Article 3.3 activities were a net sink in Austria: Net CO₂ removals amounted to 1 259 Gg CO₂.

CO₂ removals from Afforestation/Reforestation (AR) in Austria amounted to 2 621 Gg CO₂. 410 Gg CO₂ resulted from cropland converted to forest land, 976 Gg CO₂ from grassland, 481 Gg CO₂ from other land, 440 Gg CO₂ from settlement and 314 Gg CO₂ from wetland. Emissions from Deforestation (D) activities were approximately 1 362 Gg CO₂ in 2010. Forest land converted to cropland amounted to 141 Gg CO₂, to grassland 412 Gg CO₂, to other land 340 Gg CO₂, to settlement 385 Gg CO₂ and to wetland 83 Gg CO₂.

ES.4 Overview of Emission Estimates and Trends of Indirect GHGs and SO₂

Emissions of indirect greenhouse gases decreased in the period from 1990 to 2010: NO_x by 3.8%, CO by 55.6%, NMVOC by 52.0%, and SO₂ by 74.9%. The most important emission source for NO_x, SO₂ and CO is fuel combustion. The most important emission source for NMVOC is Solvent and other Product Use.

Table 3: Emissions of indirect GHGs and SO₂ 1990–2010.

		NO _x	CO	NMVOC	SO ₂
1990		194.68	1 435.65	275.87	74.40
1991		201.89	1 499.75	266.31	71.51
1992		192.24	1 470.78	241.39	55.12
1993		186.84	1 438.88	242.33	53.49
1994		181.14	1 385.51	226.33	47.87
1995		181.05	1 272.49	226.14	47.45
1996		203.09	1 247.14	220.21	44.73
1997		190.90	1 150.20	204.29	40.19
1998		204.77	1 108.41	187.76	35.54
1999		197.56	1 030.48	174.04	33.73
2000	[Gt]	205.10	957.03	178.22	31.64
2001		215.16	917.55	176.89	32.69
2002		221.10	880.69	175.90	31.17
2003		232.37	872.17	172.47	31.89
2004		230.68	833.35	153.64	27.32
2005		234.71	806.86	161.67	27.06
2006		221.36	767.58	171.98	28.05
2007		215.04	715.20	158.35	24.45
2008		202.62	676.26	149.23	22.01
2009		185.75	630.00	120.56	17.33
2010		187.31	636.95	132.52	18.67

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 protocol⁵: carbon dioxide (CO₂), methane (CH₄), nitrous oxide (N₂O) as well as hydrogenated fluorocarbons (HFCs), perfluorated halocarbons (PFCs) and sulphur hexafluoride (SF₆).

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 April 2011, 190 Parties had ratified the KP, accounting for 63.7% of emissions of Annex I 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 2009. 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.

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 *Air Pollution Control & Climate Change Mitigation* of the Umweltbundesamt in Vienna; since 2005 it is accredited as *Inspection Body for Emission Inventories* according to ISO/IEC 17020. In 2011 the re-accreditation was passed successfully.

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, 2009, 2010 and 2011. In February 2007 the in-country review of the initial report of Austria (the Pre-commitment period review) took place, it included the review of assigned amount, the national inventory system and the national registry. The reports on these reviews can be found on the UNFCCC website⁶.

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.1 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).

⁶ [http://unfccc.int/resource/webdocs/iri\(2\)/2001/aut.pdf](http://unfccc.int/resource/webdocs/iri(2)/2001/aut.pdf),
[http://unfccc.int/resource/webdocs/iri\(3\)/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_iir_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 Protocol⁷.

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 13.1, 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 13.1.

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 *Air Pollution Control & Climate Change Mitigation* 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).

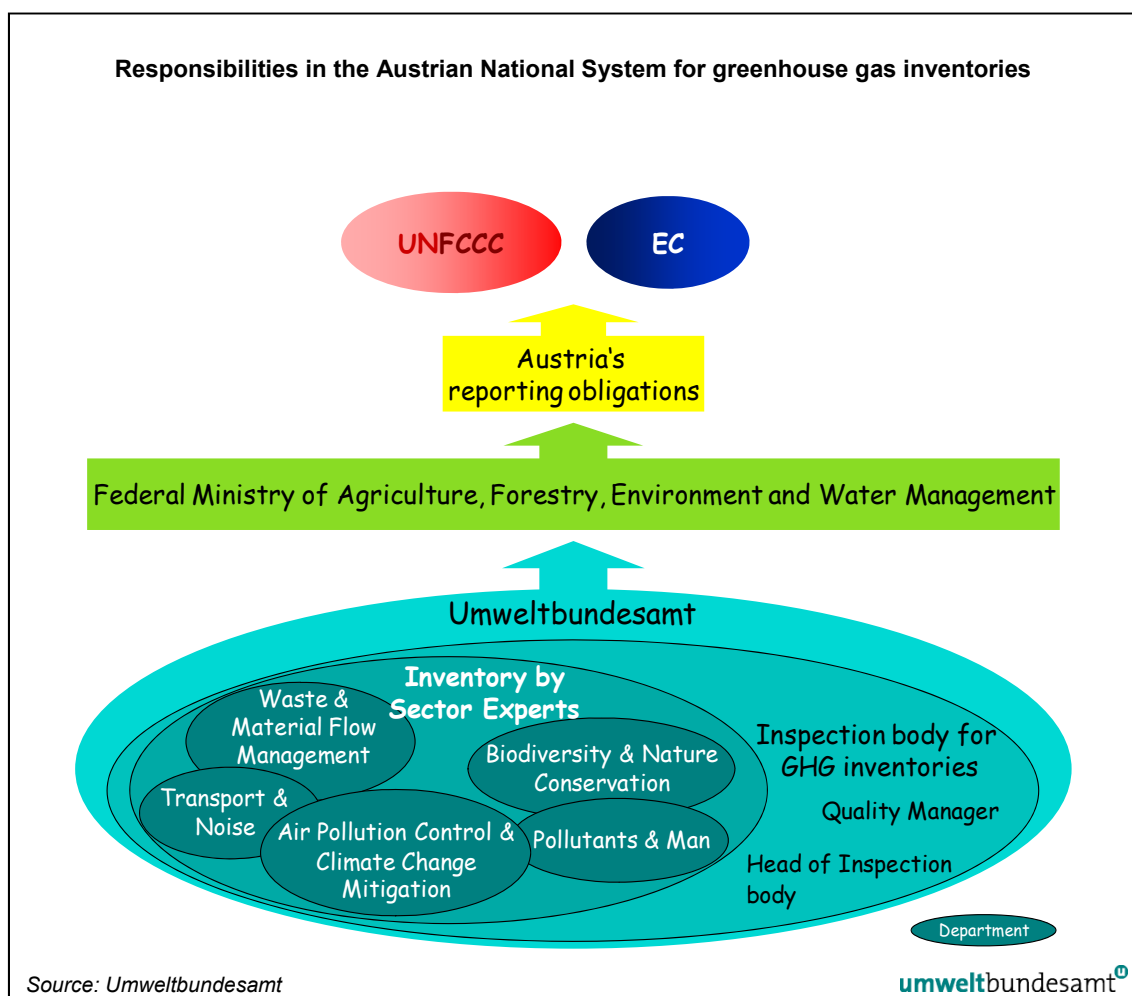


Figure 1: Responsibilities in the Austrian National System for greenhouse gas inventories.

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 Labour⁹. 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, who 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 Emissions¹⁰
- This ordinance pertains to the Austrian Emissions Certificate Trading Act¹¹ 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 Economy, Family and Youth (BMWFJ) 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 (Bundesstatistikgesetz¹²), 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*.

⁸ „Akkreditierungsgesetz“, 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 licensee 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 the operators of landfill sites have to report type and amount of waste deposited annually. This reports (collected in a central database) provide the main basis for calculating emissions from the sector *Waste*.
- Until 2008 the Umweltbundesamt has run a landfill database for solid waste disposals (Deponiedatenbank), where the data (reports) provided by the landfill operators were incorporated.
- However, since 2009 – starting with the deposited waste of the year 2008 – landfill operators are obliged to register their data electronically at the portal of <http://edm.gv.at> (Electronic Data Management).¹⁵ Responsible for data collection and analysis is the BMLFUW. The necessary data is requested by the Umweltbundesamt for the purpose of inventory preparation.
- Since 2004 there is a reporting obligation to the BMLFUW under the Austrian Fluorinated Compounds (FC) Ordinance¹⁶ 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 (“Inspektionsstelle Emissionsbilanzen”).

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 activities at the Inspection Body, information on audits and reviews and also a statement on the fulfilment of each item of last year's improvement plan.

¹³ „Emissionsschutzgesetz für Kesselanlagen“, Federal Law Gazette I No. 150/2004

¹⁴ „Deponieverordnung“, Federal Law Gazette No 164/1996, last amended by Federal Law Gazette II No 49/2004

¹⁵ „Deponieverordnung 2008“, Federal Law Gazette II No 39/2008

¹⁶ „Industriegas-Verordnung (HFKW-FKW-SF6-VO)“, Federal Law Gazette II No. 447/2002

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.

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, but also on improvement ideas of the sector experts or external experts.

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, 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 of the National Inventory Report to the EC	March 15
UNFCCC Submission NIR	Submission of 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 2010 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)¹⁷, 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.

¹⁷ currently applied: CRF 3.4.3

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 ExcelTM spreadsheets in combination with Visual BasicTM 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: Öko-Recherche GmbH, Frankfurt (2010)
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 National agricultural statistics and land use statistics obtained from Statistik Austria	Umweltbundesamt
Waste	Database on landfills run by the Umweltbundesamt (1998-2007), Electronic Data Management operated by the BMLFUW (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 data¹⁸. 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 Management. 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.

¹⁸ „Industrie und Gewerbestatistik“ published by STATISTIK AUSTRIA for the years until 1995; „Konjunkturstatistik im produzierenden Bereich“ published by STATISTIK AUSTRIA for the years since 1997.

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 Council¹⁹. 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 CO₂ (since 2005) and N₂O (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 (~31 Tg CO₂ in 2010).

Plant operators have to report their CO₂ and N₂O emissions annually; for the first time they reported their CO₂ 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/EC²⁰. In Austria, member state specific regulations are defined in the Austrian Emissions Allowance Trading Act²¹ and the Austrian Monitoring, Reporting and Verification Ordinance²². This ordinance also states that 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 CO₂ and N₂O 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 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 public²³. 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.

¹⁹ 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

²⁰ 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

²¹ Emissionszertifikate-Gesetz, Federal Law Gazette I No. 46/2004

²² Überwachungs-, Berichterstattungs- und Prüfungs-Verordnung, Federal Law Gazette II No. 339/2007

²³ 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.

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 and waste transfers from 2007 under the E-PRTR, which is an annual reporting obligation. The plausibility of the reports is checked by the competent authorities and Umweltbundesamt. 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 to be 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 possible.

1.4.2 KP-LULUCF inventory

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.

A detailed description of the used methods is provided in Chapter 10. Furthermore the methods used to estimate emissions/removals from ARD activities are of the same tier as those used for the UNFCCC reporting (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 CO₂, CH₄, N₂O, HFC, PFC and SF₆, and all IPCC categories.

The presented key category analysis was performed by the Umweltbundesamt with data for greenhouse gas emissions of the submission 2012 and comprises a level assessment for the years 1990 and 2010 and a trend assessment for the trend of the year 2010 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 KP-LULUCF)

The method used to identify key source categories follows the Tier 1 approach. Additionally, a Tier 2 analysis has been conducted for this years' submission for the first time (as encouraged in FCCC/ARR/2010/AUT). The results are included in Annex 1, a comparison with the results of Tier 1 is shown in this chapter.

The identified key categories are listed in Table 7. The key categories without LULUCF (presented in Annex 1) comprise 81 585 Gg CO₂e in the year 2010, which corresponds to 96.4% of Austria's total greenhouse gas emissions (without LULUCF). The key categories including LULUCF amounted to 77 941 Gg CO₂e in 2010.

Table 7: Austrian key categories based on emission data submitted to the UNFCCC in 2012.

IPCC Category Description		Gas	Emissions 2010 [Gg CO ₂ e]
1 A 3 b diesel oil	Road Transportation	CO ₂	16 280
1 A 2 gaseous	Manufacturing Industries and Construction	CO ₂	6 848
2 C 1	Iron and Steel Production	CO ₂	5 460
1 A 1 a gaseous	Public Electricity and Heat Production	CO ₂	5 307
1 A 3 b gasoline	Road Transportation	CO ₂	5 270
1 A 4 stat-liquid	Other Sectors	CO ₂	5 196
1 A 2 solid	Manufacturing Industries and Construction	CO ₂	4 944
1 A 4 gaseous	Other Sectors	CO ₂	4 666
1 A 1 a solid	Public Electricity and Heat Production	CO ₂	3 870
4 A 1	Cattle	CH ₄	3 045
1 A 1 b liquid	Petroleum refining	CO ₂	2 195
1 A 2 stat-liquid	Manufacturing Industries and Construction	CO ₂	1 811
4 D 1	Direct Soil Emissions	N ₂ O	1 738
2 A 1	Cement Production	CO ₂	1 622
6 A	SOLID WASTE DISPOSAL ON LAND	CH ₄	1 350
2 F 1/2/3/4/5	ODS Substitutes	HFC/PFC	1 165
4 D 3	Indirect Emissions	N ₂ O	1 096
1 A 2 mobile-liquid	Manufacturing Industries and Construction	CO ₂	1 069
1 A 1 a other	Public Electricity and Heat Production	CO ₂	825
1 A 2 other	Manufacturing Industries and Construction	CO ₂	783

IPCC Category Description		Gas	Emissions 2010 [Gg CO ₂ e]
4 B 1	Cattle	N ₂ O	744
1 A 1 a liquid	Public Electricity and Heat Production	CO ₂	728
1 A 1 c gaseous	Manufacture of Solid fuels and Other Energy Industries	CO ₂	719
1 A 4 mobile-diesel	Other Sectors	CO ₂	704
2 A 2	Lime Production	CO ₂	574
2 B 1	Ammonia Production	CO ₂	538
1 A 1 b gaseous	Petroleum refining	CO ₂	530
5 B 2	Land converted to cropland	CO ₂	454
5 C 2	Land converted to grassland	CO ₂	367
5 D 2	Land converted to Wetlands	CO ₂	356
5 F 2	Land converted to Other land	CO ₂	347
1 A 3 e gaseous	Other	CO ₂	320
2 A 7 b	Sinter Production	CO ₂	314
2 A 3	Limestone and Dolomite Use	CO ₂	294
6 B	WASTEWATER HANDLING	N ₂ O	265
5 E 2	Land converted to Settlements	CO ₂	248
2 F 9	Other Sources of SF ₆	PFC/SF ₆	245
1 A 4 solid	Other Sectors	CO ₂	245
4 B 1	Cattle	CH ₄	229
1 A 4 biomass	Other Sectors	PFC	203
3	SOLVENT AND OTHER PRODUCT USE	CO ₂	177
2 B 2	Nitric Acid Production	N ₂ O	63
1 A 4 other	Other Sectors	CO ₂	2
2 C 4	SF ₆ used in Al and Mg Foundries	SF ₆	0
2 C 3	Aluminium production	PFC	0
5 A 2	Land converted to forest land	CO ₂	-2 443
5 A 1	Forest land remaining forest land	CO ₂	-2 968

The key category with the highest contribution to the national total emissions in 2010 is *1.A.3.b diesel oil*. This source has replaced 1.A Fuel Combustion – gaseous fuels²⁴ as leading key. The contribution of *1.A.3.b diesel oil* to the national total emissions in the base year was 6.9%, whereas in 2010 this contribution have increased to 19.2%. 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 (CO₂)* is also the most important category in terms of emission trends: Since 1990 emissions increased by 204%.

The second most important source of greenhouse gas emissions in 2010 in Austria is *1.A.2 Manufacturing Industries and Construction – gaseous (CO₂)*. Its contribution to national total emissions is 8.1% in 2010 compared to 5.5% in the base year.

The key category with the highest contribution to national removals is *5.A.1 Forest land remaining forest land (CO₂)*.

²⁴ Until submission 2011 1.A gaseous fuels has been treated as one sector for the key category analysis because the same emission factor is used for all sub categories.

Comparison to last years' submission

The results of this years' key category analysis covers all categories already defined as key last year. The main difference to last years' submission is the splitting up of 1.A Fuel Combustion – gaseous fuels²⁵ into the different sub categories (disaggregation). This has been done in response to a question during the Review 2011.

Comparison Tier 1 – Tier 2 KCA (including LULUCF)

The following categories were identified as key category pursuant to Tier 2 analysis additionally to the Tier 1 analysis:

- 4.D.2 Pasture Range and Paddock Manure (N₂O)
- 5.B.1 Cropland remaining cropland (CO₂)

Detailed results are shown in Annex 1.

1.5.2 KP-LULUCF inventory

According to the IPCC GPG for LULUCF the key categories for Kyoto Protocol activities can be derived 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 7 in this NIR and Table 5.4.4 in GPG LULUCF).

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 review 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.

²⁵ Until submission 2011 1.A gaseous fuels has been treated as one sector for the key category analysis because the same emission factor is used for all sub categories.

1.6.1.1 QA/QC Plan

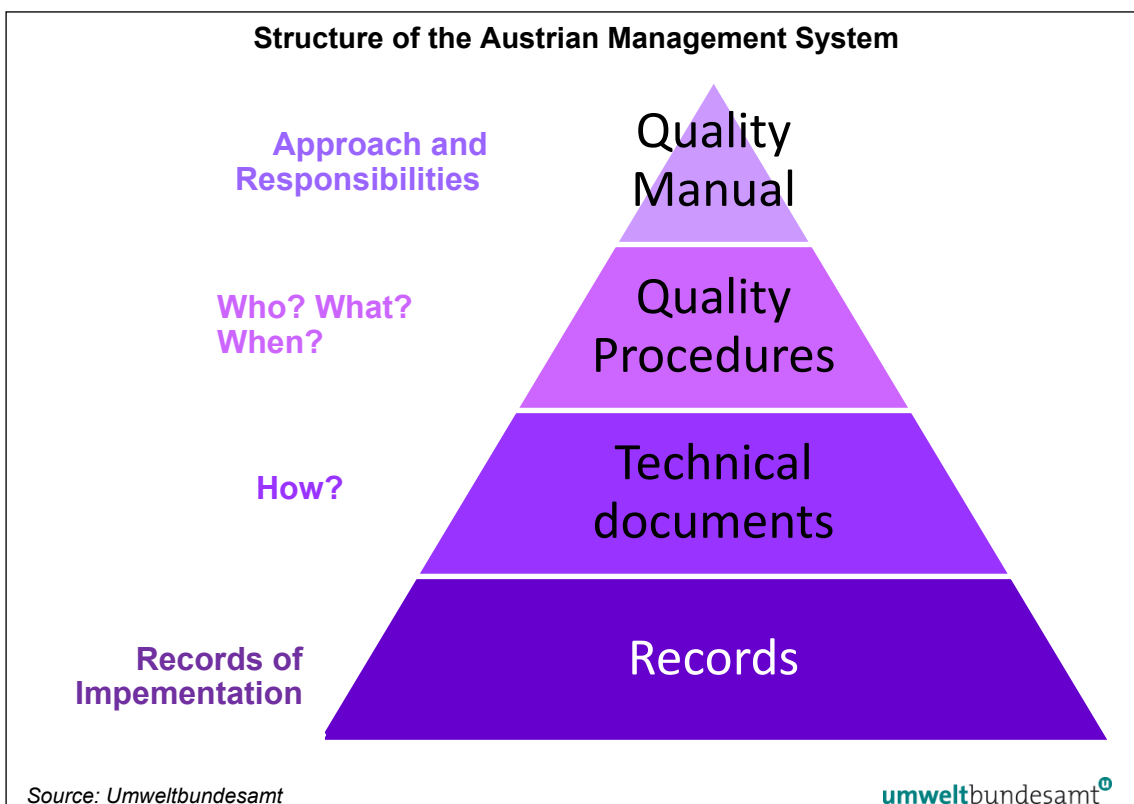
Activities to be conducted by the personnel of the inspection body are written down in quality and technical procedures, respectively that complement the Quality Manual. Such activities are:

- QC activities
- procedures for country specific methodologies
- internal audits (QM specific)
- procedures for sub-contracting
- inventory improvement plan
- documentation and archiving
- treatment of confidential data
- annual management review

Quality Manual

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

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



1.6.1.1.1 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). 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 the data management of the inventory:

Tier 2/category specific: by the sector expert in the course of the inventory preparation

Tier 1/general:

- Step 1: QC by the sector expert after emissions have been estimated
- Step 2: QC by the data manager in the course of the preparation of the overall inventory
- Step 3: QC by the sector expert or deputy after inventory has been finished

1.6.1.2 QA Activities

The following QA activities are performed:

Validation of methodologies and calculation:

Before methodologies are applied the methodology is defined as a SOP (standard operating procedure) together with a template for calculating emissions, where needed. The SOP is checked for applicability and completeness of information needed and finally approved by the head of the inspection body. New and changed calculation files are validated before use.

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 January 2011. It was a re-accreditation audit which is scheduled every five years. It approved the conformity with the standard, renewing the accreditation of 2005.

Audits of data suppliers

Since 2007, Statistik Austria (energy balance, agricultural statistical data), the administrators of the landfill database and the Institute for Industrial Ecology has been audited.

1.6.1.3 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 sources 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.

1.6.1.4 Archiving and documentation

For each sector the documentation includes:

Documentation of the methodology:

- description (source/sink category, emissions, key source, completeness, uncertainty),
- methodology,
- template for emission estimation,
- documentation of validation.

Documentation of actual emission calculation:

- methodology,
- “logbook” (who did what and when),
- calculation file,
- references for activity data, emission factors and/or emissions, respectively,
- documentation of assumptions, sources of data and information, expert judgments etc. to allow full reproduction and understanding of choices,
- recalculations,
- planned improvements,
- QC activities.

1.6.1.5 Focus of QA/QC activities in the year 2011/2012

Following a recommendation of the accreditation audit to streamline the documentation of the management system, a completely revised quality manual was produced; in the course of this work the revision of ISO/IEC 17020 was taken into account, the new manual being more user-friendly and providing an improved presentation of requirements relating to reporting obligations in the context of emission inventories. The management processes of the QMS and the process of inventory preparation remained mostly unchanged; however the documentation as well as forms such as checklists have been improved (e.g. the checklists for QA/QC that have been incorporated into the documentation files, and simplification of the management review process and report, respectively). Furthermore a monthly jour-fixe has been introduced to improve internal communication.

On April 3rd 2012 an external audit led by a representative appointed by the accreditation body has taken place to assess the QM system with regard to compliance with the underlying standard ISO 17020, to check its implementation in practice and to assure that measures and recommendations as set out in previous audits have been implemented accordingly. Such an audit

is obligatory every 15 months. The final judgement of the auditor confirmed the compliance and practicability of the QM system; only two small improvement measures regarding transparency of the System have been raised that could easily be implemented in the Quality Management Manual.

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 is 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 2000²⁶.

- 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.

- 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.

Also in case of voluntary reviews an absolute confidential treatment of data exchanged is ensured by strictly adhering to the rules of the QM System of the Inspection Body.

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

1.7.1 GHG inventory

Separate uncertainty calculations were performed using a spreadsheet prepared specifically according to the “Tier 1” approach (IPCC 2000), and with a Monte Carlo approach fully considering statistical dependence of detailed input data as described in Annex 7 (“Tier 2” approach). It should be noted that the “Monte-Carlo” approach, averaging a large number of randomly varied input data, may exhibit slightly different results in total and source category emissions than a direct calculation. This difference is similar to a rounding error and may be ignored.

Results of Tier 1 are presented in Table 8 (excluding LULUCF) and 9 (including LULUCF) for the key categories of the Austrian GHG inventory. Submission 2012 includes a complete uncertainty analysis for the whole LULUCF sector, thus the recommendation made in previous review reports has been implemented now. Table 10 presents the results of the Tier 2 approach for all

²⁶ 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.

key categories. Uncertainties are presented for each category, and for the level of target year 2010 as well as for the trend in percentage points relative to the total base year (1990) emissions.

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

IPCC Key category	Gas	Activity data uncertainty	Emission factor uncertainty	Combined uncertainty	Combined uncertainty as % of total national emissions in year t	Uncertainty introduced into the trend in total national emissions
		Input data	Input data	$\sqrt{E^2 + F^2}$	$G * D / \sum D$	$\sqrt{K^2 + L2}$
		%	%	%	%	%
1 A 1 a gaseous: Public Electricity and Heat Production	CO ₂	2.0	0.5	2.1	0.13	0.20
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	0.23	0.24
1 A 1 a solid: Public Electricity and Heat Production	CO ₂	0.5	0.5	0.7	0.03	0.04
1 A 1 b gaseous: Petroleum refining	CO ₂	2.0	0.5	2.1	0.01	0.02
1 A 1 b liquid: Petroleum refining	CO ₂	0.5	0.5	0.7	0.02	0.02
1 A 1 c gaseous: Manufacture of Solid fuels and Other Energy Industries	CO ₂	2.0	0.5	2.1	0.02	0.03
1 A 2 gaseous: Manufacturing Industries and Construction	CO ₂	5.0	0.5	5.0	0.42	0.64
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	0.21	0.20
1 A 2 solid: Manufacturing Industries and Construction	CO ₂	1.0	0.5	1.1	0.07	0.09
1 A 2 stat-liquid: Manufacturing Industries and Construction	CO ₂	3.0	0.5	3.0	0.07	0.10
1 A 3 b diesel oil: Road Transportation	CO ₂	3.0	3.0	4.2	0.85	1.01
1 A 3 b gasoline: Road Transportation	CO ₂	3.0	3.0	4.2	0.27	0.33
1 A 3 e gaseous: Other	CO ₂	2.0	0.5	2.1	0.01	0.01
1 A 4 biomass: Other Sectors	CH ₄	10.0	50.0	51.0	0.13	0.10
1 A 4 gaseous: Other Sectors	CO ₂	5.0	0.5	5.0	0.29	0.44
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	0.00	0.10
1 A 4 solid: Other Sectors	CO ₂	1.0	0.5	1.1	0.00	0.02
1 A 4 stat-liquid: Other Sectors	CO ₂	3.0	0.5	3.0	0.19	0.29
2 A 1: Cement Production	CO ₂	1.1	2.0	2.3	0.05	0.04
2 A 2: Lime Production	CO ₂	1.6	5.0	5.2	0.04	0.02
2 A 3: Limestone and Dolomite Use	CO ₂	19.6	2.0	19.7	0.07	0.11
2 A 7 b: Sinter Production	CO ₂	2.0	5.0	5.4	0.02	0.02
2 B 1: Ammonia Production	CO ₂	2.0	4.6	5.0	0.03	0.02
2 B 2: Nitric Acid Production	N ₂ O	2.0	5.0	5.4	0.00	0.06
2 C 1: Iron and Steel Production	CO ₂	0.5	0.5	0.7	0.05	0.05
2 C 3: Aluminium production	PFC	2.0	50.0	50.0	0.00	0.76
2 C 4: SF ₆ 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/PFC	20.0	50.0	53.9	0.77	0.87
2 F 9: Other Sources of SF ₆	PFC/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	0.02	0.02
3: SOLVENT AND OTHER PRODUCT USE	N ₂ O	20.0	0.0	20.0	0.04	0.06
4 A 1: Cattle	CH ₄	10.0	20.0	22.4	0.83	0.61
4 B 1: Cattle	CH ₄	10.0	50.0	51.0	0.14	0.07
4 B 1: Cattle	N ₂ O	10.0	100.0	100.5	0.92	0.17
4 D 1: Direct Soil Emissions	N ₂ O	5.0	150.0	150.1	3.20	0.68
4 D 3: Indirect Emissions	N ₂ O	5.0	150.0	150.1	2.02	0.75
6 A: SOLID WASTE DISPOSAL ON LAND	CH ₄	12.0	25.0	27.7	0.46	0.80
6 B: WASTEWATER HANDLING	N ₂ O	20.0	50.0	53.9	0.17	0.14
Total Key Categories including LULUCF	Gg CO₂ e				4.24	2.34

Table 9: Tier 1 Uncertainty calculation and reporting according IPCC (2000) Table 6.1. – including LULUCF

IPCC Key category	Gas	Activity data uncertainty	Emission factor uncertainty	Combined uncertainty	Combined uncertainty as % of total national emissions in year t	Uncertainty introduced into the trend in total national emissions
		Input data	Input data	$\sqrt{E^2 + F^2}$	$G \cdot D / \sum D$	$\sqrt{K^2 + L2}$
		%	%	%	%	%
1 A 1 a gaseous: Public Electricity and Heat Production	CO ₂	2.0	0.5	2.1	0.14	0.23
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	0.24	0.28
1 A 1 a solid: Public Electricity and Heat Production	CO ₂	0.5	0.5	0.7	0.04	0.05
1 A 1 b gaseous: Petroleum refining	CO ₂	2.0	0.5	2.1	0.01	0.02
1 A 1 b liquid: Petroleum refining	CO ₂	0.5	0.5	0.7	0.02	0.02
1 A 1 c gaseous: Manufacture of Solid fuels and Other Energy Industries	CO ₂	2.0	0.5	2.1	0.02	0.03
1 A 2 gaseous: Manufacturing Industries and Construction	CO ₂	0.0	0.5	0.5	0.04	0.01
1 A 2 mobile-liquid: Manufacturing Industries and Construction	CO ₂	3.0	0.5	3.0	0.04	0.07
1 A 2 other: Manufacturing Industries and Construction	CO ₂	10.0	20.0	22.4	0.22	0.22
1 A 2 solid: Manufacturing Industries and Construction	CO ₂	1.0	0.5	1.1	0.07	0.11
1 A 2 stat-liquid: Manufacturing Industries and Construction	CO ₂	3.0	0.5	3.0	0.07	0.12
1 A 3 b diesel oil: Road Transportation	CO ₂	3.0	3.0	4.2	0.89	1.15
1 A 3 b gasoline: Road Transportation	CO ₂	3.0	3.0	4.2	0.29	0.39
1 A 3 e gaseous: Other	CO ₂	2.0	0.5	2.1	0.01	0.01
1 A 4 biomass: Other Sectors	CH ₄	10.0	50.0	51.0	0.13	0.14
1 A 4 gaseous: Other Sectors	CO ₂	0.0	0.5	0.5	0.03	0.01
1 A 4 mobile-diesel: Other Sectors	CO ₂	3.0	0.5	3.0	0.03	0.05
1 A 4 other: Other Sectors	CO ₂	10.0	20.0	22.4	0.00	0.13
1 A 4 solid: Other Sectors	CO ₂	1.0	0.5	1.1	0.00	0.02
1 A 4 stat-liquid: Other Sectors	CO ₂	3.0	0.5	3.0	0.20	0.34
1 B 2 a: Oil	CO ₂	0.5	0.5	0.7	0.00	0.00
2 A 1: Cement Production	CO ₂	1.1	2.0	2.3	0.05	0.05
2 A 2: Lime Production	CO ₂	1.6	5.0	5.2	0.04	0.02
2 A 3: Limestone and Dolomite Use	CO ₂	20.0	2.0	20.1	0.08	0.13
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 ₂ O	2.0	5.0	5.4	0.00	0.08
2 C 1: Iron and Steel Production	CO ₂	0.5	0.5	0.7	0.05	0.06
2 C 3: Aluminium production	PFC	2.0	50.0	50.0	0.00	0.96
2 C 4: SF ₆ 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/PFC	20.0	50.0	53.9	0.80	1.01
2 F 9: Other Sources of SF ₆	PFC/SF ₆	25.0	50.0	55.9	0.18	0.15
3: SOLVENT AND OTHER PRODUCT USE	CO ₂	5.0	10.0	11.2	0.03	0.03
4 A 1: Cattle	CH ₄	10.0	20.0	22.4	0.87	0.76
4 B 1: Cattle	CH ₄	10.0	50.0	51.0	0.15	0.10
4 B 1: Cattle	N ₂ O	10.0	100.0	100.5	0.96	0.30
4 D 1: Direct Soil Emissions	N ₂ O	5.0	150.0	150.1	3.35	1.26
4 D 3: Indirect Emissions	N ₂ O	5.0	150.0	150.1	2.11	1.20
5 A 1: Forest land remaining forest land	CO ₂			547.0	-20.83	0.00
5 A 2: Land converted to forest land	CO ₂			94.0	-2.95	0.00
5 B 2: Land converted to cropland	CO ₂			225.0	1.31	0.00
5 C 2: Land converted to grassland	CO ₂			572.0	2.69	0.00
5 D 2: Land converted to Wetlands	CO ₂			184.0	0.84	0.00
5 E 2: Land converted to Settlements	CO ₂			346.0	1.10	0.00
5 F 2: Land converted to Other land	CO ₂			905.0	4.03	0.00
6 A: SOLID WASTE DISPOSAL ON LAND	CH ₄	12.0	25.0	27.7	0.48	1.06
6 B: WASTEWATER HANDLING	N ₂ O	20.0	50.0	53.9	0.18	0.15
Total Key Categories including LULUCF	Gg CO₂ e				22.1	2.95

As can be seen, including the LULUCF sector in the analysis resulted in a high overall uncertainty. This is mainly due to the inclusion of the litter/soil C pool of 5.A.1 in the analysis, which has a high uncertainty (makes up about 70% of overall LULUCF uncertainty). A detailed description can be found in chapter 7.1.5. Without considering the uncertainty of litter/soil C stock change of 5.A.1 the overall uncertainty would amount to 7.8%.

Table 10: Tier 2 Uncertainty reporting according IPCC (2000) Table 6.2. – excluding LULUCF

IPCC Source category	Gas	Uncertainty in year t emissions as % of emissions in the category		Uncertainty introduced on national total in year 2010	Uncertainty introduced into the trend in total national emissions
		% below (2.5 percentile)	% above (97.5)	%	%-points
1 A 1 a gaseous: Public Electricity and Heat Production	CO ₂	2	2	0.1	0.2
1 A 1 a liquid: Public Electricity and Heat Production	CO ₂	0.7	0.7	0.0	0.0
1 A 1 a other: Public Electricity and Heat Production	CO ₂	21.3	22.5	0.2	0.2
1 A 1 a solid: Public Electricity and Heat Production	CO ₂	0.7	0.7	0.0	0.0
1 A 1 b gaseous: Petroleum refining	CO ₂	2.0	2.0	0.0	0.0
1 A 1 b liquid: Petroleum refining	CO ₂	0.6	0.6	0.0	0.0
1 A 1 c gaseous: Manufacture of Solid fuels and Other Energy Ind	CO ₂	2.0	2.0	0.0	0.0
1 A 2 gaseous: Manufacturing Industries and Construction	CO ₂	4.9	4.9	0.4	0.5
1 A 2 mobile-liquid: Manufacturing Industries and Construction	CO ₂	3.0	2.9	0.0	0.0
1 A 2 other: Manufacturing Industries and Construction	CO ₂	21.3	22.6	0.2	0.2
1 A 2 solid: Manufacturing Industries and Construction	CO ₂	1.1	1.1	0.1	0.1
1 A 2 stat-liquid: Manufacturing Industries and Construction	CO ₂	2.5	2.5	0.1	0.1
1 A 3 b diesel oil: Road Transportation	CO ₂	4.1	4.2	0.8	0.8
1 A 3 b gasoline: Road Transportation	CO ₂	4.1	4.2	0.3	0.4
1 A 3 e gaseous: Other	CO ₂	2.0	2.0	0.0	0.0
1 A 4 biomass: Other Sectors	CH ₄	49.8	50.3	0.1	0.1
1 A 4 gaseous: Other Sectors	CO ₂	4.9	4.9	0.3	0.3
1 A 4 mobile-diesel: Other Sectors	CO ₂	3.0	2.9	0.0	0.0
1 A 4 other: Other Sectors	CO ₂	21.3	22.6	0.0	0.1
1 A 4 solid: Other Sectors	CO ₂	1.1	1.1	0.0	0.0
1 A 4 stat-liquid: Other Sectors	CO ₂	2.9	2.8	0.2	0.3
2 A 1: Cement Production	CO ₂	2.3	2.2	0.0	0.1
2 A 2: Lime Production	CO ₂	5.1	5.2	0.0	0.1
2 A 3: Limestone and Dolomite Use	CO ₂	19.2	19.2	0.1	0.1
2 A 7 b: Sinter Production	CO ₂	5.3	5.3	0.0	0.0
2 B 1: Ammonia Production	CO ₂	4.9	5.0	0.0	0.0
2 B 2: Nitric Acid Production	N ₂ O	5.3	5.3	0.0	0.1
2 C 1: Iron and Steel Production	CO ₂	0.7	0.7	0.0	0.0
2 C 3: Aluminium production	F-Gases	-	-	0.0	0.7
2 C 4: SF ₆ used in Al and Mg Foundries	F-Gases	4.9	4.9	0.0	0.0
2 F 1/2/3/4/5: ODS Substitutes	F-Gases	53.5	53.0	0.7	0.8
2 F 9: Other Sources of SF ₆	F-Gases	54.6	54.6	0.2	0.2
3: SOLVENT AND OTHER PRODUCT USE	CO ₂	7.6	7.9	0.0	0.0
3: SOLVENT AND OTHER PRODUCT USE	N ₂ O	19.6	19.6	0.0	0.1
4 A 1: Cattle	CH ₄	20.5	21.0	0.8	0.4
4 B 1: Cattle	CH ₄	68.9	69.4	0.2	0.1
4 B 1: Cattle	N ₂ O	50.2	101.1	0.7	0.1
4 D 1: Direct Soil Emissions	N ₂ O	70.1	200.7	3.1	0.4
4 D 3: Indirect Emissions	N ₂ O	70.1	200.7	2.0	0.5
6 A: SOLID WASTE DISPOSAL ON LAND	CH ₄	26.3	28.0	0.4	0.8
6 B: WASTEWATER HANDLING	N ₂ O	50.7	55.6	0.2	0.1

1.7.2 KP-LULUCF inventory

The assessment of the uncertainties of emissions/removals of the ARD lands is planned for submission 2014 when the ARD NFI 2011 to 2013 will be completed.

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 addressed. 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 SF₆ 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:

$$\text{Transparency [\%]} = [1 - (\text{number of IE}/\text{number of estimates})] * 100$$

$$\text{Completeness [\%]} = [1 - (\text{number of NE}/\text{number of estimates})] * 100$$

In the following table transparency and completeness of submission 2012 is compared to the values of 2011. Minor changes of the transparency have occurred since last submission.

Table 11: Transparency and completeness in UNFCCC submissions 2012 and 2011.

Sector	Submission 2012				Submission 2011*			
	IE	NE	Transparency	Completeness	IE	NE	Transparency	Completeness
1 Energy	36	0	90%	100%	32	0	91%	100%
2 Industrial Processes	41	24	93%	96%	41	24	93%	96%
3 Solvents	0	0	100%	100%	0	0	100%	100%
4 Agriculture	2	0	96%	100%	2	0	96%	100%
5 LULUCF	13	7	95%	97%	13	7	95%	97%
6 Waste	0	0	100%	100%	0	0	100%	100%
Total	92	31	93%	98%	88	31	93%	98%
Total number of estimates**	1 257				1 257			

* changes to parameters presented in NIR 2011 are due to small adaptations of counting.

** including IE and NE, but also NO and NA

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 (base year).

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”²⁷ – 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

In 2010, Austria's total greenhouse gas emissions (without LULUCF) amounted to 84.6 million tonnes CO₂ equivalents. Compared to the base year, emissions increased by 8.2% (CO₂: +16.5%). The trend is dominated by the trend of the energy sector.

Compared to 2009 emissions increased by 6.1% (CO₂: +7.5%). The key driver for the emissions increase between 2009 and 2010 was the recovery after the weak economic situation in 2009 expressed by:

- the again increased amount of fuel consumed in the transport sector (mainly freight transport on road),
- the increased demand for electricity, as well as
- the rise in industrial production of energy-intensive products (steel).

In addition, weather circumstances contributed to the emissions increase, affecting emissions for heating demand as well as hydro power generation.

Table 12: Summary of Austria's anthropogenic greenhouse gas emissions from 1990–2010 (emissions without LULUCF).

GHG	Total	CO ₂	CH ₄	N ₂ O	HFCs	PFCs	SF ₆
1990*	78 162.33	62 059.59	8 304.66	6 198.25	26.32	1 079.24	494.28
1991	82 203.00	65 643.84	8 268.14	6 529.63	29.56	1 087.08	644.74
1992	75 442.31	60 138.33	7 986.05	6 134.39	32.31	462.32	688.92
1993	75 488.13	60 516.13	7 934.59	5 960.40	243.56	52.57	780.89
1994	76 373.04	60 899.75	7 708.51	6 441.57	293.06	58.30	971.85
1995	79 806.18	63 943.97	7 618.18	6 606.82	411.88	71.27	1 154.06
1996	82 888.33	67 383.73	7 398.53	6 268.29	531.93	71.70	1 234.15
1997	82 469.57	67 180.02	7 093.97	6 299.48	651.68	105.15	1 139.26

²⁷ 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 ₂ O	HFCs	PFCs	SF ₆
1998	81 862.56	66 763.01	6 943.43	6 417.65	769.31	55.95	913.21
1999	80 254.13	65 344.86	6 774.34	6 392.50	876.61	78.63	787.19
2000	80 469.58	65 972.21	6 625.71	6 289.48	901.85	84.79	595.54
2001	84 343.58	70 004.86	6 490.28	6 175.35	924.89	95.91	652.28
2002	85 992.07	71 720.08	6 393.61	6 176.67	969.18	97.70	634.81
2003	91 882.00	77 758.24	6 391.35	6 099.84	949.51	116.44	566.62
2004	91 458.44	78 215.90	6 251.63	5 401.82	955.10	136.65	497.35
2005	92 879.51	79 723.89	6 094.53	5 433.59	986.36	133.82	507.33
2006	90 059.07	77 032.53	5 978.19	5 474.91	962.57	145.72	465.15
2007	87 365.67	74 362.72	5 872.33	5 504.04	1 061.91	190.12	374.54
2008	86 955.53	73 921.54	5 731.45	5 688.19	1 057.99	173.53	382.84
2009	79 739.35	67 225.70	5 663.35	5 409.51	1 056.61	35.05	349.14
2010	84 593.94	72 290.47	5 574.51	5 153.46	1 160.63	69.85	345.01

* BY= Base Year: 1990 for all gases

Note: Global warming potentials (GWPs) used (100 years time horizon): carbon dioxide (CO₂) = 1; methane (CH₄) = 21; nitrous oxide (N₂O) = 310; sulphur hexafluoride (SF₆) = 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.

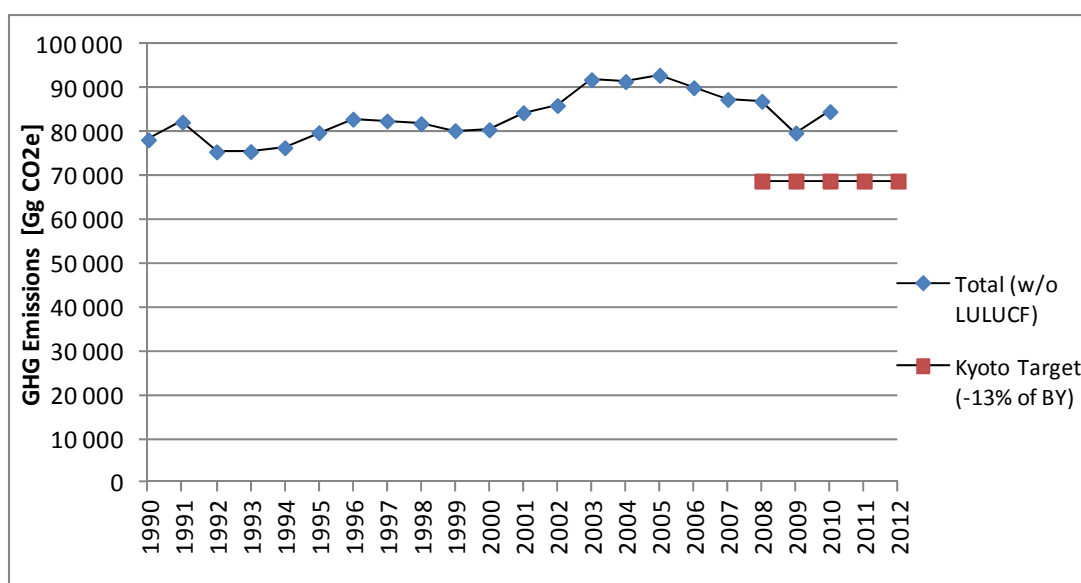


Figure 3: Trend in total GHG emissions 1990–2010 without LULUCF.

2.2 Emission Trends by Gas

The most important GHG in Austria is carbon dioxide (CO₂) with a share of 85.5% in 2010. The CO₂ emissions primarily result from combustion activities. Methane (CH₄), 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 6.1%. 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 13: Austria's greenhouse gas emissions by gas in the base year and in 2010.

GHG	BY 1990	2010	BY 1990	2010
	CO ₂ equivalent [Gg]		Share [%]	
Total	78 162	84 594	100.0	100.0
CO ₂	62 060	72 290	79.4	85.5
CH ₄	8 305	5 575	10.6	6.6
N ₂ O	6 198	5 153	7.9	6.1
F-Gases	1 600	1 575	2.0	1.9

Emissions without LULUCF

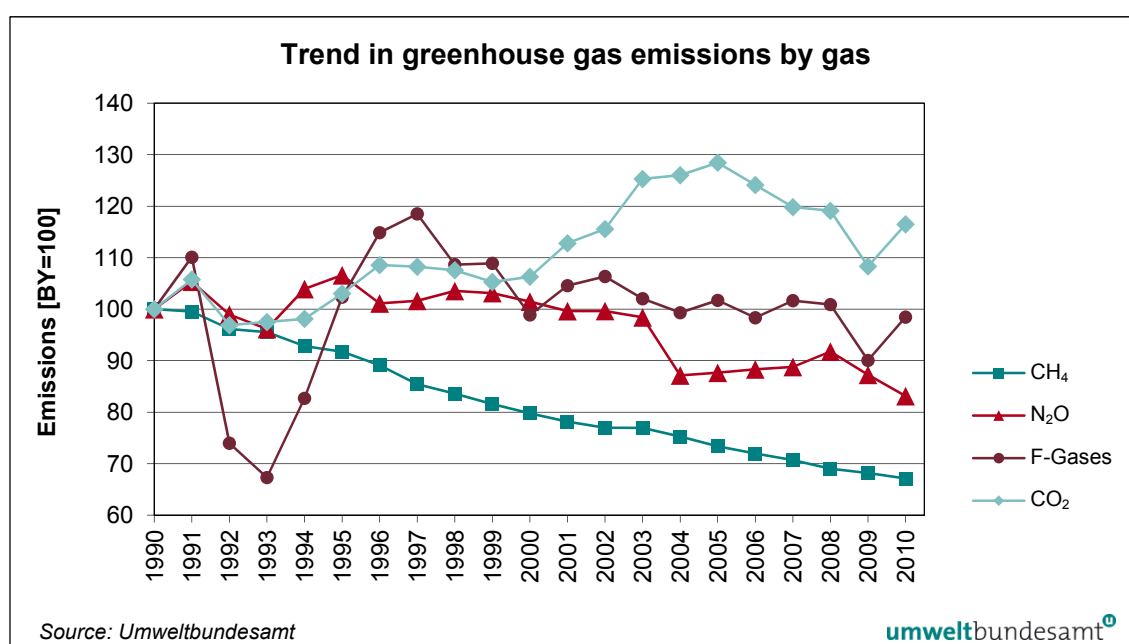


Figure 4: Trend in greenhouse gas emissions 1990–2010 by gas in index form (base year = 100).

CO₂

CO₂ emissions increased by 16.5% from 1990 to 2010. In absolute figures, CO₂ emissions increased from 62 060 to 72 290 Gg during the period from 1990 to 2010 mainly due to higher emissions from transport, which increased by 61.2%.

The main source of CO₂ 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 CO₂ emissions should have been reduced to the levels of 1990 by 2000, but the CO₂ 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.

CH₄

CH₄ emissions decreased steadily during the period from 1990 to 2010 from 8 305 to 5 575 Gg CO₂ equivalents. In 2010, CH₄ emissions were 32.9% below the level of the base year, mainly due to lower emissions from solid waste disposal sites.

The main sources of CH₄ emissions in Austria are solid waste disposal on land (landfills) and agriculture (enteric fermentation).

N₂O

N₂O emissions in Austria fluctuated between 1990 and 1998, increasing by 3.5% over this period. Since then emissions have shown a decreasing trend, resulting in 5 153 Gg CO₂ equivalents in 2010 compared to 6 198 in the base year (minus 16.9%). The general decrease is mainly due to lower N₂O emissions from agricultural soils; the strong decrease 2003–2004 was due to emission reduction measures in the chemical industry. Also the decline since 2008 is mainly attributable to the chemical industry.

The main source of N₂O emissions are agricultural soils with a share of 57% in national total N₂O emissions. Manure management has a share of 18% and fuel combustion, which is another important source with regard to national total N₂O emissions, has a share of 14%.

HFCs

HFC emissions increased remarkably during the period from 1990 to 2010 from 26 to 1 161 Gg CO₂ 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 2010, from 1 079 to 70 Gg CO₂ equivalents. PFCs were in the base year mainly emitted as by-products of primary aluminium production, which closed down in Austria in 1992; Semiconductor manufacture is the main source of PFC emissions.

SF₆

SF₆ emissions in 1990 amounted to 494 Gg CO₂ equivalents. They increased steadily until 1996 reaching a maximum of 1 234 Gg CO₂ equivalents. Since then they have been decreasing, in 2010 SF₆ emissions amounted to 345 Gg CO₂ equivalents, which was 30.2% below the level of the base year (1990).

The main sources of SF₆ emissions is semiconductor manufacture and disposal of noise insulating windows.

2.3 Emission Trends by Source

Table 14 presents a summary of Austria's anthropogenic greenhouse gas emissions by sector.

Table 14: Summary of Austria's anthropogenic greenhouse gas emissions by sector from 1990–2010.

	Total	Energy	Industrial processes	Solvents	Agriculture	LULUCF	Waste
1990	78 162.33	55 396.89	10 108.40	511.80	8 557.96	-10 022.56	3 587.28
1991	82 203.00	59 290.61	10 126.98	465.98	8 747.51	-15 740.22	3 571.93
1992	75 442.31	54 363.89	8 912.12	417.65	8 284.72	-10 942.04	3 463.94
1993	75 488.13	54 779.83	8 824.00	418.48	8 050.88	-11 378.39	3 414.94
1994	76 373.04	54 815.08	9 343.79	403.26	8 556.67	-10 246.21	3 254.24
1995	79 806.18	57 669.86	9 896.75	422.45	8 720.66	-11 597.40	3 096.47
1996	82 888.33	61 474.07	9 813.62	405.66	8 246.32	-8 492.38	2 948.66
1997	82 469.57	60 554.13	10 450.56	424.37	8 223.84	-17 156.97	2 816.67
1998	81 862.56	60 531.37	9 971.69	406.32	8 227.12	-15 261.56	2 726.05
1999	80 254.13	59 274.55	9 851.69	392.26	8 104.16	-18 136.35	2 631.47
2000	80 469.58	59 250.78	10 324.58	425.12	7 910.93	-15 035.87	2 558.17
2001	84 343.58	63 374.21	10 176.58	424.82	7 863.86	-16 923.46	2 504.11
2002	85 992.07	64 487.54	10 794.43	427.08	7 761.32	-10 978.34	2 521.70
2003	91 882.00	70 596.35	10 746.65	418.42	7 554.56	-931.20	2 566.02
2004	91 458.44	71 070.90	10 115.55	374.23	7 450.57	-5 988.73	2 447.19
2005	92 879.51	72 112.85	10 623.26	386.59	7 412.12	-7 395.44	2 344.70
2006	90 059.07	68 943.92	10 984.18	415.03	7 447.12	-1 583.08	2 268.81
2007	87 365.67	65 845.55	11 460.03	388.34	7 512.44	-518.57	2 159.30
2008	86 955.53	65 000.43	11 910.82	367.24	7 647.15	385.02	2 029.90
2009	79 739.35	60 219.86	9 675.39	299.16	7 631.63	-3 644.48	1 913.30
2010	84 593.94	64 327.66	10 680.47	327.12	7 452.64	-3 610.72	1 806.05

Total emissions without LULUCF

The dominant sector regarding GHG emissions in Austria is the energy sector, which caused 76.0% of total greenhouse gas emissions in Austria in 2010 (70.9% in 1990), followed by the Sector *Industrial Processes*, which caused 12.6% (2010) of greenhouse gas emissions. In 2010 emissions from *Energy* are 16.1% and from *Industrial Processes* are 5.7% higher than in the base year. All the other sectors show decreasing GHG emissions. The most significant decreases in absolute terms occurred in the sectors *Waste* and *Agriculture*, but also *Solvents* showed significant reductions.

Table 15: Austria's greenhouse gas emissions by sector in the base year (1990) and in 2010 as well as their share and trend.

GHG	1990	2010	Trend 1990–2010	1990	2010
	Emissions [Gg CO ₂ e]			Share [%]	
Total	78 162	84 594	8.2%	100%	100%
1 Energy	55 397	64 328	16.1%	70.9%	76.0%
2 Industry	10 108	10 680	5.7%	12.9%	12.6%
3 Solvent	512	327	-36.1%	0.7%	0.4%
4 Agriculture	8 558	7 453	-12.9%	10.9%	8.8%
5 LULUCF	-10 023	-3 611	-64.0%		
6 Waste	3 587	1 806	-49.7%	4.6%	2.1%

Total emissions without emissions from LULUCF

A description and interpretation of emissions trends per sector is given in the following sub-chapters.

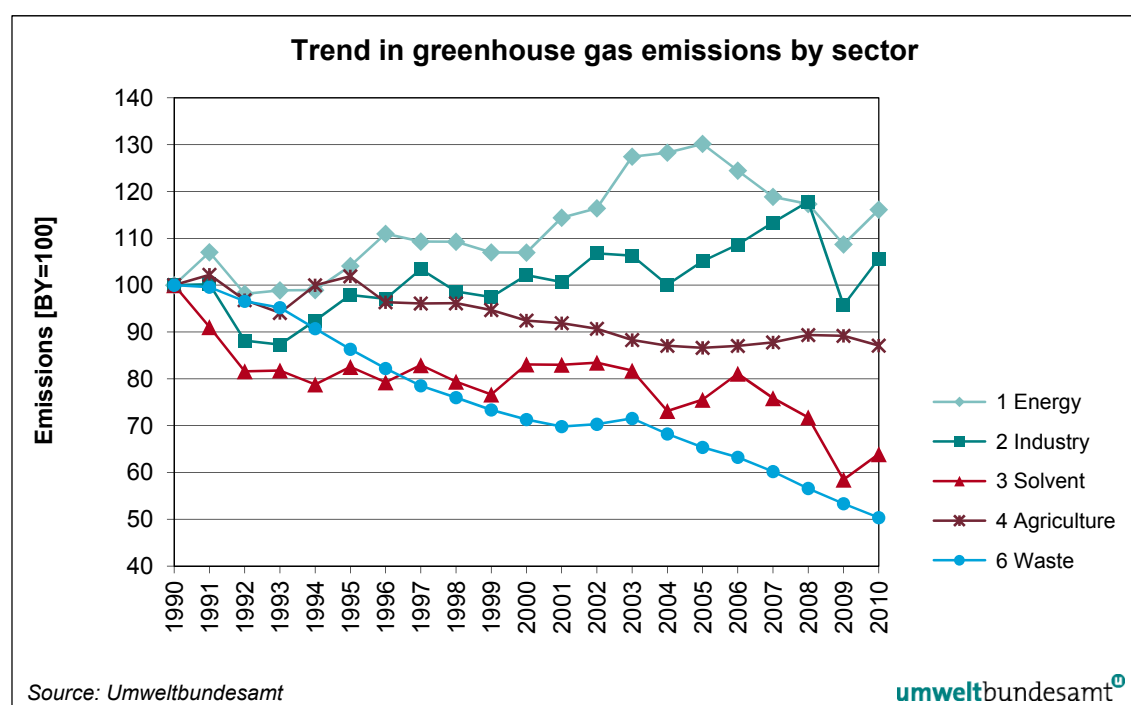


Figure 5: Trend in greenhouse gas emissions 1990–2010 by sector in index form (base year 1990 = 100).

2.3.1 Energy

The overall trend in greenhouse gas emissions from the sector *Energy* shows increasing emissions with a plus of 16% from 1990 to 2010. 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 power plants as well as the economic situation (2009).

From 2009 to 2010, emissions from the energy sector increased by 6.8% mainly due to the recovery from the economic crisis (increased production output, demand for electricity, freight volumes) and unfavourable (hydro power) and cold climatic circumstances.

In 2010, greenhouse gas emissions from the energy sector amounted to 64 328 Gg CO₂ equivalents which correspond to 76% of the total national emissions. 99% of the emissions from this sector originate from fossil fuel combustion; fugitive emissions from fuels are of minor importance.

CO₂ contributed 98% to the total greenhouse gas emissions from the energy sector, CH₄ 0.8% and N₂O 1.1%.

The most important sub-sector of energy in 2010 was transport with a share of 35%, followed by manufacturing industries and construction (24%), energy industries (22%), and other sectors (18%).

Trend 1990–2010 – by subsector

The strong rise in emissions since 1990 from sub-sector transport (+60%) is 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.

The gradually replacement of vehicles by newer, less consuming cars with less specific fuel consumption as well as the increased use of biofuels have contributed to the decreasing trend of the last few years. However, from 2009 to 2010, total GHG emissions from transport increased by 3.0%, mainly due to higher emissions from freight transport.

Energy related emissions from manufacturing industries and construction increased by 22% from 1990 to 2010. Fuel consumption increased by 45% in that period, mainly due to increased use of gas and especially biomass. As gas has a lower carbon content, and CO₂ emissions from biomass combustion are not accounted for under the UNFCCC reporting framework, the increase in GHG emissions is significantly smaller compared to the increase in fuel combustion.

In 2010 emissions from sub-sector energy industries were 3.3% above the level of the base year. Except for 2010, emissions are continuously decreasing since 2005, basically because of the growing importance of renewable energy sources, the substitution of solid and liquid fuels by natural gas and biomass as well as improvements in efficiency. Since 1990 the share of biomass used as a fuel in this sector increased from 0.9% to 20% (2010), the contribution of hydro and wind power plants to total electricity production decreased from 72% to 67% (2010).

The variation in demand for heating and hot water generation due to climatic circumstances and the shift in the fuel mix are the most important drivers for emissions from other sectors. Emissions in 2010 were 21% lower than in the base year. This reduction is mainly attributable to the declining consumption of heating oil and solid fuels. Total fuel consumption of this sub sector increased by 0.3% since 1990.

2.3.2 Industrial processes

The overall trend in greenhouse gas emissions from industrial processes shows increasing emissions with an increase of 5.7% from 1990 to 2010. 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 N₂O abatement techniques in the chemical industry in 2004 and again in 2009 (which became fully operational in 2010), (iii) increasing metal production resulting in 9.0% higher CO₂-emissions in 2010 compared to 1990 and (iv) a strong increase of HFC emissions in the period 1992 to 2010 from 32 to 1 161 Gg CO₂ equivalents.

From 2009 to 2010, emissions from this sector increased by 10.4%, mainly due to the recovery of industry (especially metal industry) from the effects of the economic downturn in 2009.

In 2010, greenhouse gas emissions from industrial processes amounted to 10 680 Gg CO₂ equivalents, which corresponds to 13% 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 11%, SF₆ with 3.2%, PFCs with 0.7%, N₂O with 0.6% and finally CH₄ with 0.2%.

The most important sub-sectors of the industrial processes sector are metal production and mineral products, which caused 51% and 27% of the emissions from this sector in 2010.

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 36% from 1990 to 2010. The main driver is a decreasing use of solvents as a result of legal measures and decreasing N₂O use.

From 2009 to 2010 emissions decreased considerably by 9.3%.

In 2010, greenhouse gas emissions from solvent and other product use amounted to 327 Gg CO₂ equivalents, which corresponds to 0.4% of the total national emissions.

54% of these greenhouse gas emissions were indirect CO₂ emissions, 46% were contributed by N₂O emissions.

2.3.4 Agriculture

The overall trend in greenhouse gas emissions from agriculture shows decreasing emissions, with a decrease of 12.9% from 1990 to 2010. The main drivers for this trend are decreasing livestock numbers and lower amounts of N-fertilizers applied on agricultural soils. 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.

From 2009 to 2010 emissions decreased by 2.3% mainly due to decreased mineral fertilizer sales.

In 2010, emissions from agriculture amounted to 7 453 Gg CO₂ 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 N₂O and CH₄ emissions: In 2010 75% (12 Gg) of total N₂O emissions and 65% (171 Gg) of total CH₄ emissions in Austria originated from this sector. For N₂O this corresponds to 52% of the GHG emissions from agriculture and for methane to 48%.

The most important sub-sectors of agriculture are enteric fermentation, which contributed 44% of total greenhouse gas emissions from the agricultural sector, followed by agricultural soils with a contribution of 39%.

2.3.5 LULUCF

The overall trend in net removals from LULUCF is minus 64% over the observed period (1990-2010). The main driver for this trend is the change of the biomass carbon stock in forest land. Fluctuations are due to weather conditions which affect the growth rates on the one hand (e.g. very low increment in 2003) and wind throws on the other, as well as timber demand and prices (e.g. very high harvest rates in 2007 and 2008).

In 2010, net removals from this category amounted to 3 611 Gg CO₂ equivalents, which corresponds to 4% of national total GHG emissions (without LULUCF) compared to 13% in the base year.²⁸

The **most important sub-sector** is forest land (5.A) with net removals of 5 411 Gg CO₂ in 2010. Small CO₂, CH₄ and N₂O emissions arise from the other sub-sectors, where total net emissions amounted to 1 750 Gg CO₂ equivalents in 2010.

The last available NFI for the estimates in the forest sector is the NFI 2007/09. For the years after 2008 the mean results for the NFI period 2007/09 are reported.

2.3.6 Waste

The overall trend in greenhouse gas emissions from waste shows decreasing emissions, with a decrease of 50% from 1990 to 2010. The main driver for this trend is the implementation of 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 improved. The legal basis for the reduced deposition as well as the landfill gas recovery is the Landfill Ordinance. Since 2009 all of the waste generated has to be pre-treated before deposition.

From 2009 to 2010 GHG emissions decreased by 5.6% as a result of the implementation of the Landfill Ordinance described above as well as due to the declining emissions from waste being deposited in the past.

In 2010, greenhouse gas emissions from the waste sector amounted to 1 806 Gg CO₂ equivalents, which corresponds to 2.1% of the total national emissions.

The most important greenhouse gas of the waste sector is CH₄ with a share of 79.2% of the total GHG emissions from this sector in 2010, followed by N₂O with 20.7%, and CO₂ with 0.1%.

The most important sub-sector of the waste sector is solid waste disposal on land, which caused 75% of the emissions from this sector in 2010; the second largest source was waste water handling with 16%.

2.4 Emission Trends for Indirect Greenhouse Gases and SO₂

Emission estimates for NO_x, CO, NMVOC and SO₂ 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) 2012, Submission under the UNECE/CLRTAP Convention*, which will be published in spring 2012 (UMWELTBUNDESAMT 2012).

²⁸ 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 (1990–2010) as well as emission targets²⁹ 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 16. These reduction targets should be met by 2010 by parties to the UNECE/LRTAP convention who signed this protocol.

Table 16: Total emissions and trends 1990–2010 of indirect GHGs and SO₂ as well as emission targets for air pollutants covered by the Multi-Effect Protocol and CO.

		NO _x	CO	NM VOC	SO ₂
1990		194.68	1 435.65	275.87	74.40
1991		201.89	1 499.75	266.31	71.51
1992		192.24	1 470.78	241.39	55.12
1993		186.84	1 438.88	242.33	53.49
1994		181.14	1 385.51	226.33	47.87
1995		181.05	1 272.49	226.14	47.45
1996		203.09	1 247.14	220.21	44.73
1997		190.90	1 150.20	204.29	40.19
1998		204.77	1 108.41	187.76	35.54
1999		197.56	1 030.48	174.04	33.73
2000		205.10	957.03	178.22	31.64
2001	5	215.16	917.55	176.89	32.69
2002		221.10	880.69	175.90	31.17
2003		232.37	872.17	172.47	31.89
2004		230.68	833.35	153.64	27.32
2005		234.71	806.86	161.67	27.06
2006		221.36	767.58	171.98	28.05
2007		215.04	715.20	158.35	24.45
2008		202.62	676.26	149.23	22.01
2009		185.75	630.00	120.56	17.33
2010		187.31	636.95	132.52	18.67
Trend 1990–2010		-3.8%	-55.6%	-52.0%	-74.9%
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

²⁹ 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).

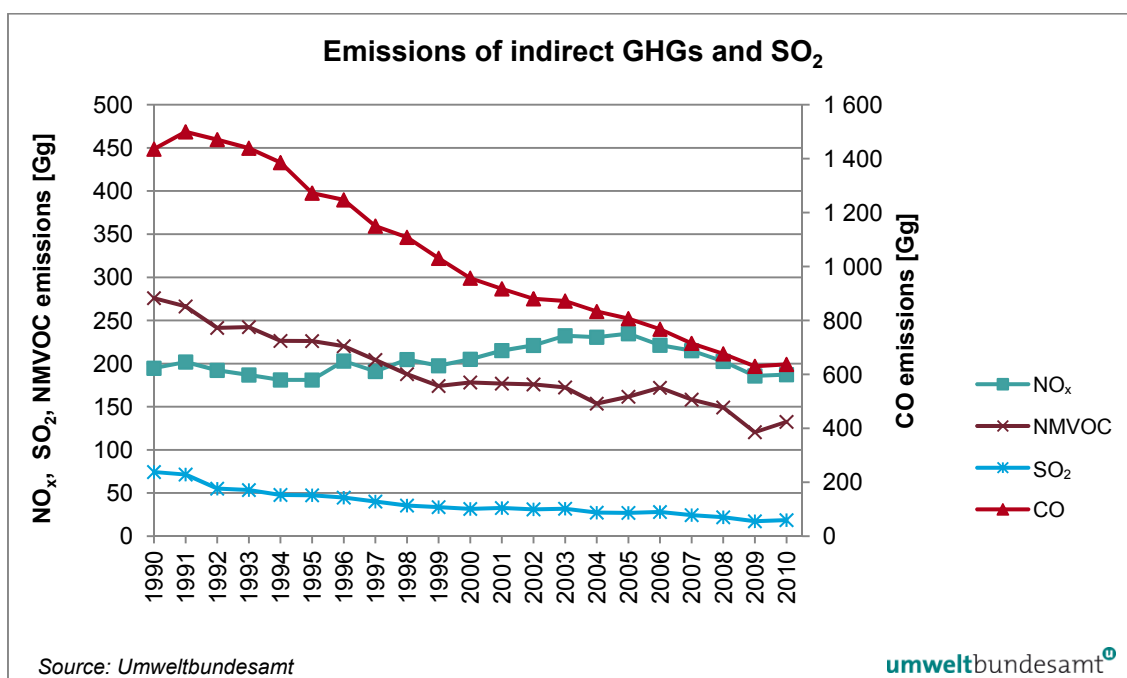


Figure 6: Emissions of indirect GHGs and SO₂ 1990–2010.

The most important emission source for NO_x, SO₂ and CO is fuel combustion. The most important emission source for NMVOC is Solvent and other Product Use.

NO_x

NO_x emissions decreased from 195 to 187 Gg during the period from 1990 to 2010. In 2010 the NO_x emissions were 3.8% below the level of 1990.

In 2010 about 96% of NO_x emissions in Austria originated from fossil fuel combustion, with the major part originating from mobile combustion – road transport (58% in national total NO_x emission).

CO

CO emissions decreased from 1 436 to 637 Gg during the period from 1990 to 2010. In 2010 CO emissions were 55.6% below the level of 1990.

In the year 2010, 95% of total CO emissions in Austria originated from fuel combustion activities. The most important sub-source regarding CO emissions is the residential sector (42% in National Total CO emission) followed by mobile combustion – road transport (25% in national total CO emission).

NMVOC

NMVOC emissions decreased from 276 to 133 Gg during the period from 1990 to 2010. In 2010 NMVOC emissions were 52.0% below the level of 1990.

The most important emission sources for NMVOC emissions are solvent use and fossil fuel combustion, contributing 56% and 38% respectively of national total NMVOC emissions in 2010.

SO₂

SO₂ emissions decreased from 74 to 19 Gg during the period from 1990 to 2010. In 2010 SO₂ emissions were 74.9% below the level of 1990.

The decrease is mainly due to lower emissions from residential heating (-91%), combustion in the manufacturing Industries and construction (-40%) and energy industries (-77%).

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

In 2010 Article 3.3 activities were a net sink in Austria: Net CO₂ removals amounted to 1 259 Gg CO₂.

CO₂ removals from Afforestation/Reforestation (AR) in Austria amounted to 2 621 Gg CO₂. 410 Gg CO₂ resulted from cropland converted to forest land, 976 Gg CO₂ from grassland, 481 Gg CO₂ from other land, 440 Gg CO₂ from settlement and 314 Gg CO₂ from wetland. Emissions from Deforestation (D) activities were approximately 1 362 Gg CO₂ in 2010. Forest land converted to cropland amounted to 141 Gg CO₂, to grassland 412 Gg CO₂, to other land 340 Gg CO₂, to settlement 385 Gg CO₂ and to wetland 83 Gg CO₂.

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 make up less than 1% of total emissions from this sector.

Emissions from the energy sector are the main source of GHGs in Austria: in the year 2010 about 76% of national total GHGs emissions and 87.3% of national total anthropogenic CO₂ emissions from Austria arose from the energy sector.

3.1.1 Emission Trends

Emissions from the energy sector increased by 16.1% from 55.4 Tg CO₂ equivalents in 1990 to 64.3 Tg CO₂ equivalents in 2010, which is mainly caused by increasing emissions from transport

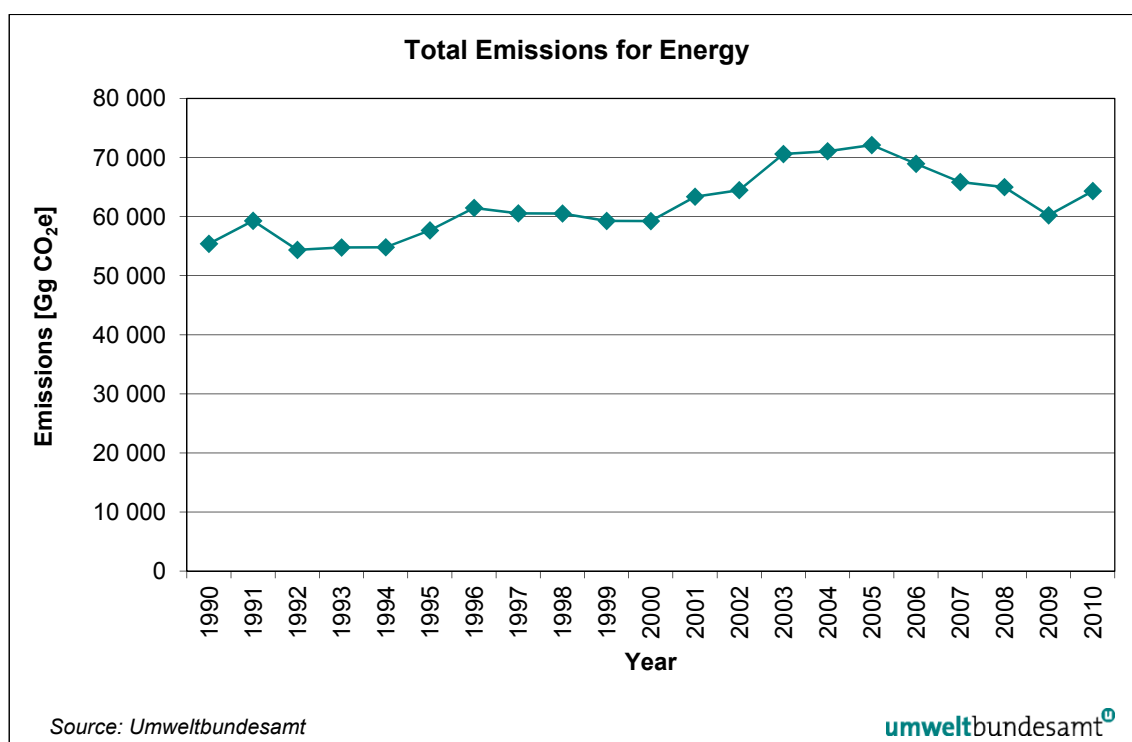


Figure 7: Trend of GHG emissions from 1990–2010 for energy.

Total emissions from energy mainly consist of CO₂ whereas N₂O and CH₄ emissions only make up about 1.1% and 0.8%, respectively. The increase of CO₂ and N₂O emissions is mainly caused by the increasing activity of transport. The decrease of CH₄ emissions mainly occurs in the residential sector due to a shift to more efficient biomass heating. The strong increase of CO₂ emissions from 2002 to 2003 was additionally caused by public electricity plants. Between 2005 and 2009 emissions from public electricity production, manufacturing industries, 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") and the strong increase of biofuel use although inland passenger and transport vehicle kilometres show a slight increase. Between 2008 and 2009 GHG emissions from *1.A.2 Manufacturing Industries* decreased by -8.7% which is mainly due to the economic crisis and especially due to less steel production which resulted in leads to -18% GHG emissions of category *1.A.2.a Iron and Steel*. In 2010 the emissions of *1.A.2. Manufacturing Industries* increased by +6.2% and reached almost the level of 2008.

Table 17: Emissions of greenhouse gases and their trend from 1990–2010 from IPCC Category 1 Energy.

	CO ₂ [Gg]	CH ₄ [Gg]	N ₂ O [Gg]	Gg CO ₂ equivalent
1990	54 172	31,90	1,79	55 397
1991	57 963	33,70	2,00	59 291
1992	53 065	32,72	1,97	54 364
1993	53 466	32,48	2,04	54 780
1994	53 538	30,36	2,06	54 815
1995	56 355	31,14	2,13	57 670
1996	60 112	31,82	2,24	61 474
1997	59 299	27,30	2,20	60 554
1998	59 256	26,53	2,32	60 531
1999	58 002	26,03	2,34	59 274
2000	57 991	25,20	2,36	59 251
2001	62 086	25,17	2,45	63 374
2002	63 219	23,91	2,47	64 487
2003	69 309	23,69	2,55	70 596
2004	69 784	23,90	2,53	71 071
2005	70 793	24,26	2,61	72 113
2006	67 660	23,65	2,54	68 944
2007	64 582	23,40	2,49	65 845
2008	63 753	23,63	2,42	65 000
2009	59 017	23,80	2,27	60 220
2010	63 088	25,12	2,30	64 328
<i>Trend 1990–2010</i>	<i>16.5%</i>	<i>-21.2%</i>	<i>28.2%</i>	<i>16.1%</i>

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, GHG emissions from this category decreased since 1990 because of a change in the fuel mix and less heating degree days since 2006. 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 GHG emissions from *1.B fugitive emissions from fuels* is mainly caused by the increase of CH₄ emissions from natural gas distribution, reflecting the increase of the length of natural gas pipelines and the distribution network.

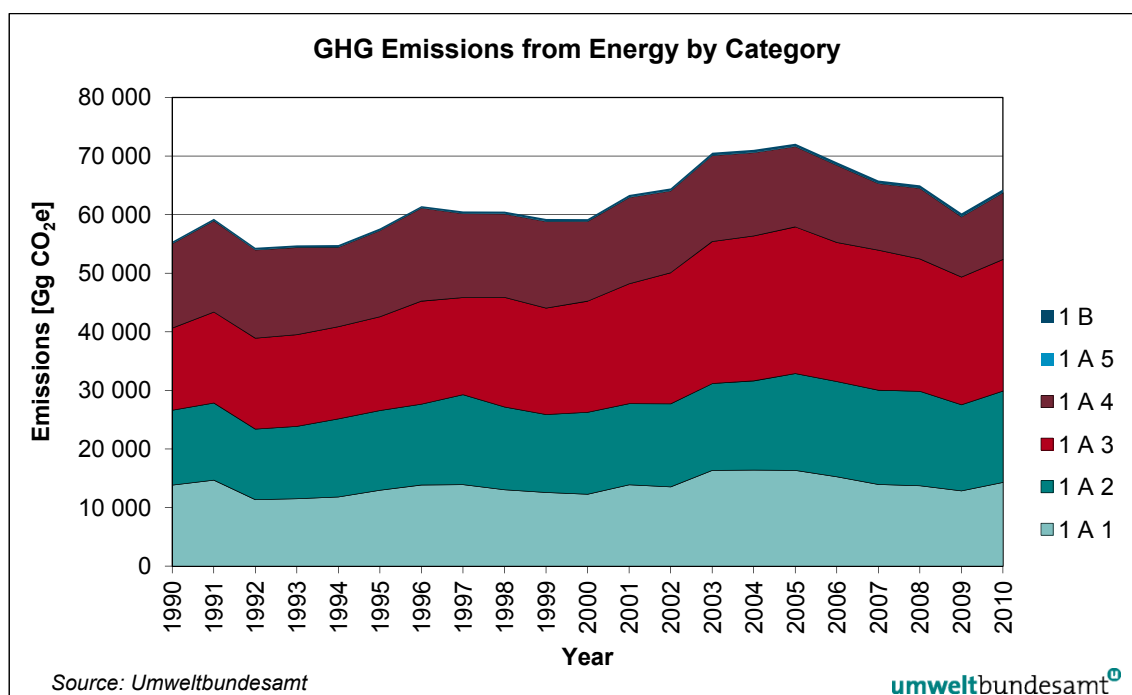


Figure 8: GHG emissions in [Gg CO₂ equivalent] from 1990–2010 from Energy by sub categories.

Table 18: Total GHG emissions in [Gg CO₂ equivalent] from 1990–2010 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	55 397	55 086	13 842	12 774	14 030	14 405	36	311	11	300
1991	59 291	58 973	14 679	13 170	15 534	15 551	38	318	9	308
1992	54 364	54 019	11 360	12 042	15 519	15 063	35	345	8	337
1993	54 780	54 441	11 513	12 348	15 663	14 876	40	339	8	331
1994	54 815	54 469	11 809	13 339	15 729	13 549	43	346	6	340
1995	57 670	57 317	12 971	13 595	16 013	14 705	33	353	6	347
1996	61 474	61 178	13 856	13 819	17 573	15 890	40	296	5	291
1997	60 554	60 207	13 925	15 360	16 579	14 305	38	347	5	342
1998	60 531	60 167	13 058	14 116	18 709	14 241	43	364	5	359
1999	59 274	58 893	12 581	13 315	18 167	14 788	43	381	5	376
2000	59 251	58 873	12 275	14 003	18 970	13 583	42	378	6	372
2001	63 374	62 980	13 889	13 858	20 466	14 725	42	394	5	388
2002	64 487	64 110	13 537	14 179	22 391	13 960	43	377	6	371
2003	70 596	70 151	16 361	14 817	24 246	14 684	44	445	5	440
2004	71 071	70 630	16 405	15 237	24 751	14 194	44	441	1	440
2005	72 113	71 672	16 359	16 526	25 040	13 703	45	441	0.03	441
2006	68 944	68 466	15 254	16 265	23 736	13 165	45	478	0.03	478
2007	65 845	65 354	13 943	16 102	23 892	11 371	46	491	NO	491
2008	65 000	64 531	13 736	16 104	22 604	12 041	46	469	NO	469
2009	60 220	59 681	12 858	14 701	21 806	10 269	47	539	NO	539
2010	64 328	63 811	14 293	15 618	22 452	11 401	47	516	NO	516
<i>Trend</i>										
1990-2010	16.1%	15.8%	3.3%	22.3%	60.0%	-20.9%	31.8%	66.2%	-100%	72.3%

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 CO₂ 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 CO₂ emissions

In the following, CO₂ emissions from the sectoral and reference approach are compared and explanations for the differences are provided.

The following figure shows the results for the two approaches for the period 1990–2010. Solid fuels show the most significant deviation.

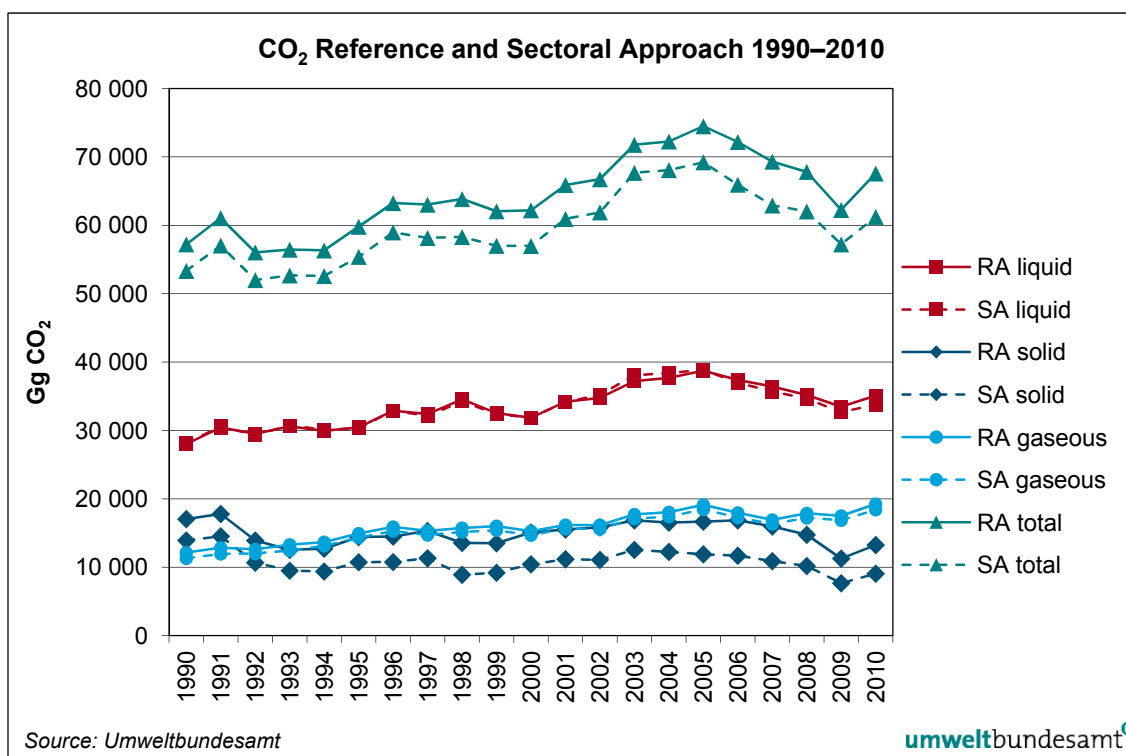


Figure 9: CO₂ Reference and Sectoral Approach 1990 to 2010.

Table 19 presents CO₂ emissions of the sectoral and reference approach.

Table 19: CO₂ 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	28 022	17 039	12 146	57 207	28 113	13 924	11 301	732	54 070
1991	30 424	17 789	12 841	61 055	30 589	14 518	11 940	805	57 852
1992	29 519	13 908	12 610	56 037	29 322	10 666	12 000	956	52 945
1993	30 603	12 542	13 298	56 444	30 731	9 495	12 453	675	53 354
1994	29 938	12 723	13 679	56 339	30 100	9 379	13 111	820	53 410
1995	30 454	14 414	14 935	59 804	30 309	10 741	14 339	839	56 228
1996	32 880	14 491	15 897	63 267	32 921	10 760	15 287	1 073	60 041
1997	32 396	15 304	15 321	63 021	32 123	11 318	14 720	1 017	59 179
1998	34 556	13 559	15 729	63 844	34 247	8 905	15 144	818	59 114
1999	32 539	13 513	16 004	62 056	32 399	9 192	15 412	828	57 831
2000	31 849	15 072	15 273	62 194	31 883	10 423	14 686	834	57 827
2001	34 197	15 513	16 186	65 896	34 136	11 177	15 632	958	61 903
2002	34 755	15 829	16 160	66 743	35 226	11 081	15 582	1 163	63 052
2003	37 212	16 846	17 721	71 779	38 052	12 543	17 092	1 389	69 076
2004	37 675	16 538	18 042	72 255	38 417	12 247	17 405	1 505	69 574
2005	38 728	16 657	19 116	74 502	38 864	11 890	18 460	1 374	70 588
2006	37 388	16 855	17 949	72 192	36 993	11 680	17 269	1 486	67 428
2007	36 422	15 963	16 927	69 312	35 692	10 898	16 324	1 430	64 345
2008	35 175	14 750	17 887	67 812	34 639	10 187	17 219	1 495	63 541
2009	33 472	11 267	17 515	62 255	32 680	7 667	16 873	1 532	58 752
2010	35 092	13 248	19 246	67 585	33 779	9 059	18 402	1 610	62 851

Table 20 presents the difference of CO₂ emissions in percent between reference and sectoral approach.

Table 20: Difference of CO₂ emissions by type of fuel in percent.

Year	Liquid	Solid	Gaseous	Total
1990	-0.32%	22.37%	7.48%	5.80%
1991	-0.54%	22.53%	7.55%	5.54%
1992	0.67%	30.39%	5.08%	5.84%
1993	-0.42%	32.10%	6.79%	5.79%
1994	-0.54%	35.65%	4.33%	5.48%
1995	0.48%	34.20%	4.15%	6.36%
1996	-0.12%	34.68%	3.99%	5.37%
1997	0.85%	35.22%	4.08%	6.49%
1998	0.90%	52.27%	3.86%	8.00%
1999	0.43%	47.00%	3.84%	7.31%
2000	-0.11%	44.60%	3.99%	7.55%
2001	0.18%	38.80%	3.54%	6.45%
2002	-1.34%	42.85%	3.71%	5.85%
2003	-2.21%	34.31%	3.68%	3.91%
2004	-1.93%	35.04%	3.66%	3.85%

Year	Liquid	Solid	Gaseous	Total
2005	-0.35%	40.09%	3.56%	5.55%
2006	1.07%	44.30%	3.94%	7.06%
2007	2.05%	46.48%	3.69%	7.72%
2008	1.55%	44.79%	3.88%	6.72%
2009	2.42%	46.96%	3.81%	5.96%
2010	3.89%	46.24%	4.58%	7.53%

Positive numbers indicate that CO₂ emissions from the reference approach are higher than emissions from the sectoral approach.

Explanation of differences

- **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 coke used for carbide production which are included in category *2.B.4 Carbide Production*. In the sectoral approach plant specific CO₂ emission factors are used for large coal boilers since 2005.
- **Liquid Fuels:** The 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 emissions from plastics waste incineration are reported as "other fuels" but in the reference approach it is included in "liquid fuels". 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 CO₂ emissions from diesel are fully accounted as fossil emissions while in the sectoral the share of mixed biofuels is accounted as biogenic.
- **Gaseous fuels:** 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".
- In the sectoral approach sector- or even plant-specific net calorific values are taken to calculate the energy consumption whereas in the reference approach average (country specific) calorific values are applied.

Quantification of differences

- By quantifying the difference between the two approaches the remaining difference is between -0.4 to +2.8%.
- 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 21 presents the differences which can be easily quantified. Positive numbers indicate CO₂ emissions not included in the sectoral approach. Negative numbers indicate CO₂ 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 21: 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 Difference ⁽²⁾
1990	19	826	2 704	-732	0	2 817	0.6%
1991	17	884	2 722	-805	0	2 818	0.6%
1992	15	595	2 458	-956	0	2 111	1.8%
1993	14	831	2 526	-675	0	2 697	0.7%
1994	11	556	2 767	-820	0	2 515	0.7%
1995	13	583	3 136	-839	0	2 893	1.2%
1996	12	597	2 918	-1 073	0	2 454	1.2%
1997	10	591	3 316	-1 017	0	2 900	1.5%
1998	0	585	3 214	-818	0	2 980	2.8%
1999	2	590	3 102	-828	0	2 866	2.2%
2000	5	735	3 489	-834	0	3 395	1.6%
2001	3	551	3 449	-958	0	3 044	1.5%
2002	5	573	3 879	-1 163	0	3 293	0.6%
2003	5	643	3 721	-1 389	0	2 979	-0.4%
2004	4	694	3 650	-1 505	0	2 842	-0.2%
2005	5	739	4 128	-1 374	125	3 622	0.4%
2006	5	752	4 206	-1 486	879	4 356	0.6%
2007	5	673	4 214	-1 430	1 010	4 471	0.7%
2008	5	724	4 187	-1 495	993	4 414	-0.2%
2009	5	796	3 243	-1 532	1 254	3 767	-0.4%
2010	5	883	3 979	-1 610	1 327	4 583	0.2%

¹⁾ Deviation due to losses and statistical differences.

²⁾ (RA-SA)/SA. Negative numbers indicate that CO₂ emissions from the reference approach are lower than emissions from the sectoral approach.

³⁾ CO₂ emissions of non energy use of natural gas used for ammonia production are reported under category 2.B.1.

⁴⁾ Process emissions of coke oven coke and other bituminous coal used in blast furnaces. Emissions are allocated to 2 C 1 Iron and Steel Production.

⁵⁾ Share of biofuels in diesel and gasoline.

Natural Gas

The following figure shows the quantified difference for natural gas in more detail. The national default CO₂ emission factor (55.4 t /TJ) has been used for emission calculation of columns B, F and G. Formula for C = B - (D + F + H). Energy consumption of columns E and G is according to the national energy balance. Column A shows the remaining difference not further quantifiable with this easy approach. The maximum of approx. 1% difference results for the year 2009.

Quantification of difference between RA and SA for natural gas								
	A	B	C	D	E	F	G	H
	(RA-SA)/SA	RA	RA-SA-processes	SA	Inkl. In RA Losses		Inkl. In RA Non Energy Use 2.B.1	
Year	%	[Mio t CO ₂]	[Mio t CO ₂]	[Mio t CO ₂]	[PJ]	[Mio t CO ₂]	[PJ]	[Mio t CO ₂]
1990	0%	12,1	0,0	11,3	0,35	0,000	15	0,8
1991	0%	12,8	0,0	11,9	0,30	0,000	16	0,9
1992	0%	12,6	0,0	12,0	0,27	0,000	11	0,6
1993	0%	13,3	0,0	12,5	0,25	0,000	15	0,8
1994	0%	13,7	0,0	13,1	0,21	0,000	10	0,6
1995	0%	14,9	0,0	14,3	0,24	0,000	11	0,6
1996	0%	15,9	0,0	15,3	0,22	0,000	11	0,6
1997	0%	15,3	0,0	14,7	0,18	0,000	11	0,6
1998	0%	15,7	0,0	15,1	0,00	0,000	11	0,6
1999	0%	16,0	0,0	15,4	0,04	0,000	11	0,6
2000	-1%	15,3	-0,1	14,7	0,08	0,000	13	0,7
2001	0%	16,2	0,0	15,6	0,06	0,000	10	0,6
2002	0%	16,2	0,0	15,6	0,09	0,000	10	0,6
2003	0%	17,7	0,0	17,1	0,08	0,000	12	0,6
2004	0%	18,0	-0,1	17,4	0,08	0,000	13	0,7
2005	0%	19,1	-0,1	18,5	0,08	0,000	13	0,7
2006	0%	17,9	-0,1	17,3	0,08	0,000	14	0,8
2007	0%	16,9	-0,1	16,3	0,08	0,000	12	0,7
2008	0%	17,9	-0,1	17,2	0,09	0,000	13	0,7
2009	-1%	17,5	-0,2	16,9	0,09	0,000	14	0,8
2010	0%	19,2	0,0	18,4	0,09	0,000	16	0,9

Source: Umweltbundesamt

umweltbundesamt[®]

Figure 10: Quantification of difference between RA and SA for natural gas.

Solid Fuels

The following figure shows the quantified difference for solid fuels in more detail. Emissions from non energy use of solid fuels are reported under category 2.C.1 iron and steel production together with emissions from iron ore and other reducing agents such as plastics and waste oil. The values for unit conversion, carbon content and oxidation factors for emission calculation of columns F and H have been taken from the RA. Column C shows the remaining difference between the two approaches. Formula for C = B - (D + F + H). Non energy use of columns E and G is according to the national energy balance. Column A shows the remaining difference not further quantifiable with this easy approach. The difference for the year 2010 remains about 7%.

Quantification of difference between RA and SA for solid fuels								
	A	B	C	D	E	F	G	H
	(RA-SA)/SA	RA	RA- (SA+ coke + bit.coal)	SA	Inkl. In RA Coke non energy use		Inkl. In RA Bit. Coal non energy use	
Year	%	[Mio t CO ₂]	[Mio t CO ₂]	[Mio t CO ₂]	[kt]	[Mio t CO ₂]	[kt]	[Mio t CO ₂]
1990	5%	17,0	0,7	13,9	820	2,5	2	0,0
1991	5%	17,8	0,7	14,5	852	2,6	2	0,0
1992	9%	13,9	0,9	10,7	763	2,3	2	0,0
1993	6%	12,5	0,6	9,5	817	2,5	2	0,0
1994	7%	12,7	0,7	9,4	891	2,7	1	0,0
1995	6%	14,4	0,6	10,7	1 010	3,0	1	0,0
1996	9%	14,5	1,0	10,8	932	2,8	1	0,0
1997	7%	15,3	0,8	11,3	1 069	3,2	1	0,0
1998	21%	13,6	1,8	8,9	944	2,8	1	0,0
1999	17%	13,5	1,5	9,2	931	2,8	1	0,0
2000	15%	15,1	1,5	10,4	1 037	3,1	1	0,0
2001	11%	15,5	1,2	11,2	1 025	3,1	1	0,0
2002	12%	15,8	1,4	11,1	1 117	3,4	2	0,0
2003	9%	16,8	1,1	12,5	1 059	3,2	2	0,0
2004	11%	16,5	1,3	12,2	984	3,0	1	0,0
2005	8%	16,7	0,9	11,9	1 266	3,8	1	0,0
2006	13%	16,9	1,5	11,7	1 196	3,7	1	0,0
2007	12%	16,0	1,3	10,9	1 172	3,6	85	0,2
2008	6%	14,7	0,7	10,2	1 105	3,4	183	0,5
2009	5%	11,3	0,4	7,7	941	2,9	110	0,3
2010	7%	13,2	0,6	9,1	1 045	3,2	137	0,3

Source: Umweltbundesamt

umweltbundesamt[®]

Figure 11: Quantification of difference between RA and SA for solid fuels.

3.2.1.2 Comparison of energy consumption

Table 22 shows the energy consumption of the two approaches. For the reference approach non energy consumption according to the energy balance has been subtracted. The comparison shown in Table 23 is equal to CRF table 1.A(c). Please note that positive numbers indicate that the RA shows higher energy consumption than the SA.

Table 22: Energy consumption of sectoral and reference approach in [PJ].

Year	Reference Approach w/o non energy use				Sectoral Approach				
	Liquid	Solid	Gaseous	Total	Liquid	Solid	Gaseous	Other	Total
1990	375.26	148.05	203.98	727.29	379.06	139.89	203.98	8.99	731.92
1991	408.74	155.49	215.53	779.76	411.62	146.16	215.53	10.08	783.39
1992	395.56	118.12	216.61	730.29	395.19	108.34	216.61	12.01	732.14
1993	410.57	102.47	224.79	737.82	413.67	96.29	224.79	9.78	744.52
1994	400.26	102.18	236.67	739.10	405.81	95.06	236.67	10.53	748.06
1995	407.59	116.35	258.83	782.77	408.37	108.50	258.83	10.92	786.61
1996	440.59	119.52	275.94	836.05	444.50	109.23	275.94	14.01	843.69
1997	430.85	124.40	265.71	820.96	433.18	114.97	265.71	13.12	826.98
1998	460.91	109.46	273.36	843.74	461.68	90.34	273.36	12.28	837.68
1999	431.07	108.07	278.19	817.33	435.88	92.17	278.19	11.59	817.83
2000	421.32	122.45	262.32	806.09	431.26	105.27	265.10	12.27	813.90
2001	451.22	127.47	282.17	860.86	461.30	113.00	282.17	14.49	870.96
2002	464.05	127.85	281.27	873.17	472.10	111.99	281.27	16.78	882.14
2003	497.27	140.53	308.19	945.99	509.92	127.14	308.51	19.40	964.98
2004	501.68	139.73	313.07	954.48	510.95	124.86	314.16	24.56	974.54
2005	516.13	132.32	331.64	980.10	521.98	122.50	333.30	22.74	1 000.53
2006	495.90	136.33	310.33	942.57	501.51	120.69	311.80	25.48	959.48
2007	480.33	126.22	293.29	899.84	485.85	112.71	294.74	24.75	918.06
2008	464.83	119.75	309.71	894.29	470.06	105.32	310.89	28.22	914.49
2009	447.95	90.13	301.71	839.79	443.71	78.79	304.63	29.72	856.84
2010	465.19	107.05	331.37	903.61	457.52	93.02	332.24	34.34	917.11

Table 23: Difference of energy consumption by type of fuel in percent.

Year	Liquid	Solid	Gaseous	Total
1990	-1.00%	5.83%	0.00%	-0.63%
1991	-0.70%	6.38%	0.00%	-0.46%
1992	0.09%	9.03%	0.00%	-0.25%
1993	-0.75%	6.42%	0.00%	-0.90%
1994	-1.37%	7.49%	0.00%	-1.20%
1995	-0.19%	7.24%	0.00%	-0.49%
1996	-0.88%	9.42%	0.00%	-0.90%
1997	-0.54%	8.20%	0.00%	-0.73%
1998	-0.17%	21.16%	0.00%	0.72%
1999	-1.10%	17.25%	0.00%	-0.06%
2000	-2.30%	16.32%	-1.05%	-0.96%
2001	-2.19%	12.81%	0.00%	-1.16%
2002	-1.71%	14.16%	0.00%	-1.02%
2003	-2.48%	10.53%	-0.11%	-1.97%
2004	-1.81%	11.91%	-0.35%	-2.06%
2005	-1.12%	8.01%	-0.50%	-2.04%
2006	-1.12%	12.96%	-0.47%	-1.76%
2007	-1.14%	11.99%	-0.49%	-1.98%
2008	-1.11%	13.70%	-0.38%	-2.21%
2009	0.96%	14.39%	-0.96%	-1.99%
2010	1.68%	15.09%	-0.26%	-1.47%

Energy consumption is different between the two approaches because

- Transformation and distribution losses are not considered in the sectoral approach.
- The sectoral approach uses sector-specific NCVs.
- The methodology of the approaches is not comparable at fuel type level.

3.2.2 International bunker fuels

3.2.2.1 International navigation

In 2010, the share of international navigation in the total fuel consumption in the navigation sector in Austria amounted to 75%. Greenhouse gas emissions and activity data from navigation assigned to international bunkers are presented in the following table.

Table 24: Greenhouse gas emissions and activity from 1.C1.B International bunkers-marine 1990-2010.

	CO ₂ [Gg]	N ₂ O [Gg]	CH ₄ [Gg]	Activity [TJ]
1990	18.6	0.0065	0.0009	251
1991	19.7	0.0069	0.0010	266
1992	20.1	0.0070	0.0010	272
1993	20.6	0.0072	0.0010	279
1994	20.2	0.0071	0.0010	273
1995	19.8	0.0070	0.0010	268
1996	19.4	0.0069	0.0009	263
1997	19.0	0.0068	0.0009	258
1998	18.7	0.0067	0.0009	253
1999	18.5	0.0066	0.0009	251
2000	20.2	0.0073	0.0010	275
2001	20.2	0.0073	0.0009	275
2002	20.2	0.0073	0.0009	275
2003	17.3	0.0062	0.0008	234
2004	17.3	0.0062	0.0008	234
2005	64.5	0.0236	0.0028	889
2006	42.4	0.0166	0.0020	609
2007	36.2	0.0141	0.0017	523
2008	31.6	0.0124	0.0015	460
2009	30.9	0.0124	0.0015	460
2010	31.1	0.0121	0.0014	460

Methodological Issues

Since 2010, greenhouse gas emissions from water-borne navigation (inland navigation on the River Danube) have been reported separately for the national and the international share of navigation from 1990 onwards. For this purpose diesel consumption in navigation is obtained from the energy balance (STATISTIK AUSTRIA 2011c). This data used in the energy balance originates from the Austrian Federal Ministry of Economy, Family and Youth (BMWFJ 2011) which – according to the national oil statistics directive³⁰ (BMWFJ 2008) – collects data from all Austrian companies who export or import oil products.

³⁰ BGBl. I Nr. 53/2008 – Formsheets III based on BGBl. Nr. 630/1994

The national fuel consumption in navigation is calculated bottom-up with the GEORG model (see subchapter on mobile sources of 1 A 2 f).

The CO₂ emissions of international navigation bunker fuels shows a strong volatility during the whole time series. An investigation showed that the companies operating fuel stations along the Danube in Austria changed in 2005. Those new companies operating in Austria reduced prices in order to increase their market share and they were faster in offering better fuel qualities than other stations along the Danube. This increase in market share of fuel stations operated in Austria along the River Danube resulted in an increase of international navigation (bunkers) in the year 2005.

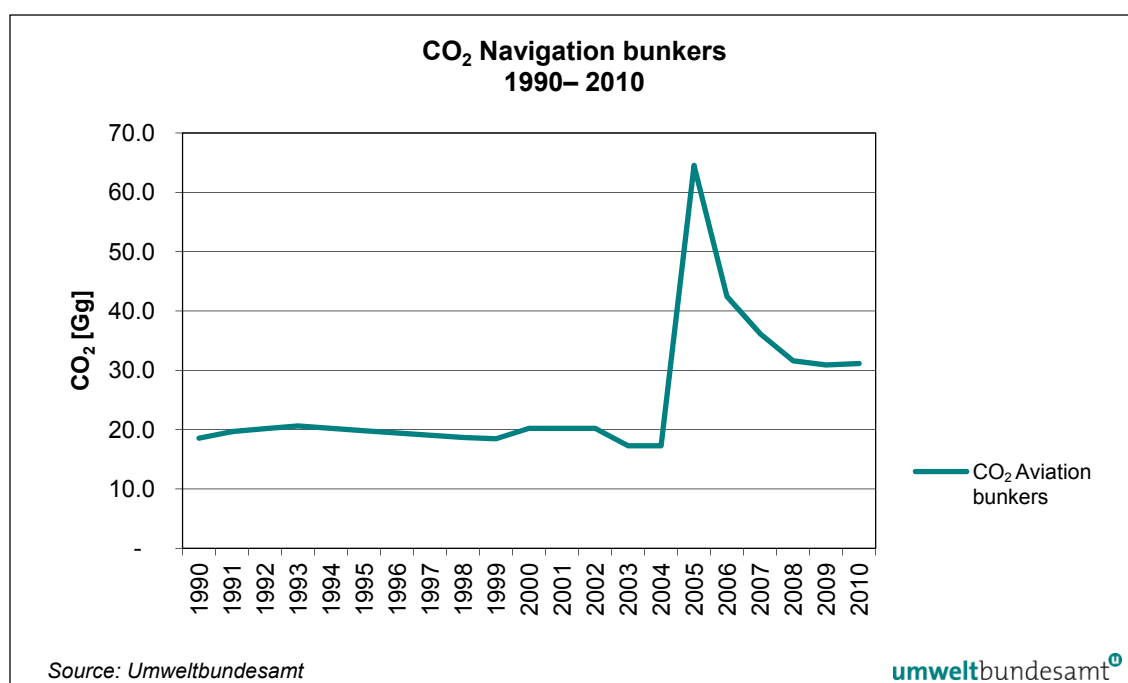


Figure 12: CO₂ Emissions navigation bunkers

3.2.2.2 International aviation

In 2010, the share of international aviation in the total fuel consumption in the aviation sector in Austria amounted to 97%. Greenhouse gas emissions and activity data 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 25: Greenhouse gas emissions and activity from 1.C1.A International bunkers-aviation 1990–2010.

	CO ₂ [Gg]		N ₂ O [Gg]		CH ₄ [Gg]	Activity [TJ]
	int. LTO	int. cruise	int. LTO	int. cruise	int. LTO	int. LTO + int. cruise
Kerosene						
1990	90	796	0.006	0.025	0.015	12,263
1991	103	891	0.006	0.028	0.016	13,757
1992	116	962	0.007	0.031	0.017	14,913
1993	129	1 011	0.008	0.032	0.018	15,779

	CO ₂ [Gg]		N ₂ O [Gg]		CH ₄ [Gg]	Activity [TJ]
	int. LTO	int. cruise	int. LTO	int. cruise	int. LTO	int. LTO + int. cruise
Kerosene						
1994	141	1 044	0.009	0.033	0.019	16,411
1995	154	1 173	0.010	0.037	0.020	18,247
1996	165	1 302	0.010	0.041	0.023	20,204
1997	175	1 350	0.011	0.043	0.027	21,019
1998	186	1 392	0.011	0.044	0.030	21,744
1999	190	1 352	0.011	0.043	0.029	21,196
2000	210	1 485	0.010	0.047	0.031	23,287
2001	200	1 452	0.010	0.046	0.030	22,677
2002	233	1 307	0.010	0.041	0.035	21,162
2003	243	1 210	0.010	0.038	0.036	19,952
2004	290	1 435	0.011	0.046	0.043	23,687
2005	270	1 689	0.012	0.054	0.040	26,915
2006	268	1 781	0.012	0.056	0.040	28,138
2007	290	1 886	0.013	0.060	0.043	29,881
2008	294	1 888	0.013	0.060	0.044	29,966
2009	269	1 624	0.012	0.052	0.040	26,003
2010	276	1 773	0.012	0.056	0.041	28,147

Methodological Issues

Emissions have been calculated using the methodology and emission factors as described in Chapter 0 (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 CO₂ 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 CO₂ 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 CO₂ 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 CO₂ 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: CO₂ 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 CO₂ 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: CO₂ emissions from coke used in iron and steel industry are reported under *2 C*.

disposal: not applicable.

Other bituminous coal

In [IEA JQ 2011] 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*. CO₂ emissions from solvent use are considered in sector *3 solvent and other product use*.

use: CO₂ 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* and *1 A 2*.

3.2.4 CO₂ capture from flue gases and subsequent CO₂ storage, if applicable

CO₂ capture from flue gases and CO₂ 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 CO₂ emission trading system (ETS) are considered.

3.2.6 Source Category Description

Transport

In 2010 the most important source of GHGs was transport, with a share of 26.5% in national total GHG emissions. 14.4% of national GHG emissions were released by passenger cars, 2.1% by light duty vehicles, 9.2% 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 0.01% 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 18.5% in 2010 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 2010 with a share of 16.9% total GHG emissions of was energy industries, where fossil fuels are used for electrical power and district heating production. In the year 2010 overall gross public electricity production was 61 768 GWh³¹ of which 40 521 GWh (66%) were generated by hydro plants, 19 093 GWh (31%) by thermal power plants and 2 154 GWh (3%) by solar, geothermal and wind power plants. Industrial auto producers generated 9 359 GWh of electricity in the year 2010. 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*).

³¹ Source: IEA Questionnaire November/2011 by STATISTIK AUSTRIA.

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 13.5% in 2010 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 0.06% to total GHG emissions in 2010.

3.2.6.1 Key Sources

The methodology and results of the key category analysis is presented in Chapter 1.5. Table 26 presents the key source categories of 1 A *Fuel Combustion Activities*.

Table 26: Key sources of 1 A Fuel combustion activities including LULUCF.

IPCC Category	Category Name	GHG	Keysource Assessment
1.A.1.a liquid	Public Electricity and Heat Production	CO ₂	LA; TA
1.A.1.a solid	Public Electricity and Heat Production	CO ₂	LA; TA
1.A.1 a gaseous	Public Electricity and Heat Production	CO ₂	LA; TA
1.A.1.a other	Public Electricity and Heat Production	CO ₂	LA 2010; TA
1.A.1.b liquid	Petroleum refining	CO ₂	LA ;TA
1.A.1 b gaseous	Petroleum refining	CO ₂	LA
1.A.1.c gaseous	Manufacture of Solid fuels and Other Energy	CO ₂	LA; TA
1.A.2 stat-liquid	Manufacturing Industries and Constr.	CO ₂	LA; TA
1.A.2 mob-liquid	Manufacturing Industries and Constr.	CO ₂	LA; TA
1.A.2 solid	Manufacturing Industries and Constr.	CO ₂	LA ;TA
1.A.2 gaseous	Manufacturing Industries and Constr.	CO ₂	LA; TA
1.A.2 other	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.3.e gaseous	Other	CO ₂	LA 2010
1.A.4 stat-liquid	Other Sectors	CO ₂	LA; TA
1.A.4 mob-diesel	Other Sectors	CO ₂	LA
1.A.4 solid	Other Sectors	CO ₂	LA 1990; TA
1.A.4 gaseous	Other Sectors	CO ₂	LA; TA
1.A.4 biomass	Other Sectors	CH ₄	LA 1990
1.A.4 other	Other Sectors	CO ₂	LA 1990; TA

LA = Level Assessment (if not further specified - for the years 1990 and 2010)

TA = Trend Assessment 2010

3.2.6.2 Completeness

Table 27 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 27: 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 ₂ O
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 ₂ O
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 ₂ O
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 ₂ O
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) CH₄ 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}: CO₂, CH₄, N₂O, NMVOC;
- 1 A 1 a Public Electricity and Heat Production, plants < 50 MW_{th}: All Pollutants;
- 1 A 1 b Petroleum Refining: CO₂, CH₄, N₂O;

- 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, SO₂, NO_x;
- 1 A 1 b *Petroleum Refining (1 plant)*: SO₂, NO_x, CO, VOC ("IE": reported under 1 B);
- 1 A 2 a *Iron and Steel (2 integrated iron & steel plants)*: CO₂, CO, VOC, SO₂, NO_x;
- 1 A 2 f *Other – Cement production (10 plants)*: CO₂, SO₂, 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 CO₂ 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 and 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 municipal waste incineration boilers)

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;
- CO₂ emission factor of fuel or process material;
- Share of non fossil CO₂ 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 CO₂ 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 CO₂ emission 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 2005–2010 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 yearly 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:

$$\text{Activity}_{\text{category, fuel}} = (\text{Energy_Balance_Activity}_{\text{category, fuel}} - \sum_i (\text{ETS_Activity}_{\text{plant } i, \text{fuel}})) \times \text{Energy_Balance_NCV}_{\text{fuel}} + \sum_i (\text{ETS_Activity}_{\text{plant } i, \text{fuel}} \times \text{ETS_NCV}_{\text{plant } i, \text{fuel}}).$$

- ETS CO₂ emissions are considered by fuel. The remaining CO₂ emissions are calculated by remaining activity data and "national default" emission factors:

$$\text{CO}_{2\text{-category, fuel}} = (\text{Energy_Balance_Activity}_{\text{category, fuel}} - \sum_i (\text{ETS_Activity}_{\text{plant } i, \text{fuel}})) \times \text{Energy_Balance_NCV}_{\text{fuel}} \times \text{Default_EF}_{\text{fuel}} + \sum_i (\text{ETS_CO}_{2\text{plant } i, \text{fuel}}).$$

Choice of emission factors for stationary sources

Emission factors for combustion plants are expressed as kg/GJ for CO₂ and as g/GJ for CH₄ and N₂O. Please note that emission factors sometimes are different for different sectors because of the different share of fuel types combusted. E.g. the CO₂ 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, CH₄ 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 CO₂ and CH₄ emission factors are national studies (BMWA-EB 1990, 1996, 2003, UMWELTBUNDESAMT 2001a). N₂O emission factors are also taken from national studies (STANZEL et al. 1995) and (BMUJF 1994). Detailed figures are included in the relevant chapters.

CO₂ emission factors for stationary sources per fuel type

Natural Gas (fossil)

For all stationary sources of natural gas combustion a CO₂ emission factor of 55.4 t CO₂/TJ (UMWELTBUNDESAMT 2001a) has been applied.

Liquid fuels (fossil)

Fuel oil: Depending on the sulphur content three fuel oil categories are considered in the inventory. CO₂ emission factors are taken from (BMWA-EB 1996).

Gasoil, Diesel Oil : CO₂ emission factors are taken from (BMWA-EB 1996).

Liquid Petroleum Gas, LPG: CO₂ emission factors are taken from (BMWA-EB 1996).

Refinery Gas: The CO₂ emission factor is based on plant specific measurements.

Solid fuels (fossil)

Coal: (BMWA-EB 1996): CO₂ emission factors are based on elemental analysis with the assumption that 100% of carbon is released as CO₂ (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 Vienna³² 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 CO₂ emission factor is converted into t CO₂/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 2010). 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.

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 CO₂/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 CO₂/TJ waste.

³² 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.

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).

CO₂ emissions reported by the ETS

The following Table 28 shows certificated CO₂ emissions from the ETS (UMWELTBUNDESAMT, ECRA 2006–2011) 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 the 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. pyrolysis material).

Table 28: 2005–2010 CO₂ emissions [Gg] as reported by the ETS.

Category		2005	2006	2007	2008	2009	2010
Total ETS ¹⁾		33 373	32 381	31 745	32 078	27 359	30 855
1.A	FUEL COMBUSTION ACTIVITIES	25 299	23 998	22 821	22 801	19 871	22 478
1.A.1.a	Public Electricity and Heat Production	11 482	10 374	9 037	8 973	7 825	9 335
1.A.1.b	Petroleum refining	2 827	2 830	2 868	2 806	2 809	2 724
1.A.1.c	Manufacture of Solid fuels and Other Energy Industries	43	50	52	47	54	47
1.A.2.a	Iron and Steel	5 688	5 527	5 582	5 765	4 446	5 545
1.A.2.b	Non-ferrous Metals	-	-	-	-	-	-
1.A.2.c	Chemicals	665	623	592	611	631	654
1.A.2.d	Pulp, Paper and Print	2 245	2 153	2 150	2 128	1 999	2 044
1.A.2.e	Food Processing, Beverages and Tobacco	316	278	283	295	304	352
1.A.2.f	Other	2 010	2 139	2 239	2 157	1 786	1 762
1.A.4.a	Commercial/Institutional	22	23	19	19	17	15
2.	INDUSTRIAL PROCESSES	8 091	8 449	8 976	9 319	7 474	8 379
2.A.1	Cement Production	1 797	1 954	2 131	2 133	1 799	1 622
2.A.2	Lime Production	579	570	596	621	507	574
2.A.3	Limestone and Dolomite Use	247	253	268	269	211	287

	Category	2005	2006	2007	2008	2009	2010
2.A.7.a	Bricks and Tiles (decarbonizing)	128	130	130	110	94	81
2.A.7.b	Sinter Production	310	312	329	332	244	314
2.A.7.c	Glass Production	35	37	40	44	41	40
2.C.1.a	Steel	763	778	826	820	614	792
2.C.1.b	Pig Iron	4 186	4 366	4 598	4 934	3 924	4 622
2.C.1.e.1	Electric furnace steel plant	45	49	58	57	42	47

¹⁾ Source: UMWELTBUNDESAMT, ECRA (2006-2011). These data do not include N₂O emissions from nitric acid production.

CO₂ emission factors reported within the ETS

Table 29 and Table 30 show the implied CO₂ emission 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 CO₂ emissions are rounded to the nearest ton whereas reported fuel consumption is not rounded.

Table 29: 2010 CO₂ 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	92.90	96.63	103.93	108.92	55.56	55.18
010101 Public Power plants >= 300 MW _{th}	93.31	-	-	-	-	55.40
010102 Public Power plants >= 50 MW _{th} < 300 MW _{th}	-	-	-	-	-	55.40
010103 Public Power plants <= 50 MW _{th}	-	-	-	-	-	55.40
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	-	53.63
010504 Other Energy Industries – Gas Turbines	-	-	-	-	-	55.40
020103 Commercial plants < 50 MW _{th}	-	-	-	-	-	55.40
0301 Industry – Steel	-	-	-	-	-	55.40
0301 Industry – Non ferrous metals	-	-	-	-	-	-
0301 Industry – Chemicals	94.12	-	-	-	73.03	55.40
0301 Industry – Pulp and Paper	91.75	-	-	-	55.94	55.40
0301 Industry – Food and Beverages	98.32	-	104.01	98.36	45.67	55.40
03010 Industry – Other	-	-	-	-	14.34	55.40
030311 Cement kilns	90.66	96.43	-	98.01	65.23	55.41
030312 Lime kilns	-	98.32	-	92.85	-	55.40
030317 Glass	-	-	-	-	-	55.40
030319 Bricks and Tiles	-	100.81	104.00	98.87	43.21	55.40
030323 Dolomite Treatment	-	-	-	94.74	-	55.40
030326 Integrated Iron & Steel works	90.65	-	103.93	-	80.73	55.14

Table 30: 2010 CO₂ implied emission factors calculated from ETS data. Oil products.

SNAP	203B light fuel oil	203C Medium fuel oil	203D Heavy fuel oil	204A Gasoil	2050 Diesel	224A other liquid	303A LPG
Weighted average	77.60	78.00	79.04	75.00	73.42	79.99	64.00
010101 Public Power plants >= 300 MW _{th}	76.55	-	78.73	75.48	73.65	-	-
010102 Public Power plants >= 50 MW _{th} < 300 MW _{th}	-	-	-	-	-	-	-
010103 Public Power plants <= 50 MW _{th}	-	-	-	-	-	-	-
010201 Public District Heating plants >= 300 MW _{th}	-	-	80.00	74.99	70.20	-	-
010202 Public District Heating plants >= 50 MW _{th} < 300 MW _{th}	77.00	78.00	78.30	74.67	52.27	-	-
010203 Public District Heating plants < 50 MW _{th}	63.11	-	80.00	75.03	-	-	64.04
010301 Refinery	-	-	-	-	-	80.48	-
010504 Other Energy Industries – Gas Turbines	-	-	-	-	-	-	-
020103 Commercial plants < 50 MW _{th}	-	-	-	77.72	0.00	-	-
0301 Industry – Steel	-	-	-	-	-	-	-
0301 Industry – Non ferrous metals	-	-	-	-	-	-	-
0301 Industry – Chemicals	-	-	82.22	-	73.09	68.22	-
0301 Industry – Pulp and Paper	77.70	-	78.74	74.61	74.17	-	-
0301 Industry – Food and Beverages	-	-	-	71.73	72.12	-	-
03010 Industry – Other	78.00	-	78.41	75.94	76.07	71.03	-
030311 Cement kilns	78.07	-	77.98	75.05	-	-	-
030312 Lime kilns	-	-	78.00	74.40	-	-	-
030317 Glass	78.00	-	-	76.04	67.02	-	-
030319 Bricks and Tiles	78.08	-	78.00	75.02	0.00	82.36	63.99
030323 Dolomite Treatment	74.09	-	-	-	84.87	99.92	64.27
030326 Integrated Iron & Steel works	78.10	-	79.28	-	-	-	-

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 2011) 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: CO₂ 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 17% for the year 2010. The increased CH₄ 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 2005–2010 CO₂ emissions from plants having a total boiler capacity of ≥ 20 MW_{th} are taken from ETS reports and CO₂ 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 3.2.3.

Emission factors

National emission factors for CO₂ and CH₄ are taken from (BMWA-EB, 1990, 1996, (UMWELT-BUNDESAMT 2001a) and (GEMIS, 2002). N₂O-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 CO₂ emission factor for municipal solid waste is taken from (ABFALLWIRTSCHAFT 2003).

Table 31: Emission factors of Category 1.A.1a for the year 2010.

Fuel	Default CO ₂ [t/TJ]	CH ₄ [kg/TJ]	N ₂ O [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
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

Fuel	Default CO ₂ [t/TJ]	CH ₄ [kg/TJ]	N ₂ O [kg/TJ]
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 CO₂ emissions from biomass.

²⁾ According to IPCC guidelines non fossil CO₂ emissions of "other fuels" are not reported.

Activity data

Total fuel consumption of Category 1.A.1.a is taken from (IEA JQ 2011) 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. The year 2010 shows a historic maximum of about 20 TWh electricity and 73 PJ district heat production from fuel combustion.

Table 32: 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	24 427
1991	43 497	30 268	13 229	0	0	0	29 038
1992	42 848	33 530	9 318	0	0	0	27 601
1993	44 809	35 070	9 738	0	1	0	30 428
1994	44 804	34 078	10 725	0	1	0	30 729
1995	47 580	35 431	12 147	0	1	1	34 426
1996	45 953	32 892	13 055	0	1	5	44 483
1997	47 527	34 532	12 973	0	2	20	40 597
1998	47 789	35 596	12 146	0	2	45	43 415
1999	52 192	39 593	12 546	0	2	51	42 465
2000	52 810	41 131	11 609	0	3	67	42 197

	Public gross electricity production [GWh]						Public Heat Production [TJ] by Combustible Fuels
	Total	Hydro ¹⁾	Combustible Fuels	Geothermal	Solar	Wind	
2001	53 763	39 681	13 972	0	5	105	44 575
2002	54 385	40 597	13 636	3	9	140	45 056
2003	52 508	34 230	17 888	3	15	372	48 896
2004	56 050	37 700	17 396	2	18	934	51 786
2005	58 097	37 787	18 956	2	21	1 331	56 987
2006	56 075	37 089	17 209	3	22	1 752	55 119
2007	55 914	38 066	15 785	2	24	2 037	54 600
2008	57 951	39 481	16 427	2	30	2 011	61 628
2009	60 642	42 424	16 199	2	49	1 968	63 487
2010	61 768	40 521	19 093	1	89	2 064	73 063

¹⁾ including pumped storage; Source: STATISTIK AUSTRIA 2011

As shown in Table 33 electricity supply increased by 10 310 GWh since 2000 of which approx. 80% has been supplied by additional imports until 2008. The year 2009 shows falling electricity consumption (supply) but an increase of production, mainly by hydro power.

Table 33: Electricity supply, gross production imports, exports and net imports [GWh].

	Electricity [GWh]				
	Supply ¹⁾	Gross production ²⁾	Imports	Exports	Net Imports
1990	46 489	50 294	6 839	7 298	-459
1991	48 793	51 483	8 503	7 738	765
1992	48 197	51 190	9 175	8 621	554
1993	49 073	52 421	8 072	8 804	-732
1994	49 596	53 132	8 219	9 043	-824
1995	50 979	56 225	7 287	9 757	-2 470
1996	52 515	54 880	9 428	8 476	952
1997	53 069	56 704	9 008	9 775	-767
1998	54 039	57 001	10 304	10 467	-163
1999	55 167	60 944	11 608	13 507	-1 899
2000	55 750	61 257	13 824	15 192	-1 368
2001	58 338	62 449	14 467	14 252	215
2002	58 074	62 499	15 375	14 676	699
2003	60 058	60 174	19 003	13 389	5 614
2004	61 320	64 151	16 629	13 548	3 081
2005	62 865	66 409	20 397	17 732	2 665
2006	65 595	64 499	21 257	14 407	6 850
2007	66 706	64 757	22 130	15 511	6 619
2008	66 144	66 877	19 796	14 933	4 863
2009	63 614	69 088	19 542	18 762	780
2010	66 060	71 127	19 898	17 567	2 331

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 which data is used for the years 1990 to 2007. 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. Large point source activity data from 2005 onwards is considered from ETS reporting.

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: CO₂ from gaseous and liquid fuels

Category 1 A 1 b *Petroleum Refining* enfolds CO₂ and N₂O emissions from fuel combustion, flaring and thermal cracking of the only petroleum refining plant in Austria. CH₄ emissions are included in category 1 B 2 a *Fugitive Emissions from Fuels – Oil*. Since 2003 the plant has been upgraded which increases CO₂ 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 4.3% for the year 2010. Crude oil input was 8 Mio t in 1990 and 7.7 Mio t in 2010.

Methodology

The IPCC Tier 2 bottom up methodology is used. Activity data is multiplied by emission factors. For calculation of CO₂ emissions plant specific emission factors are used. For calculation of N₂O 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 34: 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 CO₂ emissions are calculated by multiplying activity data from the energy balance by the emission factors in Table 34. CO₂ emissions 2002 to 2005 are reported by the Austrian Association of Mineral Oil Industries, they 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 CO₂ emissions are disaggregated to the IEA fuel types (see column “Associated IEA-fuels”) by using default emission factors for industrial boilers, subtracting the calculated CO₂ emissions from total CO₂ emissions, and associating remaining CO₂ emissions to refinery gas. The resulting IEF for refinery gas is presented in Table 35. The IEF fluctuations reflect changes in refinery gas composition.

Table 35: Implied emission factors for refinery gas.

Year	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	57.0
2000	51.9
2001	52.2
2002	74.7
2003	76.5
2004	95.7
2005	74.1
2006	60.5
2007	55.7
2008	61.1
2009	60.2
2010	63.0

N₂O emissions are calculated by multiplying fuel consumption by the emission factors presented in Table 36 (they are selected according to chapter 3.2.7).

No combustion specific CH₄ emissions are reported for this category, process-specific CH₄ 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 36: Emission factors of Category 1.A.1.b.

Fuel	CO ₂ [t/TJ]	N ₂ O [kg/TJ]
Residual Fuel Oil	80.00	0.60
Gas oil	75.00	0.60
Diesel	78.00	0.60
Petroleum	78.00	0.60
Jet Gasoline	78.00	0.60
Other Oil Products	78.00	0.60
LPG	64.00	1.00
Petrol Coke	100.88	–
Natural Gas	55.40	0.10

Activity data

Fuel consumption is taken from (IEA JQ 2011) 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 37: Refinery input/output mass balance.

Material flow [kt]	1990	1995	2000	2005	2006	2007	2008	2009	2010
Total Input	9 062	9 244	8 887	9 374	9 129	9 189	9 438	9 096	8 352
Crude oil	7 952	8 619	8 240	8 778	8 513	8 496	8 710	8 286	7 719
NGL	41	43	107	43	47	184	80	130	134
Feedstocks	1 069	582	541	526	470	348	406	461	317
Biofuel (blending)	-	-	-	27	99	161	242	219	181
Total Output	8 881	9 025	8 658	9 222	8 994	9 031	9 159	8 904	8 137
Fuel oil	1 913	1 502	979	1 045	915	844	738	772	663
Gas oil	1 239	1 454	1 062	997	1 004	612	991	835	795
Diesel	1 531	1 920	2 662	2 931	2 780	2 976	3 108	3 164	2 741
Other Kerosene	31	8	1	1	1	1	3	3	3
Aviation kerosene	291	420	544	592	526	604	472	313	476
Aviation gasoline	-	-	-	0	0	0	0	0	0
Motör gasoline	2 631	2 271	1 815	1 798	1 615	1 704	1 684	1 652	1 436
White spirit	-	5	-	0	0	0	0	64	70
Bitumen	269	254	343	466	392	411	444	420	292
Other petrolium products	499	761	859	873	1 215	1 276	1 131	1 154	1 163
LPG	47	60	34	143	91	113	138	137	87
Refinery gas	373	305	312	309	390	417	383	324	347
Petroleum Coke	57	66	48	66	65	73	66	67	62
Input-Output	180	219	230	152	134	158	280	192	215

Recalculations

Revisions of gaseous and liquid fuels activity data for the years since 1999 follows the revisions of the energy balance. The change in gaseous fuel activity data is -2.2 PJ for 1999 and +7.4 PJ for 2010. This results in a revision of N₂O emissions with a maximum of + 0.8 Gg CO₂ equivalent) in 2008.

Planned improvements

No improvements are planned.

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

Key Source: CO₂ from gaseous fuels

Category 1.A.1.c *Manufacture of Solid Fuels and Other Energy Industries* enfold emissions from fuel combustion in the oil and gas extraction sector (reported by companies as 'own use'), compressors used for natural gas storage tanks and fuel use of gas processing facilities ("gas refineries"). For 1990 to 1995 transformation losses/own use in gas works are included too. The share in sector 1 A overall GHG emissions is 0.9% for the year 1990 and 1.1% for the year 2010.

Methodology

CORINAIR simple methodology is applied.

For 2005 to 2010 CO₂ emissions and activity data of natural gas storage compressors are taken from ETS data.

Emission factors

CO₂ and CH₄ emission factors are taken from studies (BMW-EB 1990, 1996).

The N₂O emission factor is taken from a national study (BMUJF 1994).

Table 38: Emission factors of Category 1.A.1.c.

Fuel	CO ₂ [t/TJ]	CH ₄ [kg/TJ]	N ₂ O [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 2011) 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 2011) 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 2011).

Recalculations

Changes of natural gas activity data are based on energy balance recalculation as described in Annex 2. The effects in GHG emissions is +85 Gg CO₂ in the year 2009 and up to +193 Gg CO₂ for the years 2002 to 2005.

3.2.7.4 1.A.2.a Iron and Steel

Key Source: CO₂ 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. CO₂ 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 9.2% for the year 2010.

Methodology

Two iron and steel production sites (the only operating blast furnaces in Austria) are considered as point sources. For 1990 to 2002 CO₂ 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 CO₂ emissions from total integrated steel plants' CO₂ emissions is explained in the methodology chapter of category *2.C.1*.

CO₂, NMVOC, CO, NO_x and SO₂ 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 CO₂ emission factors taken from (BMWA-EB 1996) are applied. The remaining CO₂ 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 2011). The complex carbon fluxes in iron and steel plants cannot be well modelled within the energy balance which leads to a fluctuation of implied CO₂ emission factors for *1 A 2 a* solid fuels over time. CO₂ emissions 2005 to 2010 are reported from plant operators. The emissions declaration includes emissions from natural gas consumption not included in the ETS.

N₂O emissions of the two iron and steel plants are calculated with the CORINAIR simple methodology.

CH₄ emissions are calculated under the assumption that the ratio of CH₄ emissions to the reported NMVOC emissions is equal to the ratio of CH₄ 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 CH₄ emissions were estimated to be 80 t. In a last step CH₄ emissions were allocated to the different fuel types.

Point source CO₂ emissions 2003 and 2004

Since for the years 2003 and 2004 no point source CO₂ 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. CO₂ emissions from coke ovens (2004: 285 Gg) are estimated by means of coke oven output and an emission factor of 0.2 t CO₂/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 CO₂ emissions from blast furnaces are reported under category *2.C.1*.

Table 39: Greenhouse gas emissions from Category 1.A.2.a by sub sources.

	other sources			Integrated steel plants		
	CO ₂ [Gg]	CH ₄ [Gg]	N ₂ O [Gg]	CO ₂ [Gg]	CH ₄ [Gg]	N ₂ O [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	303	0.008	0.001	4 889	0.028	0.052
2002	397	0.011	0.001	5 118	0.027	0.052
2003	368	0.010	0.001	5 263	0.068	0.053
2004	300	0.008	0.001	5 557	0.081	0.054
2005	460	0.012	0.002	6 003	0.089	0.057
2006	507	0.014	0.002	5 851	0.095	0.060
2007	390	0.011	0.001	5 927	0.090	0.062
2008	403	0.011	0.002	5 796	0.081	0.059
2009	620	0.016	0.004	4 471	0.078	0.046
2010	252	0.007	0.001	5 583	0.074	0.057

Emission factors

CO₂ and CH₄ emission factors are taken from studies (BMWA-EB 1990, 1996) and (UMWELT-BUNDESAMT 2002), N₂O emission factors are taken from the national study (BMUJF 1994).

The selected and calculated emission factors for 2010 are presented in Table 40 and Table 41.

Table 40: Emission factors of Category 1.A.2.a for 2010, area sources.

Fuel	CO ₂ [t/TJ]	CH ₄ [kg/TJ]	N ₂ O [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 CO₂ emissions from biomass.

Table 41: Emission factors of Category 1.A.2.a for 2010, point sources.

Fuel	CO ₂ [t/TJ]	CH ₄ [kg/TJ]	N ₂ O [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 2011) as presented in Annex 4.

Point source activity data are reported by plant operators which are widely consistent with (IEA JQ 2011).

Recalculations

The update of activity data according to the revised energy balance as described in Annex 2 resulted in a shift of 168 Gg CO₂ to category 2.C.1 for the year 2009 (following the revision of the energy balance regarding non energy use of coke oven coke used in blast furnaces). Recalculations in the year 2004 are due to a revised natural gas consumption according to the revised energy balance and result in +130 Gg CO₂ emissions.

3.2.7.5 1.A.2.b Non-Ferrous Metals

Key Source: CO₂ from 1.A.2 gaseous, solid and liquid-stationary fuels

Category 1.A.2.b *Non-Ferrous Metals* enfolds emissions from fuel combustion in non ferrous metal industry. The share in total GHG emissions from sector 1.A is 0.2% for the year 1990 and 0.4% for the year 2010.

Methodology

CORINAIR simple methodology is applied. Fuel consumption is taken from (IEA JQ 2011) as described in Annex 4.

CO₂ and CH₄ emission factors are taken from studies (BMWA-EB 1990, 1996) and (UMWELT-BUNDESAMT 2002).

N₂O emission factors are taken from a national study (BMUJF 1994).

The emission factors for 2010 are presented in the following table.

Table 42: Emission factors of Category 1.A.2.b for 2010.

Fuel	CO ₂ [t/TJ]	CH ₄ [kg/TJ]	N ₂ O [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 2011) as presented in Annex 4.

Recalculations

Minor changes of activity data are based on a recalculation of the energy balance as described in Annex 2 and result in +3 Gg CO₂ emissions from natural gas in the year 2009.

3.2.7.6 1.A.2.c Chemicals

Key Source: CO₂ 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 2010. 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 2010 CO₂ ETS data are considered.

CO₂ emissions from industrial waste: Table 43 shows the composition of the implied emissions factor 2000–2010 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 CO₂ 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 CO₂ 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 43: Composition of 1.A.2.c Chemical industries – industrial waste – CO₂ IEF for the years 2000 to 2010.

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	52.97
2005	5 670	1 500	104.17	378	70.62	3 792	52.09	67.10
2006	4 707	1 500	104.17	560	74.59	2 647	52.09	71.36
2007	3 204	1 500	104.17	528	75.01	1 177	52.09	80.24
2008	4 088	1 500	104.17	329	77.11	2 259	52.09	73.21
2009	3 324	1 500	104.17	480	43.09	1 345	52.09	74.29
2010	4 350	1 500	104.17	293	73.03	2 558	52.09	71.45

¹⁾ For 2000 to 2004 the value of 2005 has been selected.

Emission factors

CO₂ and CH₄ emission factors are taken from studies (BMWA-EB 1990, 1996) and (UMWELT-BUNDESAMT 2002). N₂O emission factors are taken from a national study (BMUJF 1994).

Table 44: Emission factors of Category 1 A 2 c for 2010.

Fuel	CO ₂ [t/TJ]	CH ₄ [kg/TJ]	N ₂ O [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	71.45 ³⁾	12.00	1.40

¹⁾ Reported as CO₂ emissions from biomass

²⁾ According to IPCC guidelines non fossil CO₂ 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 2011) 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 are due to revision of the energy balance and mainly affect CO₂ emissions from liquid fuels (+47 Gg CO₂ in 2009).

3.2.7.7 1.A.2.d Pulp, Paper and Print

Key Source: CO₂ 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 3.5% for the year 2010.

Methodology

The CORINAIR simple methodology is applied. For the years 2005 to 2010 CO₂ ETS data are considered.

CO₂ emissions from industrial waste: The following Table 45 shows the composition of the implied emissions factor 2000-2010 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 CO₂ 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 45: Composition of 1.A.2.d Pulp, Paper and Print – industrial waste – CO₂ IEF for the years 2000 to 2010.

Year	Total energy use (energy balance)	ETS		CO ₂ IEF	CO ₂
	[TJ]	[TJ]	CO ₂ IEF	[t/TJ]	[Gg]
2000	0			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	88	111	64.29	64.29	7.15
2006	66	149	43.85	43.85	6.53
2007	177	170	65.52	65.52	11.14
2008	96	130	68.42	68.42	8.92
2009	141	118	74.65	74.65	8.79
2010	272	142	55.94	55.94	7.93

Emission factors

CO₂ and CH₄ emission factors are taken from studies (BMW-EB 1990, 1996) and (UMWELT-BUNDESAMT 2002). N₂O emission factors are taken from a national study (BMUJF 1994).

Emission factors for 2010 are presented in the following table.

Table 46: Emission factors of Category 1.A.2.d for 2010.

Fuel	CO ₂ [t/TJ]	CH ₄ [kg/TJ]	N ₂ O [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 CO₂ emissions from biomass

²⁾ Including sewage sludge from paper mills

³⁾ According to IPCC guidelines non fossil CO₂ emissions of "other fuels" are not reported.

Activity data

Fuel consumption is taken from (IEA JQ 2011) as presented in Annex 4.

Recalculations

Changes of activity data are based on a recalculation of the energy balance as described in Annex 2. The most important recalculation for the year 2009 is -93 Gg CO₂ from natural gas.

3.2.7.8 1.A.2.e Food Processing, Beverages and Tobacco

Key Source: CO₂ from 1.A.2 gaseous, solid and liquid-stationary fuels

Category 1.A.2.e Food Processing, Beverages and Tobacco enfold 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 1.6% for the year 2010.

Methodology

CORINAIR simple methodology is applied. For the years 2005 to 2019 CO₂ ETS data are considered.

Emission factors

CO₂ and CH₄ emission factors are taken from studies (BMWA-EB 1990, 1996) and (UMWELT-BUNDESAMT 2002). N₂O emission factors are taken from a national study (BMUJF 1994).

Emission factors for 2010 are presented in the following table.

Table 47: Emission factors of Category 1.A.2.e for 2010.

Fuel	CO ₂ [t/TJ]	CH ₄ [kg/TJ]	N ₂ O [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 CO₂ emissions from biomass

²⁾ According to IPCC guidelines non fossil CO₂ emissions of "other fuels" are not reported.

Activity data

Fuel consumption is taken from (IEA JQ 2011) 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 the following changes in 2009 emissions: +31 Gg CO₂ from liquid fuels and +34 Gg CO₂ from gaseous fuels.

3.2.7.9 1.A.2.f Manufacturing Industries and Construction – Other

Key Source: CO₂ from 1.A.2 gaseous, solid and liquid-stationary fuels

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

The share in total GHG emissions from Sector 1.A is 6.7% for the year 1990 and 7.6% for the year 2010. N₂O emissions mainly arise from mobile machinery (1990: 66%; 2010: 62%).

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 6.7% for the year 1990 and 7.6% for the year 2010.

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*. Between 2008 and 2010 clinker production was falling by 23% from 4 mio t to 3.1 mio t.

Methodology

Information about CO₂ 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, 2009, 2010, 2011). 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 2010.

For the studies mentioned above CO₂ 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 CO₂ in the waste gas flow were calculated. With the average flow of dry waste gas the plant specific CO₂ emission mass stream and consequently the plant specific emission factors (normalized to ton clinker and/ or ton cement) were calculated.

CO₂ 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 CO₂ emissions are calculated by multiplying activity data by national default emission factors (for sources of emission factors see relating chapter). The remaining CO₂ emissions are allocated to industrial waste.

CO₂ emissions 2004 to 2010 are taken from the ETS allocation plan survey and ETS data.

CH₄ and N₂O 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 3.75 GJ/t clinker in 2010.

Hard Coal, Brown Coal, Petrol Coke and Industrial Waste

In (IEA JQ 2011) the category *Non-metallic Mineral Products* enfoldes 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 petrol coke until 2001 but from 2002 on a share is allocated to magnesia production from dolomite by using ETS data. The following table shows the amount, NVCs and CO₂ 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 and 82.83 t CO₂/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 explicitly 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: glycerine, carcass meal, animal fat, sewage sludge, paper fibre residue and sawdust.

Table 48: Industrial waste used as fuel in cement kilns 1990-2010.

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	-	-

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				
2004	-	257	22.07	63.36	-	-
2005	58	204	23.28	68.92	10.32	79.25
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
2009	33	331	20.29	61.41	21.42	82.83
2010	62	293	21.89	65.23	18.59	83.82

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 2011).

Activity data 2005–2010

For the years 2005–2010 ETS data are taken.

Emission factors

CO₂ and CH₄ emission factors are taken from studies (BMW-EB 1990, 1996).

N₂O 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 2010 ETS data is considered for glass, bricks & tiles and lime manufacturing plants.

Activity data

Fuel consumption is taken from (IEA JQ 2011) 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 2011) 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 2011).

Emission factors

CO₂ and CH₄ emission factors are taken from studies (BMW-EB 1990, 1996) and (UMWELT-BUNDESAMT 2002). N₂O emission factors are taken from a national study (BMUJF 1994).

The emission factors for 2010 are presented in the following table.

Table 49: Emission factors of Category 1.A.2.f stationary sources for 2010.

Fuel	CO ₂ [t/TJ]	CH ₄ [kg/TJ]	N ₂ O [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	65.23 ³⁾	12.00	1.40

¹⁾ Reported as CO₂ emissions from biomass

²⁾ According to IPCC guidelines non fossil CO₂ 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 2009 mainly affect CO₂ emissions from natural gas (+276 Gg CO₂) and liquid fuels (+109 Gg CO₂).

For 2005 to 2009 the non energy use of natural gas which could not be allocated to process emissions under 2.B.1 Ammonia Production is now considered under 1.A.2.f Other Manufacturing Industries. This is due to a personal communication from Statistik Austria that non energy use includes additional use.

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

In the following chapter 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 2 f (*mobile off-road sources*) is 0.5% for the year 1990 and 1.8% for the year 2010. All GHG emissions originate from liquid fossil fuel combustion.

Table 50: Greenhouse gas emissions from Category 1 A 2 f mobile sources 1990-2010.

	CO ₂ [Gg]	CH ₄ [Gg]	N ₂ O [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	565
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	1 220
2009	1 108	0.03	0.21	1 173
2010	1 069	0.02	0.19	1 130
<i>Trend 1990–2010</i>	318.1%	83.2%	116.4%	298.1%

Combustion of liquid fossil fuels is the only mobile source of CO₂ emissions from category 1 A 2 f.

In 2010, the total of avoided fossil CO₂ emissions by the use of biofuels amounted to 1.709 Gg in Austria. 5% of these emissions are attached to mobile off-road sources in the industry sector.

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. lead-ers, diggers, ...) were taken from:

- Statistik Austria (fuel statistics),
- Questionnaire to vehicle and machinery users,
- Information from vehicle and machinery manufacturers,
- 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 51: Implied emission factors and activities for industrial off-road traffic 1990–2010.

	Activity	Implied Emission Factors		
	TJ	CO ₂ t/TJ	CH ₄ kg/TJ	N ₂ O 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

	Activity	Implied Emission Factors		
	TJ	CO ₂ t/TJ	CH ₄ kg/TJ	N ₂ O kg/TJ
1996	5 991	73.85	3.43	28.49
1997	5 675	73.85	3.41	28.73
1998	6 673	73.84	3.31	29.26
1999	6 393	73.67	3.28	29.39
2000	7 467	73.67	3.22	29.73
2001	7 027	73.67	3.22	29.79
2002	6 830	73.67	3.11	29.21
2003	7 259	73.67	2.69	26.78
2004	8 041	73.67	2.48	22.80
2005	11 010	73.69	2.08	18.77
2006	13 260	73.66	1.93	17.01
2007	14 276	73.66	1.81	15.35
2008	15 635	73.66	1.73	13.97
2009	15 042	73.66	1.73	13.84
2010	14 516	73.66	1.71	13.43

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 52 to Table 55. These implied emission factors represent emissions according to the engine power output and also fuel consumption.

Table 52: Implied emission factors for diesel engines > 80 kW.

Year	CO ₂ [t/TJ]	CH ₄ [kg/TJ]	N ₂ O
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 53: Implied emission factors for diesel engines < 80 kW.

Year	CO ₂ [t/TJ]	CH ₄ [kg/TJ]	N ₂ O
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 54: Implied emission factors for 4-stroke-petrol engines.

Year	CO ₂	CH ₄	N ₂ O
	[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 55: Implied emission factors for 2-stroke-petrol engines.

Year	CO ₂	CH ₄	N ₂ O
	[t/TJ]	[kg/TJ]	
1993	647.24	695.28	4.11
2001	588.25	489.03	4.11
2003	572.05	461.94	4.11
2006	437.92	141.67	3.89

Recalculations

Activity data of off-road mobile machinery (especially in industry) has been updated for the whole time series and adjusted downwards according to the revised national energy balance (STATISTIK AUSTRIA 2011c).

3.2.7.10 1.A.3.a Civil Aviation

Key Source: No

Greenhouse gas emissions from national aviation are very low in comparison to total emissions from the transport sector and amounted to 0.1% in 2010. Especially between 1999 and 2005 there is no constant trend of activity data and GHG emissions respectively, which is due to a different methodology of emissions estimation that has been applied since 2000.

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 *1 B Av International Bunkers Aviation*. Military Aviation is allocated in *1 A 5 Other*. For VFR only CO₂ emissions were considered.

Table 56: Activity data 1 A 3 a Civil Aviation by subcategories 1990–2010.

Year	Activity		
	dom. LTO	dom. LTO	dom. cruise
	Kerosene [TJ]	Gasoline [TJ]	Kerosene [TJ]
1990	138	108	197
1991	149	112	259
1992	160	115	321
1993	171	119	382
1994	182	122	444
1995	192	97	503
1996	223	93	559

Year	Activity		
	dom. LTO	dom. LTO	dom. cruise
	Kerosene [TJ]	Gasoline [TJ]	Kerosene [TJ]
1997	253	105	614
1998	283	113	668
1999	290	120	705
2000	265	88	571
2001	217	81	527
2002	226	103	525
2003	221	112	526
2004	237	104	543
2005	225	121	571
2006	269	124	593
2007	274	124	614
2008	305	127	540
2009	280	141	506
2010	267	126	480

Table 57: CO₂, N₂O and CH₄ emissions from 1 A 3 a Civil Aviation by subcategories 1990–2010.

Year	CO ₂			N ₂ O		CH ₄		
	dom. LTO	dom. LTO	dom. cruise	dom. LTO	dom. cruise	dom. LTO	dom. LTO	dom. LTO
	Kerosene [Gg]	Gasoline [Gg]	Kerosene [Gg]	Kerosene [Gg]	Kerosene [Gg]	Gasoline [Gg]	Kerosene [Gg]	Gasoline [Gg]
1990	10.0	7.8	14.2	0.0006	0.0005	0.0002	0.002	0.0001
1991	10.8	8.1	18.7	0.0007	0.0006	0.0002	0.002	0.0001
1992	11.6	8.3	23.2	0.0007	0.0007	0.0002	0.002	0.0001
1993	12.4	8.6	27.6	0.0008	0.0009	0.0002	0.002	0.0001
1994	13.2	8.8	32.1	0.0008	0.0010	0.0002	0.002	0.0001
1995	14.0	7.1	36.6	0.0009	0.0012	0.0002	0.002	0.0000
1996	16.2	6.8	40.6	0.0010	0.0013	0.0002	0.003	0.0000
1997	18.4	7.6	44.5	0.0011	0.0014	0.0002	0.004	0.0001
1998	20.6	8.2	48.5	0.0012	0.0015	0.0002	0.005	0.0001
1999	21.1	8.7	51.3	0.0012	0.0016	0.0002	0.005	0.0001
2000	19.3	6.4	41.6	0.0023	0.0013	0.0002	0.005	0.0000
2001	15.8	5.9	38.4	0.0020	0.0012	0.0002	0.004	0.0000
2002	16.4	7.5	38.2	0.0021	0.0012	0.0002	0.004	0.0001
2003	16.1	8.2	38.3	0.0020	0.0012	0.0002	0.004	0.0001
2004	17.2	7.6	39.5	0.0020	0.0013	0.0002	0.004	0.0001
2005	16.4	8.8	41.6	0.0020	0.0013	0.0002	0.004	0.0001
2006	19.6	9.0	43.2	0.0021	0.0014	0.0002	0.005	0.0001
2007	20.0	9.0	44.7	0.0021	0.0014	0.0002	0.005	0.0001
2008	22.2	9.3	39.3	0.0021	0.0012	0.0003	0.006	0.0001
2009	20.4	10.3	36.8	0.0021	0.0012	0.0003	0.005	0.0001
2010	19.4	9.2	34.9	0.0021	0.0011	0.0003	0.005	0.0001

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 data³³ (flight distance and destination per aircraft type) and aircraft/engine performances data were used for the calculation.

For the years 2000–2010 the CORINAIR Tier 3a methodology was applied. Tier 3a takes into account average fuel consumption and emission data for LTO phases and various flight lengths, for an array of representative aircraft categories.

VFR

CORINAIR, simple methodology was applied.

Activity Data

IVR flights

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

For the years 2000–2010 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 types and flight distances. The fuel consumption of IFR international cruise was adjusted as explained above.

The number of flight movements per aircraft type and airport (national and international) was obtained from special analyses by Statistik Austria (STATISTIK AUSTRIA 2011a) and by Austro Control (AUSTRO CONTROL 2010). Moreover, for the calculation of passenger kilometres and ton kilometres input data was taken from the statistics of civil aviation (STATISTIK AUSTRIA 2011b). The total amount of jet kerosene and gasoline was taken from the energy balance (STATISTIK AUSTRIA 2011c).

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.

³³ This data is also used for the split between national and international aviation.

Table 58: Number of national IFR LTO cycles and fuel consumptions as obtained from the MEET model 1990–2010.

	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	2 938	12 475	21 457
2009	6 464	3 268	11 677	20 530
2010	6 159	2 920	11 074	20 532
<i>Trend 1990-2010</i>	95%	17%	146%	230%

Emission factors

CO₂

IFR / VFR

CO₂ 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 CO₂ emissions an emission factor of 3 150 kg CO₂/ Mg fuel has been used for IFR and VFR flights (CORINAIR, KALIVODA et al. 2002).

N₂O

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 N₂O/LTO for LTO and 0.1 kg N₂O/Mg fuel for cruise).

VFR

For N₂O 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.

CH₄*National/international cruise*

Following the simple methodology of the CORINAIR Guidebook, CH₄ emissions for national and international cruise are assumed to be Zero. Furthermore, for calculating CH₄ 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)

For the years 1990–1999 a country-specific methodology (consistent with the CORINAIR Tier 3b methodology), for the years 2000–2010 the CORINAIR Tier 3a methodology was applied.

To demonstrate that the deviation between the two methodologies is within an acceptable range, 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 method) and once calculated with the CORINAIR Tier 3a methodology (new method). The calculated deviation is within a tolerable range.

Table 59: Methodology dependent calculation of fuel consumption from 1 A 3 a Civil Aviation in 2000.

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%	-10%	-11%	-23%	8%

The peak of activity data and GHG emissions in 1999, followed by a decrease within two years by nearly 30% is an artefact due to the shortcomings of the method used from 1999 onwards. The old methodology reflects much better real-world effects, because this methodology is consistent with the very detailed CORINAIR Tier 3b methodology (advanced version based on (MEET 1999): air traffic movement data (flight distance and destination per aircraft type) and aircraft/engine performances data were used for the calculation. Due to budgetary constraints such a detailed study has not been repeated since then.

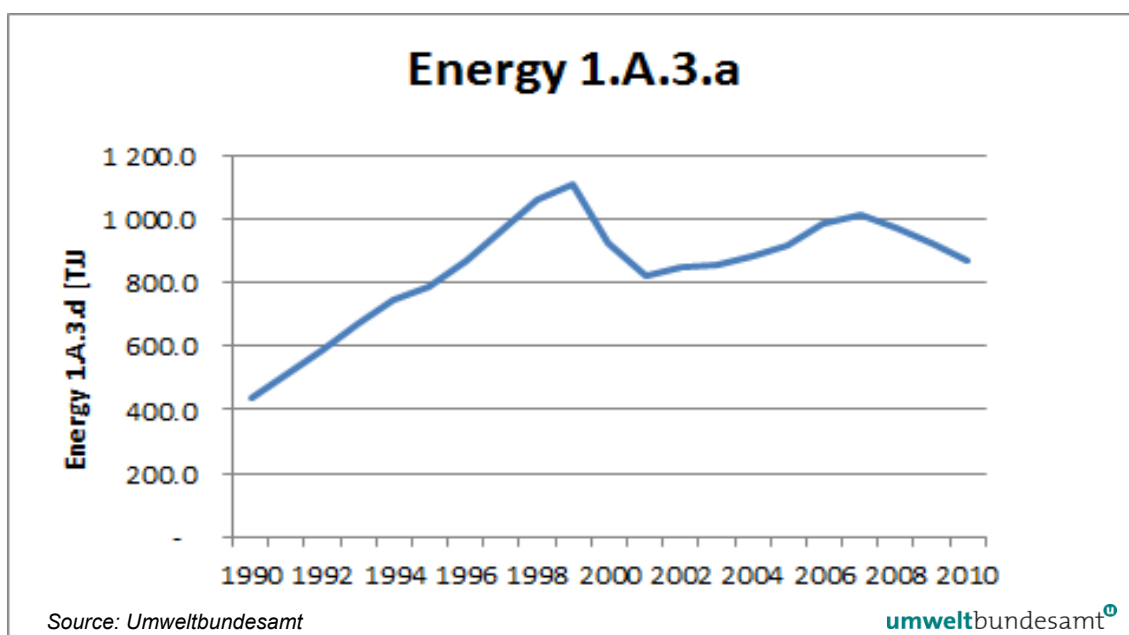


Figure 13: Activity data national aviation 1990–2010.

Recalculations

CH₄ and N₂O emissions are now reported also for aviation gasoline, leading to slightly revised emission data throughout the time-series (CH₄: + 0.0001, N₂O: 0.0003 in 2010).

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 (CO₂: diesel/gasoline)

Emissions from road transportation are covered in this category.

Table 60: Greenhouse gas emissions from Category 1 A3 b Road Transport 1990–2010.

	CO ₂ [Gg]	CH ₄ [Gg]	N ₂ O [Gg]	Gg CO ₂ equivalent
1990	13 324	3.05	0.56	13 561
1991	14 795	3.37	0.67	15 075
1992	14 770	3.36	0.71	15 061
1993	14 908	3.36	0.75	15 211
1994	14 958	3.28	0.80	15 275
1995	15 232	3.06	0.82	15 549
1996	16 792	2.75	0.85	17 112
1997	15 803	2.45	0.83	16 112
1998	17 781	2.40	0.93	18 118

	CO ₂ [Gg]	CH ₄ [Gg]	N ₂ O [Gg]	Gg CO ₂ equivalent
1999	17 163	2.08	0.90	17 486
2000	18 071	1.89	0.93	18 398
2001	19 416	1.77	0.96	19 749
2002	21 524	1.74	1.03	21 881
2003	23 274	1.64	1.07	23 641
2004	23 787	1.47	1.05	24 142
2005	24 069	1.31	1.02	24 412
2006	22 684	1.13	0.94	22 998
2007	22 883	0.99	0.89	23 179
2008	21 513	0.83	0.79	21 774
2009	20 894	0.74	0.73	21 136
2010	21 662	0.69	0.69	21 890
<i>Trend 1990–2010</i>	63%	-77%	23%	61%

Table 61: GHG emissions from Road Transport differentiated by means of transportation 1990–2010.

	Passenger cars		light duty vehicles	heavy duty vehicles	moped	motorcycle
	petrol	diesel				
	[Gg CO ₂ e]	[Gg CO ₂ e]	[Gg CO ₂ e]	[Gg CO ₂ e]	[Gg CO ₂ e]	[Gg CO ₂ e]
1990	7 465	1 403	1 309	3 320	31	34
1991	8 296	1 671	1 352	3 690	29	37
1992	7 956	1 759	1 394	3 884	27	41
1993	7 656	1 888	1 417	4 179	26	45
1994	7 404	2 108	1 471	4 216	25	50
1995	7 173	2 356	1 492	4 447	24	57
1996	6 640	2 576	1 510	6 301	23	63
1997	6 287	2 859	1 545	5 330	22	70
1998	6 628	3 356	1 589	6 445	22	78
1999	6 155	3 557	1 640	6 027	21	86
2000	5 964	3 906	1 688	6 730	20	91
2001	6 036	4 470	1 700	7 428	20	95
2002	6 558	5 429	1 696	8 079	19	100
2003	6 728	6 294	1 715	8 782	18	104
2004	6 538	6 882	1 740	8 857	18	107
2005	6 334	7 262	1 787	8 902	18	110
2006	6 067	7 252	1 808	7 740	17	113
2007	5 929	7 510	1 857	7 749	17	117
2008	5 329	7 239	1 810	7 261	17	119
2009	5 335	7 104	1 757	6 801	17	123
2010	5 248	6 974	1 771	7 753	16	127
<i>Trend 1990–2010</i>	-30%	397%	35%	134%	-47%	270%

In 2010, 54% of the total greenhouse gas emissions from *1 A 3 Transport* are caused by passenger cars (petrol and diesel) and one third by heavy duty vehicles. In comparison with the emissions of 1990 passenger cars caused 63% of total GHG emissions from *1 A 3 Transport*; heavy duty vehicles 49%.

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; HAUSBERGER 2010).

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, CO₂, SO₂ and several unregulated pollutants among them CH₄ and N₂O).

Figure 14 shows a schematic picture of the methodology of GLOBEMI.

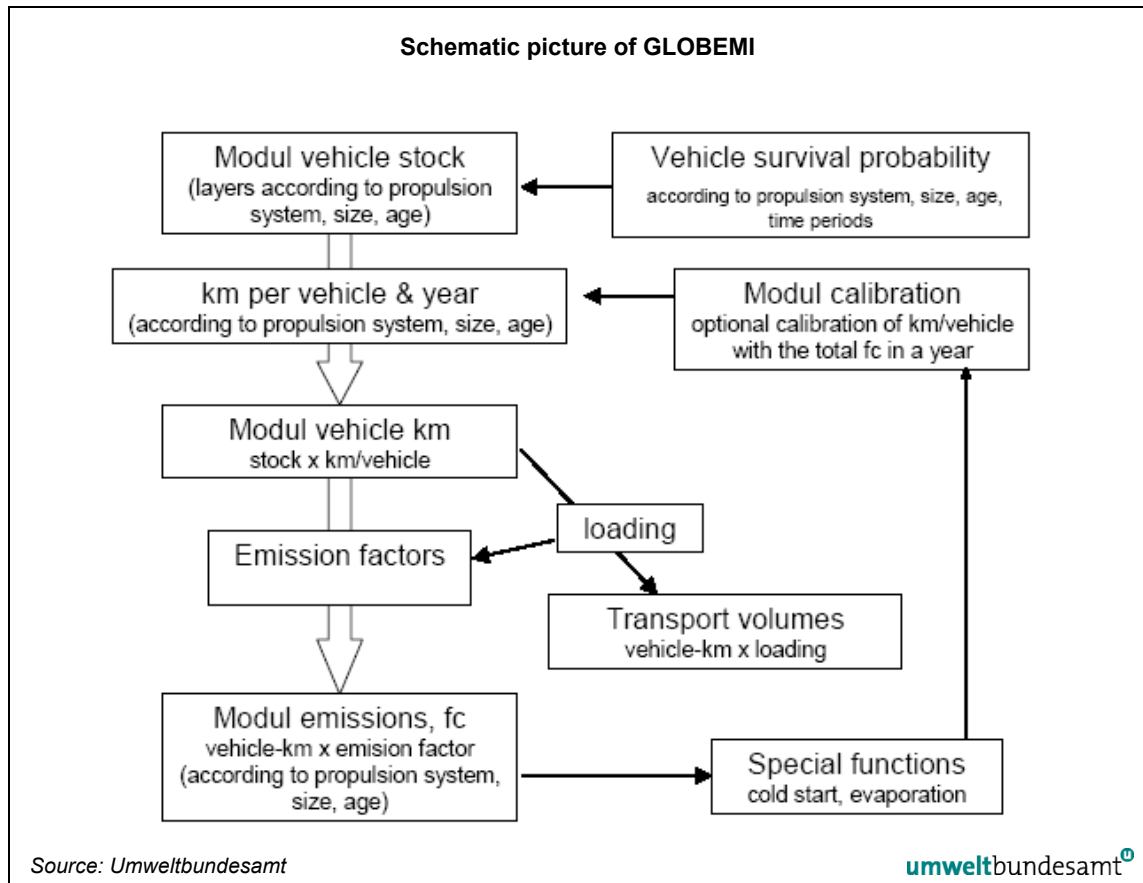


Figure 14: Schematic picture of the GLOBEMI model.

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.

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

- 2) Assessment of the km per vehicle for each vehicle layer using age and size dependent functions of the average mileage driven. If option switched on, iterative adaptation of the km per vehicle to meet the total fuel consumption targets.
- 3) Calculation of the total mileage of each emission category (e.g. passenger car diesel, <1500ccm, EURO 3)

$$\text{total mileage}_{E_i} = \sum_{Jg=\text{start}}^{\text{end}} (stock_{Jg, year\ i} \times km/vehicle_{Jg, year\ i})$$

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

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

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

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

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

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

7) Summation over all vehicle categories

with $Jg_{i..}$.. Index for a vehicle layer (defined size class, propulsion type, year of first registration)

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

Emission factors used for GLOBEMI are based on a representative number of vehicles and engines measured in real-world driving situations taken from the "Handbook of Emission Factors" (HBEFA) Version 2.1 (HAUSBERGER & KELLER et al. 1998) and on ARTEMIS measurements (basically for passenger cars, light duty vehicles and motorcycles) which are taken into account in HBEFA.

Activity data

Bottom up Methodology - fuel consumed

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

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.

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

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

Calculated total fuel consumption of road transport is summed up with total fuel consumption of off road traffic.

Top down Methodology – Fuel sold

The difference between the fuel consumption calculated in the bottom up methodology for traffic and off road transport within Austria and total fuel sales in Austria (obtained from national statistics; STATISTIK AUSTRIA 2011c) is allocated to fuel export (fuel sold in Austria but consumed abroad).

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

Biofuels

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 2010 a consumption of 502 000 tons of biodiesel, 61 000 tons of bioethanol (for blending with gasoline) and 17 000 tons of plant oil is used as input data for the calculation model based on the results of investigations on biodiesel in the transport sector in Austria (UMWELTBUNDESAMT 2011a).

In 2010 the energetic substitution by biofuels amounted to 7.4% in the road transport sector. Compared to 2005, the first year of blending biofuels, the substitution amounted to only 0.8% (UMWELTBUNDESAMT 2006b, UMWELTBUNDESAMT 2011a)

The following table gives an overview of the use of biofuels and the corresponding amount of substituted CO₂ emissions in the road transport sector between 2010 and 2005, the first year of blending biofuels in Austria.

Table 62: Substitution of CO₂ emissions in 1.A.3.b Road Transport by the use of biofuels in absolute figures 2005–2010.

	passenger cars	light duty vehicles	heavy duty vehicles
	[Gg CO₂]	[Gg CO₂]	[Gg CO₂]
2005	102	21	112
2006	365	82	380
2007	471	96	425
2008	672	111	453
2009	849	142	561
2010	810	133	589
<i>Trend 2005–2010</i>	696%	538%	425%

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 63: Implied emission factors of passenger cars 1990–2010.

	Activity	Implied Emission Factors		
		CO ₂	CH ₄	N ₂ O
	TJ	T/TJ	kg/TJ	kg/TJ
1990	116 480	80.06	18.92	3.93
1991	130 745	66.39	19.67	4.31
1992	127 195	76.57	20.42	4.68
1993	124 786	75.93	21.08	5.03
1994	124 159	74.86	20.94	5.46
1995	124 426	74.32	19.43	5.57
1996	120 204	77.06	17.61	5.73
1997	119 530	74.94	15.73	5.80
1998	130 514	68.13	14.11	5.88
1999	127 107	76.37	12.36	5.91
2000	129 182	73.12	10.85	5.93
2001	137 704	69.74	9.47	5.71
2002	157 188	65.11	8.24	5.47
2003	171 088	68.35	7.09	5.21
2004	176 773	71.96	6.01	4.92
2005	179 141	73.28	5.11	4.69
2006	177 050	75.21	4.32	4.40
2007	178 787	73.06	3.62	4.10
2008	167 133	78.97	3.07	3.87
2009	165 026	74.88	2.73	3.66
2010	162 230	75.46	2.46	3.45

The catalytic converter of former generation (EURO 1) had a higher N₂O-niveau than the catalysts of the newer generation (as of EURO 2). Therefore, since 1996 (implementation of EURO 2) the implied emission factor of N₂O is decreasing steadily.

The decrease of the IEF for CH₄ is also due to the increasing share of vehicles with catalytic converters and improved combustion technologies.

Table 64: Implied emission factors of light duty vehicles 1990–2010.

	Activity	Implied Emission Factors		
	TJ	CO ₂ T/TJ	CH ₄ kg/TJ	N ₂ O kg/TJ
1990	17 454	74.13	13.92	1.78
1991	18 037	74.12	12.91	1.83
1992	18 604	74.11	11.95	1.89
1993	18 906	74.09	11.19	1.94
1994	19 649	74.08	9.93	1.93
1995	19 973	73.95	8.75	1.91
1996	20 217	73.93	7.74	1.88
1997	20 703	73.91	6.72	1.84
1998	21 303	73.90	5.80	1.80
1999	22 041	73.75	4.95	1.76
2000	22 697	73.73	4.24	1.71
2001	22 874	73.72	3.66	1.68
2002	22 832	73.71	3.16	1.63
2003	23 091	73.71	2.69	1.60
2004	23 441	73.71	2.25	1.56
2005	24 063	73.73	2.04	1.56
2006	24 393	73.61	1.75	1.55
2007	25 054	73.62	1.40	1.50
2008	24 421	73.63	1.05	1.46
2009	23 713	73.64	0.85	1.43
2010	23 913	73.64	0.71	1.36

Table 65: Implied emission factors of heavy duty vehicles 1990–2010.

	Activity	CO ₂	CH ₄	N ₂ O
	TJ	T/TJ	kg/TJ	kg/TJ
1990	44 530	74.02	2.21	1.57
1991	49 502	74.02	2.08	1.55
1992	52 111	74.02	1.98	1.53
1993	56 073	74.02	1.89	1.51
1994	56 586	74.02	1.84	1.47
1995	59 828	73.85	1.78	1.42
1996	84 785	73.84	1.60	1.40
1997	71 731	73.84	1.53	1.38
1998	86 753	73.84	1.38	1.37
1999	81 312	73.67	1.30	1.35
2000	90 804	73.67	1.22	1.34
2001	100 256	73.67	1.15	1.29
2002	109 063	73.67	1.10	1.24
2003	118 575	73.67	1.06	1.20
2004	119 603	73.67	1.06	1.17
2005	120 193	73.68	1.05	1.16
2006	104 531	73.67	1.07	1.15
2007	104 677	73.67	1.04	1.11
2008	98 093	73.67	1.02	1.07
2009	91 900	73.67	1.04	1.00
2010	104 812	73.67	1.04	0.90

Table 66: Implied emission factors of mopeds 1990–2010.

	Activity	CO ₂	CH ₄	N ₂ O
	TJ	T/TJ	kg/TJ	kg/TJ
1990	277	74.30	1 753	0.68
1991	259	74.29	1 737	0.67
1992	248	74.29	1 682	0.65
1993	237	74.27	1 636	0.63
1994	229	74.25	1 575	0.61
1995	223	74.26	1 510	0.59
1996	219	74.21	1 445	0.56
1997	215	74.16	1 382	0.54
1998	213	74.15	1 309	0.51
1999	209	74.13	1 250	-
2000	203	74.10	1 208	-
2001	199	74.04	1 161	-
2002	193	74.04	1 121	-
2003	190	74.04	1 070	-
2004	186	74.07	1 026	-
2005	187	74.21	961	-
2006	191	72.97	882	-
2007	192	73.01	825	-
2008	189	73.06	785	-
2009	188	73.08	736	-
2010	185	73.08	698	-

Table 67: Implied emission factors of motorcycles 1990–2010.

	Activity	CO ₂	CH ₄	N ₂ O
	TJ	T/TJ	kg/TJ	kg/TJ
1990	456	74.30	35.3	0.877
1991	486	74.29	34.9	0.822
1992	541	74.29	34.4	0.739
1993	599	74.27	33.7	0.835
1994	670	74.25	33.2	0.896
1995	760	74.26	32.5	0.790
1996	843	74.21	31.9	0.830
1997	926	74.16	31.4	0.864
1998	1 036	74.15	30.9	0.869
1999	1 147	74.13	30.4	0.872
2000	1 212	74.10	29.8	0.825
2001	1 273	74.04	29.2	0.864
2002	1 335	74.04	28.6	0.899
2003	1 386	74.04	27.9	0.866
2004	1 424	74.07	27.2	0.842
2005	1 460	74.21	26.7	0.890
2006	1 534	72.97	25.4	0.847
2007	1 588	73.01	24.7	0.819
2008	1 616	73.06	24.4	0.805
2009	1 671	73.08	23.6	0.838
2010	1 721	73.08	23.0	0.829

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 CO₂ emission factors is estimated to be 3%.
- N₂O 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 N₂O 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 the quantity structure of road transport (result of new traffic census) resulted in an increase of the transport volume (+2%) and consequently of fuel consumption (+0.9%) in 2010 compared to the previous submission. These data has been generated from automatic vehicle counting checkpoints on highways.
- An adaption of out-dated age pattern and failure rates of the Austrian vehicle fleet according to actual fleet structure data from national statistics has lead to an adjustment of the Austrian inland fleet towards newer vehicles.
- Update of statistical energy data, particularly the biodiesel/alternative fuel consumption.
- Adaption of the specific CO₂ emission factors of passenger cars according to the national CO₂ monitoring data for the Austrian fleet (UMWELTBUNDESAMT 2011d).

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 68: Greenhouse gas emissions from Category 1 A 3 c Railways 1990–2010.

	CO ₂ [Gg]	CH ₄ [Gg]	N ₂ O [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	161	0.01	0.06
2006	156	0.01	0.06
2007	155	0.01	0.06
2008	153	0.01	0.06
2009	148	0.01	0.05
2010	149	0.01	0.05
<i>Trend 1990–2010</i>	-17%	-31%	-13%

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 69: Emission factors and activity data for railway 1990–2010.

	Activity	Implied Emission Factors		
		CO ₂	CH ₄	N ₂ O
	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
1999	1 830	74.03	3.55	26.15

	Activity	Implied Emission Factors		
		CO ₂	CH ₄	N ₂ O
	TJ	T/TJ	kg/TJ	kg/TJ
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	2 180	73.73	3.20	26.46
2006	2 121	73.73	3.25	27.05
2007	2 098	73.72	3.21	26.76
2008	2 080	73.72	3.17	26.50
2009	2 007	73.74	3.17	26.55
2010	2 016	73.72	3.08	25.95

Recalculations

Revisions of the years 2005-2009 (all gases) are due to updated energy data.

3.2.7.13 1.A.3.d Navigation

Key Source: No

This sector includes emissions from diesel, gasoline and gas fuelled ships used by vessels/ships of all flags that depart and arrive in Austria. The main sources are the river Danube and some other smaller rivers and lakes.

Table 70: Greenhouse gas emissions from Category 1 A 3 d Navigation 1990-2010.

	CO ₂ [Gg]	CH ₄ [Gg]	N ₂ O [Gg]
1990	14	0.007	0.002
1991	14	0.007	0.002
1992	14	0.007	0.002
1993	14	0.007	0.002
1994	13	0.007	0.002
1995	13	0.007	0.002
1996	13	0.007	0.002
1997	14	0.007	0.002
1998	14	0.007	0.002
1999	14	0.006	0.002
2000	14	0.006	0.002
2001	13	0.006	0.002
2002	13	0.006	0.002
2003	12	0.006	0.001
2004	15	0.006	0.002
2005	14	0.006	0.002
2006	14	0.005	0.002
2007	14	0.005	0.002

	CO ₂ [Gg]	CH ₄ [Gg]	N ₂ O [Gg]
2008	12	0.005	0.002
2009	11	0.005	0.001
2010	11	0.004	0.001
<i>Trend 1990–2010</i>	-21%	-40%	-27%

Methodology

Up to 2009 Austria has reported emissions from water-borne navigation in the Danube river entirely as domestic navigation under category 1.A.3.d.

As noted by the ERT, Austria presented in the **2010 submission** a disaggregation between domestic and international navigation, considering previous recommendations of the ERT. The following approach was used:

Fuel sold in Austria along the River Danube (in 2011, there are six fuelling stations for ships operating in Austria and the Ministry of Economy is collecting information on the fuel sold in those fuelling stations) was used as a proxy for fuel sold in international transport as most transport along the River Danube is across borders (being either transit, import or export transport). The difference between fuel attributed to total navigation and fuel sold along the River Danube was allocated to domestic navigation.

In the **submission 2011**, building on data used in the model GEORG (see 1 A 2 f), domestic navigation was calculated following the bottom-up approach - the assumption being that domestic navigation is navigation between harbours located in Austria using the transport, expressed in

$$\text{tons} \times \text{kilometer} \rightarrow (\text{GWh/tkm} \cdot \text{tkm}; \text{CO}_2/\text{tkm} \cdot \text{tkm}, \text{etc.})$$

Table 71: Emission factors and activity data for the sector Navigation 1990–2010.

	Activity	Implied Emission Factors		
		CO ₂	CH ₄	N ₂ O
	TJ	T/TJ	kg/TJ	kg/TJ
1990	190	74.21	38.36	9.48
1991	193	74.21	37.74	9.75
1992	192	74.21	37.77	9.71
1993	184	74.20	39.06	9.10
1994	181	74.19	39.23	8.89
1995	182	74.15	38.36	9.08
1996	182	74.11	37.61	9.24
1997	192	74.06	35.18	10.24
1998	194	74.05	34.21	10.52
1999	184	73.99	35.10	9.87
2000	189	73.96	33.69	10.47
2001	181	73.93	34.32	9.87
2002	172	73.95	35.22	9.11
2003	167	73.95	35.40	8.68
2004	198	73.93	29.44	11.50
2005	194	74.02	28.74	11.45
2006	186	73.20	28.66	10.87

	Activity	Implied Emission Factors		
		CO ₂	CH ₄	N ₂ O
	TJ	T/TJ	kg/TJ	kg/TJ
2007	185	73.24	27.57	10.94
2008	164	73.22	29.58	9.39
2009	151	73.20	30.33	8.39
2010	152	73.21	28.93	8.63

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 (CO₂: gaseous)

Category 1.A.3.e *Other Transportation* enfold 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 0.5% for the year 2010. 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 2011) as presented in Annex 4.

Emission factors

CO₂ and CH₄ emission factors are taken from studies (BMWA-EB 1996) and (UMWELTBUNDES-AMT 2002).

N₂O emission factors are taken from a national study (BMUJF 1994).

Table 72: Emission factors of Category 1 A 2 e for all years.

Fuel	CO ₂ [t/TJ]	CH ₄ [kg/TJ]	N ₂ O [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* enfold 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 26.1% for the year 1990 and 17.9% for the year 2010.

1.A.4 Other sectors – stationary sources

Key Source: CO₂ from gaseous, liquid and solid solid; CH₄ 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 cannot always be made by the interviewed person or interviewers.

The share in total GHG emissions from sector 1.A is 24.3% for the year 1990 and 16.4% for the year 2010.

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 2011) 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

CO₂, CH₄ and VOC emission factors are taken from studies (BMWA-EB 1990, 1996) and (UMWELTBUNDESAMT 2002). N₂O emission factors are taken from a national study (BMUJF 1994). CO₂ 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.

CH₄ 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 CH₄ emissions than conventional boiler types.

Table 73: Share of CH₄ 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 2010 are presented in the following table.

Table 74: Emission factors of Category 1.A.4 conventional boilers for the year 2010.

Fuel	CO ₂ [t/TJ]	CH ₄ [kg/TJ]		N ₂ O [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⁾	138.37 ³⁾ 136.96 ³⁾	178.31 ³⁾	3–5	7.00
Wood Waste	110.00 ¹⁾	19.91 ³⁾	178.31 ³⁾	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 CO₂ emissions from biomass

²⁾ According to IPCC guidelines non fossil CO₂ emissions of “other fuels” are not reported.

³⁾ Implied emission factor

Because no measurements are available, CH₄ emission factors for new biomass heatings (Table 75) 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 75: Emission factors of Category 1 A 4 new biomass boilers.

Fuel	CO ₂ [t/TJ]	CH ₄ [kg/TJ]		N ₂ O [kg/TJ]	
		CH/AH	Stove	CH and AH	Stove
Fuel Wood	100.00 ¹⁾	112.7/108.2	115.6	3.00	7.00
Wood Chips	110.00 ¹⁾	27.06	–	2.00	–
Pellets	110.00 ¹⁾	12.14	–	2.00	–

¹⁾ Reported as CO₂ emissions from biomass.

Activity data

Total fuel consumption for each of the sub categories of 1.A.4 is taken from (IEA JQ 2011) as presented in Annex 4.

Since (IEA JQ 2011) 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 2011).

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

Table 76: Share of 1.A.4.b heating type on fuel category for the year 2010.

	Central Heating	Appartement Heating	Stove
Hard Coal	77%	6%	17%
Brown Coal			
Brown Coal Briquettes			
Coke	94%	3%	3%
Gas oil			
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 CH₄ emissions than equipment installed before 2000. The accumulated consumption in 2009 is 37.4 PJ which is 60% 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 77: Number of biomass boiler sales 2000-2010 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
2009	8 446	2 600	4 328	8 530
2010	8 131	2 000	3 656	6 211

Year	Pellet boilers	Pellet stoves	Wood chip boilers	Log wood boilers
Accumulated total	75 094	24 884	36 267	58 335
Avg. yearly consumption per boiler or stove [GJ]	203	48	331	236
Total Consumption of new boilers 2010 [TJ]	15 251	1 194	11 994	13 740

Figure 15 shows activity data of 1.A.4.b Residential (without mobile machinery) by type of fuel together with the correlating heating degree days for the years 1990 to 2010.

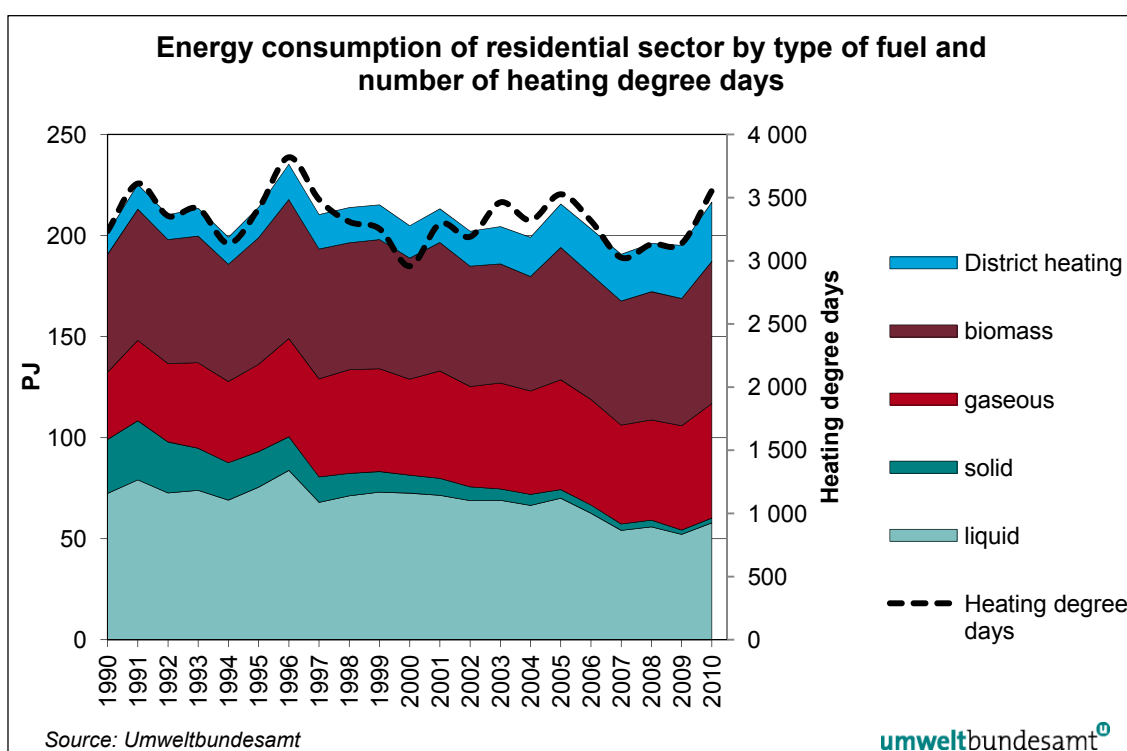


Figure 15: Energy consumption [PJ] of residential sector by type of fuel and number of heating degree days 1990–2010.

Recalculations

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

Recalculations due to the revised energy balance affect activity data 1999 to 2009 which mainly implies changes in CO₂ emissions for natural gas 1999 (+129 Gg CO₂) to 2009 (-667 Gg CO₂), solid fuels 2001 (-3 Gg CO₂) to 2009 (-121 Gg CO₂).

The amount of LPG used for transport which has been reported under category 1.A.4.a so far is now allocated under category 1.A.3.b which implies -27 Gg CO₂ in the year 2009. Total recalculations of liquid fuels implies -199 Gg CO₂ in 2009. Biomass consumption has been revised from 2001 to 2009 (-1.7 PJ which is -2%).

Improvements and change in methodology

The amount of LPG used for transport which has been reported under category 1.A.4.a so far is now allocated under category 1.A.3.b.

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 79.

Table 78: Greenhouse gas emissions from mobile sources of Household and Gardening 1990–2010.

	CO ₂ [Gg]	CH ₄ [Gg]	N ₂ O [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	145	0.06	0.03
1996	144	0.06	0.03
1997	143	0.06	0.03
1998	142	0.06	0.03
1999	141	0.05	0.03
2000	141	0.05	0.03
2001	142	0.05	0.03
2002	141	0.05	0.02
2003	141	0.05	0.02
2004	141	0.05	0.02
2005	138	0.05	0.02
2006	135	0.04	0.02
2007	132	0.04	0.02
2008	129	0.04	0.02
2009	126	0.03	0.01
2010	124	0.03	0.01
Trend 1990–2010	-14%	-54%	-42%

Table 79: Emission factors and activity data for mobile sources of Household and Gardening 1990–2010.

	Activity	Implied Emission Factors		
		CO ₂	CH ₄	N ₂ O
	TJ	T/TJ	kg/TJ	kg/TJ
1990	1 945	74.17	33.27	12.22
1991	1 949	74.17	33.29	12.21
1992	1 967	74.17	33.17	12.28
1993	1 978	74.16	33.08	12.34

	Activity	Implied Emission Factors		
		CO ₂	CH ₄	N ₂ O
	TJ	T/TJ	kg/TJ	kg/TJ
1994	1 957	74.15	33.02	12.81
1995	1 963	74.07	31.84	13.21
1996	1 947	74.05	31.02	13.16
1997	1 929	74.02	30.17	13.24
1998	1 914	74.01	29.28	13.34
1999	1 912	73.93	28.40	13.41
2000	1 913	73.91	27.58	13.53
2001	1 916	73.88	26.95	13.62
2002	1 911	73.88	26.33	12.14
2003	1 906	73.88	26.15	12.00
2004	1 908	73.90	25.58	10.46
2005	1 872	73.98	24.33	10.25
2006	1 840	73.27	23.07	10.00
2007	1 806	73.30	21.69	9.26
2008	1 754	73.32	20.45	8.98
2009	1 712	73.33	19.11	8.59
2010	1 692	73.34	17.75	8.09

1.A.4.c Agriculture and Forestry

Key Source: Yes (CO₂: 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 80: Greenhouse gas emissions for mobile sources of Agriculture and Forestry 1990-2010.

	Agriculture			Forestry		
	CO ₂ [Gg]	CH ₄ [Gg]	N ₂ O [Gg]	CO ₂ [Gg]	CH ₄ [Gg]	N ₂ O [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
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

	Agriculture			Forestry		
	CO ₂ [Gg]	CH ₄ [Gg]	N ₂ O [Gg]	CO ₂ [Gg]	CH ₄ [Gg]	N ₂ O [Gg]
2002	723	0.04	0.27	85	0.02	0.03
2003	692	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	727	0.04	0.24	101	0.03	0.03
2009	673	0.03	0.21	76	0.02	0.02
2010	655	0.03	0.19	81	0.02	0.02
<i>Trend 1990-2010</i>	-5%	-34%	-16%	-3%	-19%	-15%

Table 81: Emission factors and activity data for mobile sources of Agriculture and Forestry 1990–2010.

	Agriculture				Forestry			
	Activity [TJ]	Implied Emission Factors			Activity [TJ]	Implied Emission Factors		
		CO ₂ [t/TJ]	CH ₄ [kg/TJ]	N ₂ O [kg/TJ]		CO ₂ [t/TJ]	CH ₄ [kg/TJ]	N ₂ O [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	9 420	74.0	5.0	24.9	1 090	74.1	19.2	21.7
1994	9 476	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	20.8	21.7
1996	9 441	73.8	4.8	25.8	1 139	73.9	21.1	21.9
1997	9 923	73.8	4.6	26.2	1 178	73.9	20.0	22.5
1998	9 747	73.8	4.5	26.6	1 148	73.9	19.3	22.9
1999	9 865	73.7	4.4	26.9	1 159	73.7	18.7	23.2
2000	9 580	73.7	4.4	27.2	1 116	73.7	18.0	23.6
2001	9 878	73.7	4.3	27.5	1 145	73.7	17.4	23.9
2002	9 816	73.7	4.2	27.5	1 159	73.7	18.2	23.5
2003	9 398	73.7	4.2	26.9	1 153	73.7	19.9	22.5
2004	9 686	73.7	4.0	26.3	1 170	73.7	18.7	22.2
2005	10 195	73.7	3.9	25.8	1 216	73.8	17.7	21.9
2006	9 906	73.7	3.9	25.7	1 231	73.5	19.5	21.2
2007	9 834	73.7	3.8	24.8	1 360	73.5	19.2	20.4
2008	9 874	73.7	3.6	23.8	1 375	73.5	19.2	19.7
2009	9 131	73.7	3.6	23.1	1 037	73.5	19.3	19.0
2010	8 894	73.7	3.5	21.8	1 108	73.5	19.0	18.0

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 (inland).

Table 82: Greenhouse gas emissions from Military aviation 1990–2010.

	CO ₂ [Gg]	CH ₄ [Gg]	N ₂ O [Gg]
	military kerosene		
1990	33	0.0021	0.0011
1991	35	0.0022	0.0011
1992	32	0.0020	0.0010
1993	37	0.0024	0.0012
1994	39	0.0025	0.0013
1995	30	0.0019	0.0010
1996	37	0.0023	0.0012
1997	35	0.0021	0.0011
1998	40	0.0024	0.0013
1999	40	0.0023	0.0013
2000	39	0.0024	0.0013
2001	39	0.0025	0.0013
2002	40	0.0025	0.0013
2003	40	0.0025	0.0013
2004	41	0.0026	0.0013
2005	42	0.0026	0.0014
2006	42	0.0026	0.0014
2007	43	0.0027	0.0014
2008	43	0.0027	0.0014
2009	44	0.0027	0.0014
2010	44	0.0028	0.0015

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 CO₂ emissions an emission factor of 3 150 kg CO₂/Mg fuel has been used, it was taken from (KALIVODA et al. 2002).

CH₄ emission factor follows the CORINAIR Guidebook (10% of total VOC emissions, simple methodology).

As recommended in the IPCC GPG, for calculation of N₂O 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 2010 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 83: Greenhouse gas emissions from Military (Off-Road without Aviation) 1990–2010.

	CO ₂ [Gg]	CH ₄ [Gg]	N ₂ O [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	2.11	0.00010	0.0008	28.5
1994	2.11	0.00009	0.0008	28.5
1995	2.09	0.00009	0.0008	28.3
1996	2.08	0.00009	0.0008	28.1
1997	2.06	0.00008	0.0008	27.9
1998	2.05	0.00008	0.0008	27.7
1999	2.03	0.00008	0.0008	27.6
2000	2.02	0.00008	0.0008	27.5
2001	2.02	0.00008	0.0008	27.4
2002	2.01	0.00007	0.0008	27.3
2003	2.01	0.00007	0.0008	27.2
2004	2.00	0.00006	0.0008	27.2
2005	1.98	0.00006	0.0007	26.8
2006	1.91	0.00005	0.0006	25.9
2007	1.90	0.00004	0.0006	25.8
2008	1.89	0.00004	0.0005	25.7
2009	1.86	0.00004	0.0005	25.3
2010	1.88	0.00004	0.0005	25.5
<i>Trend 1990–2010</i>	-12%	-60%	-37%	-11%

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 CO₂ 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 CO₂ 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 CO₂ emissions by WIFO.
- emission factors check
 - check of IEF (time series),
 - NAP1 survey: Country specific CO₂ 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,
 - repeated values.
- 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 83. For transport, the respective factors are new and have been taken from an assessment of the overall transport GHG emissions (HAUSBERGER 2005).

Table 84: 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. CO₂ 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 CH₄ 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.

Overview

The lower emissions of the year 2009 are mainly attributable to recalculated CO₂ emissions occurring in the sector energy, due to revisions of the energy balance. In addition a shift of natural gas consumption (12 PJ) from 1.A.4 Other sectors to 1.A.1.b Petroleum refining, 1.A.1.c Other energy industries and 1.A.2.f Other manufacturing industries has lead to revised data on sub-sector level for 2009.

Revisions of CH₄ and N₂O are of minor importance, and mainly arise in the sector 1.A.4. A description of the recalculations is provided at the end of each relevant chapter.

The following major revisions which affect the years from 1999 onwards are following the revisions of the national energy balance

- Hard coal
Revision of final consumption 2009 (-0.5 PJ) which affects category 1.A.4 Other Sectors.
- Coking coke
Revision of final consumption 2009 (-0.6 PJ) which affects category 1.A.4 Other Sectors.
Revision of non energy use 2009 (-2.6 PJ) which affects category 1.A.2.a Iron and Steel.
- Residual fuel oil
Revision of final consumption 2009 (-2.7 PJ) which affects categories 1.A.2 Manufacturing industries and construction and 1.A.4 Other Sectors.
- Kerosene
Harmonization of international bunker fuel consumption with the output of the inventory bottom up model for air transport.
- Motor Gasoline

Revision of final consumption 2009 (-3.0 PJ) related to a revision of the energy statistics which affects category 1.A.3.b Road Transportation.

- **Natural Gas**

Revision of gross inland consumption 2002 – 2005 (between -3.8 PJ to +10 PJ) and 2009 (+1.5 PJ). For the year 2009 final energy consumption (1.A.4 and 1.A.2) has been revised by -12.3 PJ, the transformation sector (1.A.1.a) has been revised by +0.9 PJ, energy industries (1.A.1.b and 1.A.1.c) has been revised by +9.0 PJ and non energy use has been revised by +4.0 PJ.

For 2005 to 2009 the non energy use of natural gas which could not be allocated to process emissions under 2.B.1 Ammonia Production is now considered under 1.A.2.f Other Manufacturing Industries.

- **Biomass**

Revision of log wood final consumption 2001 – 2009 (-3.3 PJ) which affects category 1.A.4 Other Sectors. Revision of other solid biomass gross consumption 2005 (-4.0 PJ) and 2009 (+3.7 PJ). This affects the transformation sector (1.A.1.a) as well as final consumption allocated to 1.A.2 Manufacturing Industries and Construction and 1.A.4 Other Sectors.

The following improvement in reporting has been carried out:

- LPG used for road transport is now reported under category 1.A.3.b – Liquefied Petroleum Gases for the whole time series. In previous submissions this fuel consumption was included in 1.A.4. under liquid fuels.

3.2.10.1 CO₂ emissions

Table 85 shows the recalculations of CO₂ emissions for the subcategories of sector *1.A Fuel Combustion*.

Table 85: Recalculation difference of CO₂ 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	-5.94	0.02	3.20	17.58	-26.73	0.00
1991	-6.04	0.01	3.57	17.86	-27.48	0.00
1992	-6.38	0.02	3.73	18.49	-28.62	0.00
1993	-6.49	-0.02	4.00	18.64	-29.11	0.00
1994	-6.62	-0.02	4.11	19.05	-29.75	0.00
1995	-7.09	0.01	4.35	20.43	-31.87	0.00
1996	-9.71	0.03	5.33	28.24	-43.31	0.00
1997	-7.61	-10.70	15.89	21.46	-34.26	0.00
1998	-8.64	0.01	5.95	23.63	-38.22	0.00
1999	-7.03	-127.23	1.06	25.37	93.77	0.00
2000	-14.52	-17.71	144.10	-170.30	29.39	0.00
2001	-6.94	12.09	-2.48	72.91	-89.46	0.00
2002	-172.75	-173.43	6.05	49.05	-54.42	0.00
2003	-17.43	198.84	9.67	50.59	-276.54	0.00
2004	466.78	211.22	269.95	46.92	-61.31	0.00
2005	9.09	178.81	157.46	42.84	-370.02	0.00

	1 A	1 A 1	1 A 2	1 A 3	1 A 4	1 A 5
2006	-43.28	-1.48	119.36	43.49	-204.65	0.00
2007	-4.46	-13.38	133.37	46.37	-170.81	0.00
2008	0.86	-20.68	118.01	59.36	-155.83	0.00
2009	-461.44	103.17	268.17	154.14	-986.92	0.00

3.2.10.2 CH₄ emissions

Table 86 shows the recalculations of CH₄ emissions for the subcategories of sector 1.A *Fuel Combustion*.

Table 86: Recalculation difference of CH₄ 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	0.00	0.00	0.01	0.00	0.00
1991	0.01	0.00	0.00	0.01	0.00	0.00
1992	0.01	0.00	0.00	0.01	0.00	0.00
1993	0.01	0.00	0.00	0.01	0.00	0.00
1994	0.01	0.00	0.00	0.01	0.00	0.00
1995	0.01	0.00	0.00	0.01	0.00	0.00
1996	0.02	0.00	0.01	0.01	0.00	0.00
1997	0.01	0.00	0.00	0.01	0.00	0.00
1998	0.01	0.00	0.00	0.01	0.00	0.00
1999	0.01	0.00	0.00	0.01	0.00	0.00
2000	0.01	0.00	0.01	0.00	0.00	0.00
2001	-0.06	0.00	0.00	0.01	-0.07	0.00
2002	-0.13	0.00	0.00	0.01	-0.15	0.00
2003	-0.22	0.01	0.00	0.01	-0.24	0.00
2004	-0.21	0.01	0.01	0.01	-0.23	0.00
2005	-0.82	0.00	0.01	0.01	-0.84	0.00
2006	-0.25	0.00	0.01	0.01	-0.26	0.00
2007	-0.30	0.00	0.01	0.01	-0.31	0.00
2008	-0.25	0.00	0.00	0.01	-0.26	0.00
2009	-0.62	0.01	0.01	0.01	-0.65	0.00

3.2.10.3 N₂O emissions

Table 87 shows the recalculations of N₂O emissions for the subcategories of sector 1.A *Fuel Combustion*.

Table 87: Recalculation difference of N₂O 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	0.00	0.00	0.00	0.00	0.00	0.00
1991	0.00	0.00	0.00	0.00	0.00	0.00
1992	0.00	0.00	0.01	0.00	0.00	0.00

	1 A	1 A 1	1 A 2	1 A 3	1 A 4	1 A 5
1993	0.00	0.00	0.01	0.00	0.00	0.00
1994	0.00	0.00	0.01	0.00	0.00	0.00
1995	0.00	0.00	0.01	-0.01	0.00	0.00
1996	0.00	0.00	0.01	-0.01	0.00	0.00
1997	-0.01	0.00	0.00	-0.01	0.00	0.00
1998	-0.01	0.00	0.00	-0.01	0.00	0.00
1999	0.00	0.00	0.00	-0.01	0.00	0.00
2000	-0.01	0.00	0.00	-0.01	0.00	0.00
2001	-0.01	0.00	0.00	-0.01	0.00	0.00
2002	-0.01	0.00	0.00	-0.01	0.00	0.00
2003	-0.01	0.00	0.00	0.00	-0.01	0.00
2004	-0.02	0.00	0.00	-0.01	-0.01	0.00
2005	-0.02	-0.01	0.00	0.01	-0.01	0.00
2006	0.00	0.00	0.00	0.00	-0.01	0.00
2007	-0.01	0.00	0.00	0.00	-0.01	0.00
2008	-0.02	0.00	-0.01	0.00	-0.01	0.00
2009	-0.03	0.01	0.00	0.01	-0.04	0.00

3.2.10.4 Emissions in Gg CO₂ equivalent

Table 88 shows the recalculations in [Gg CO₂ equivalent] for the subcategories of sector 1.A *Fuel Combustion*.

Table 88: *Recalculation difference of GHG emissions in [Gg CO₂ 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	-6.18	0.02	4.42	16.21	-26.83	0.00
1991	-5.35	0.01	5.04	17.19	-27.59	0.00
1992	-5.18	0.02	5.49	18.07	-28.76	0.00
1993	-5.12	-0.02	5.90	18.26	-29.26	0.00
1994	-6.11	-0.02	6.03	17.79	-29.91	0.00
1995	-7.05	0.01	6.33	18.66	-32.04	0.00
1996	-8.99	0.03	7.74	26.79	-43.54	0.00
1997	-9.56	-10.84	15.99	19.73	-34.44	0.00
1998	-10.82	-0.10	6.14	21.56	-38.42	0.00
1999	-8.09	-127.05	1.18	23.45	94.33	0.00
2000	-16.10	-17.57	144.37	-172.47	29.58	0.00
2001	-11.06	12.37	-2.39	70.95	-92.00	0.00
2002	-179.27	-173.66	6.15	47.04	-58.80	0.00
2003	-25.67	199.60	9.74	49.76	-284.77	0.00
2004	457.70	211.13	270.37	44.40	-68.20	0.00
2005	-13.72	175.36	156.98	45.51	-391.58	0.00
2006	-49.98	-0.66	119.72	43.96	-213.00	0.00
2007	-13.26	-12.24	132.72	46.31	-180.05	0.00
2008	-10.12	-19.29	115.68	58.10	-164.61	0.00
2009	-484.58	105.08	268.02	156.23	-1 013.91	0.00

3.2.11 Planned Improvements

At current no relevant improvements are planned.

In 2011 Statistik Austria announced, that revisions of the energy balance will be carried out for the year-1 in the future if necessary. Revisions of older data will be considered only if major errors would be detected or statistical data of better quality would become available.

3.3 Fugitive Emissions (CRF Category 1.B)

3.3.1 Source Category Description

3.3.1.1 Emission Trends

In the year 2010 0.6% of national total emissions arose from IPCC Category 1 B Fugitive Emissions. Table 89 presents GHG emissions arising from this category, their share and trend from 1990 to 2010.

Table 89: Greenhouse gas emissions from Category 1 B Fugitive Emissions.

	GHG emissions [Gg CO ₂ equivalent]		
	Total	CO ₂	CH ₄
1990	310.60	102.09	208.51
1991	317.74	111.09	206.64
1992	344.71	120.13	224.58
1993	338.86	112.13	226.73
1994	346.15	127.64	218.52
1995	352.81	127.15	225.67
1996	295.72	71.14	224.58
1997	346.63	120.63	226.01
1998	364.05	141.94	222.10
1999	381.12	170.65	210.48
2000	377.78	164.65	213.13
2001	393.84	182.85	210.99
2002	377.07	167.15	209.92
2003	445.08	233.15	211.93
2004	440.59	210.15	230.43
2005	440.75	205.15	235.60
2006	477.67	232.16	245.52
2007	491.13	237.16	253.97
2008	468.92	212.16	256.76
2009	538.83	265.16	273.67
2010	516.20	237.17	279.03
Share 2010	100%	46%	54%
Trend 1990–2010	66%	132%	34%

3.3.1.2 Completeness

Table 90 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 gas exploration and gas production are reported together under oil production (as oil and gas are extracted together at most sites) except CO₂ emissions from sour gas processing, which is reported separately under gas extraction.

Regarding petroleum refining, all CO₂ emissions, thus including flaring, are reported in the Energy Sector, as these are emissions due to combustion. Fugitive CO₂ losses are considered negligible. In category 1.B only CH₄ and NMVOC emissions, included venting, are considered.

Table 90: Overview of subcategories of Category 1.B Fugitive Emissions: transformation into SNAP Codes and status of estimation.

IPCC Category	SNAP	Status		
		CO ₂	CH ₄	
1 B 1 a Coal Mining and Handling				
i Underground Mines	050102 Underground mining	NO	NO	
ii Surface Mines	050101 Open cast mining	NA	✓	
1 B 1 b Solid Fuel Transformation		IE ¹⁾	IE ¹⁾	
1 B 2 a Oil				
i Exploration	0502 Extraction, 1 st treatment and loading of liquid fossil fuels	IE ²⁾	IE ²⁾	
ii Production		✓	✓	
iii Transport	050502 Transports and Depots	IE ²⁾	IE ²⁾	
iv Refining/Storage	0401 Processes in Petroleum Industries	NA ³⁾	✓	
v Distribution of oil products	0504 Liquid fuel distribution 0505 Petrol distribution	NA	NA ⁴⁾	
1 B 2 b Natural Gas				
i Exploration	0503 Extraction, 1 st treatment and loading of gaseous fossil fuels	NA	IE ²⁾	
ii Production/Processing		✓ ²⁾		
iii Transmission	050601 Pipelines/Storage	✓	✓	
iv Distribution	050603 Distribution Networks	NA	✓	
v Other Leakage		NO	NO	
1 B 2 c Venting/Flaring		IE ⁵⁾	IE ⁶⁾	

¹⁾ included in 1 A 2 a Iron and Steel

²⁾ 1 B 2 a i Oil Exploration, 1 B 2 a iii Transport, 1 B 2 b i Natural Gas Exploration (CH₄ emissions only, CO₂ emissions are NA) and 1 B 2 b ii Natural Gas Production/Processing, except CO₂ emissions from processing of sour gas, are included in 1 B 2 a ii.

³⁾ CO₂ emissions due to combustion are included in 1 A 1 b Petroleum Refining, fugitive CO₂ emissions are assumed to be negligible.

⁴⁾ also includes storage in storage tanks and refinery dispatch station – only NMVOC emissions are estimated as CH₄ emissions are assumed to be negligible.

⁵⁾ included in 1 A 1 b Petroleum Refining

⁶⁾ included in 1 B 2 a iv Refining/Storage

3.3.2 Methodological issues

3.3.2.1 1.B.1.a Fugitive Emissions from Fuels – Coal Mining

Emissions: CH₄

Key Source: No

This category covers methane emissions from one brown coal surface mine. CH₄ emissions from this category decreased by more than 50% from 1990 to 1999 due to lower mining activities. Before coal mining was stopped in 2007 emissions decreased sharply between 2003 and 2004 (80%, Table 91).

Emissions are calculated by multiplying the amount of brown coal produced (= activity data) by the CORINAIR default emission factor of 214 g CH₄/ Mg coal (Emission Factor Data Base #11378³⁴). Activity data are taken from the national energy balance and statistical year books (e.g. yearbook of the *Association of Mining and Steel*).

Table 91: Activity data (brown coal produced) and CH₄ emissions for Fugitive Emissions from Fuels – Coal Mining 1990–2010.

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
2009	NO	NO
2010	NO	NO

³⁴ <http://www.ipcc-nggip.iges.or.jp/EFDB/main.php>

3.3.2.2 1.B.2.a Fugitive Emissions from Fuels – Oil

Emissions: CH₄, CO₂

Key Source: No

In this category, fugitive emissions from oil refining (CH₄) and CO₂ and CH₄ emissions from combined oil and gas production are considered. CO₂ 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 CH₄ content of the NMVOC emissions is assumed to be negligible.

CO₂ and CH₄ emissions contribute approximately equally to GHG emissions from 1.B.2.a (51 and 49% in 2010 respectively). In 2010 fugitive CH₄ and CO₂ emissions from oil contributed 0.3% to total greenhouse gas emissions in Austria.

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 emission factor of 31.66 CH₄ g/t crude oil resulted from multiplying an average value of 745 kg CH₄/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 92).

Methane emissions for the years 1992 to 2010 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“.

CO₂ 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 CO₂ emissions refer to CO₂ that has been separated from the raw gas).

Table 92: Activity data (Crude Oil Refined and Gas Produced, respectively) and emissions for Fugitive Emissions from Fuels – Oil Refining and Production 1990–2010.

Year	Refining		Production				
	Crude Oil Refined [Gg]	CH ₄ [Gg]	Gas Produced [Mio m ³]	CH ₄ [Gg]	IEF CH ₄ [kg/1 000 m ³]	CO ₂ [Gg]	IEF CO ₂ [kg/1 000 m ³]
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

Refining			Production				
Year	Crude Oil Refined [Gg]	CH ₄ [Gg]	Gas Produced [Mio m ³]	CH ₄ [Gg]	IEF CH ₄ [kg/1 000 m ³]	CO ₂ [Gg]	IEF CO ₂ [kg/1 000 m ³]
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	1 531	5.51	3.60	135	88
2009	8 331	0.26	1 670	5.99	3.59	163	98
2010	7 764	0.25	1 816	6.43	3.54	145	80

1.B.2.b Fugitive Emissions from Fuels – Natural Gas

Emissions: CH₄, CO₂

Key Source: No

In this category CO₂ emissions from sour gas processing, CH₄ emissions from gas distribution and CO₂ and CH₄ emissions from gas transmission and storage are reported.

CO₂ emissions from this category mainly arise from sour gas processing; the general trend is that emissions increased due to increasing gas production. Gas transmission is only a minor source of CO₂ emissions.

CH₄ emissions contributed 60% to total GHG emissions from 1.B.2.b in 2010. In 2010 fugitive CH₄ and CO₂ emissions from natural gas contributed 0.3% to total greenhouse gas emissions in Austria. CH₄ emissions from natural gas increased between 1990 and 2010 by 44%, due to extension of the pipeline network and storage sites. Although the natural gas distribution network has more than doubled since 1990 in length, CH₄ emissions from this source have decreased due to replacement of old pipelines made of cast iron (with high emission factors) by pipelines made of plastics (with low emission factors).

Sour Gas Processing

CO₂ 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 CH₄ emissions from natural gas distribution and storage has been collected in a national study for the year 1999 (Life Cycle Inventory Austria 2000 – Review, C. Wartha, Fachhochschul-Studienzentrum Pinkafeld, 2005). 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 CH₄ 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 described in the national study. The amount of gas injection and withdrawal 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 1999 emissions from storage as compiled in the national study were divided by the mean value of the annual amount of gas injection and withdrawal for the year 1999. The resulting EF equals to 541 kg CH₄ per Mm³ 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 a Tier 2 methodology. The activity data was obtained from annual reports of the Association of the Austrian Natural Gas and District Heat Association (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 CH₄ emissions from gas transmission mainly result from compressors, connections, pneumatic aggregates, 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 495 kg CH₄ 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 through the pipelines and emission factors largely depend on the pipeline material, see Table 93. 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 with the material specific emissions factors from the national study emissions were calculated for each year.

Table 93 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 less than 5% to the total emissions from natural gas distribution in Austria.

Table 93: 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	2010	1990–2010	
Insulated steel	2 881	3 760	3 554	+23%	25
Plastics (HDPE,PVC)	6 368	18 501	23 645	271%	13
Ductile cast iron	2 213	1 720	1 516	-32%	701
Grey cast iron	210	118	18	-91%	892
Total	11 672	24 099	28 733	+146%	

Table 94: Activity data and emissions for Fugitive Emissions from Fuels – Natural Gas Distribution and Sour Gas Processing 1990–2010.

Year	Natural Gas Distribution		Sour Gas Processing	
	Gas network [km]	CH ₄ Emissions [Gg]	Sour Gas Prod. [1 000 m ³]	CO ₂ Emissions [Gg]
1990	11 672	1.99	248 090	59
1991	12 700	1.93	285 901	68
1992	13 893	1.99	357 135	80
1993	15 178	1.95	321 653	75
1994	16 589	1.87	363 582	80
1995	17 778	1.85	405 638	89
1996	18 995	1.82	136 737	30
1997	20 219	1.76	406 177	89
1998	21 339	1.74	367 195	81
1999	22 701	1.73	352 318	81
2000	24 099	1.73	358 357	93
2001	25 042	1.73	393 492	95
2002	24 216	1.68	347 513	83
2003	25 699	1.71	408 198	100
2004	26 158	1.62	373 099	88
2005	26 958	1.63	338 349	83
2006	27 413	1.63	402 990	92
2007	27 945	1.62	444 029	95
2008	28 348	1.61	372 406	77
2009	28 533	1.60	466 628	102
2010	28 733	1.58	397 132	92

Table 95: Activity data and emissions for Fugitive Emissions from Fuels – Natural Gas Transmission and Storage 1990–2010.

Year	Natural Gas Transmission (Pipelines Fugitive & Venting)			Natural Gas Storage	
	Pipelines [km]	CH ₄ Emissions [Gg]	CO ₂ Emissions [Gg]	Natural Gas Stored [Mm ³]	CH ₄ Emissions [Gg]
1990	3 628	1.79	0.09	1 500	0.81
1991	3 696	1.83	0.09	1 500	0.81
1992	5 278	2.61	0.13	1 625	0.88
1993	5 265	2.60	0.13	1 980	1.07
1994	5 546	2.74	0.14	1 329	0.72
1995	5 972	2.95	0.15	1 820	0.99
1996	5 876	2.91	0.14	1 820	0.99
1997	5 924	2.93	0.15	1 820	0.99
1998	5 918	2.93	0.14	1 820	0.99
1999	6 052	2.99	0.15	1 172	0.63
2000	5 966	2.95	0.15	1 665	0.90
2001	6 213	3.07	0.15	1 132	0.61
2002	6 232	3.08	0.15	861	0.47
2003	6 243	3.09	0.15	1 574	0.85
2004	6 288	3.11	0.15	1 507	0.82
2005	6 290	3.11	0.15	1 828	0.99
2006	6 354	3.14	0.16	2 112	1.14
2007	6 495	3.21	0.16	2 530	1.37
2008	6 545	3.24	0.16	2 949	1.60
2009	6 574	3.25	0.16	3 560	1.93
2010	6 798	3.36	0.17	3 070	1.66

3.3.3 QA/QC

Before the study Life Cycle Inventory Austria 2000 – Review (C. Wartha, Fachhochschul-Studienzentrum Pinkafeld, 2005) was used for the Austrian National Inventory, QA checks were made to ensure that the data quality was appropriate. These QA checks included consultations with the Association of Gas- and District Heating Supply Companies. Only after QA checks and consultations were finished and the quality of the data was approved, the data was used for the calculation of the national GHG emissions following the internal QA/QC requirements.

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 (low end of the range provided in Table 2.16). Emissions equal to 0.08% of the working gas capacity, which is classified between low (0.05%) and medium (0.1%) 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 689 m³/km/a are classified between low (200) and medium (2000) in the 2006 IPCC GL.

For distribution the IEFs range between 0.06 and 0.17 t/km/a, this is lower than the range given in the IPCC GPG. The mean gas losses of 124 m³/km/a are classified between low (100 m³/km/a) and medium (1 000 m³/km/a) in the 2006 IPCC GL. Material specific emission factors of pipelines are neither provided in the IPCC GPG nor in the 2006 IPCC 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 1.B.2.b Natural Gas – CH₄ 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 the 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

No recalculations have been required since last years' submission.

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 2010.

Emissions from this category comprise emissions from the following sub categories: *Mineral Products, Chemical Industry, Metal Production* and *Consumption of Halocarbons and SF₆*.

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 102.

CO₂ 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, CO₂ 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 in 2010 covering consumption and emissions in all sub-categories of 2.F. *Consumption of Halocarbons and SF₆*. 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 2010, 12.6% 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 increased production of the iron and steel industry. From 2003 to 2004 emissions decrease again due to a strong decrease of N₂O emissions from Chemical Industry. Since then emissions are increasing again due to strongly increasing activities in the iron and steel industry. Emissions decreased again from 2008 – 2009, mainly because of the economic crisis. Between 2009 and 2010 emissions increased due to recovery of the industry after the economic crisis.

In 2010, greenhouse gas emissions from Category 2 *Industrial Processes* amounted to 10 680 Gg CO₂ equivalent compared to 10 108 Gg in the base year.

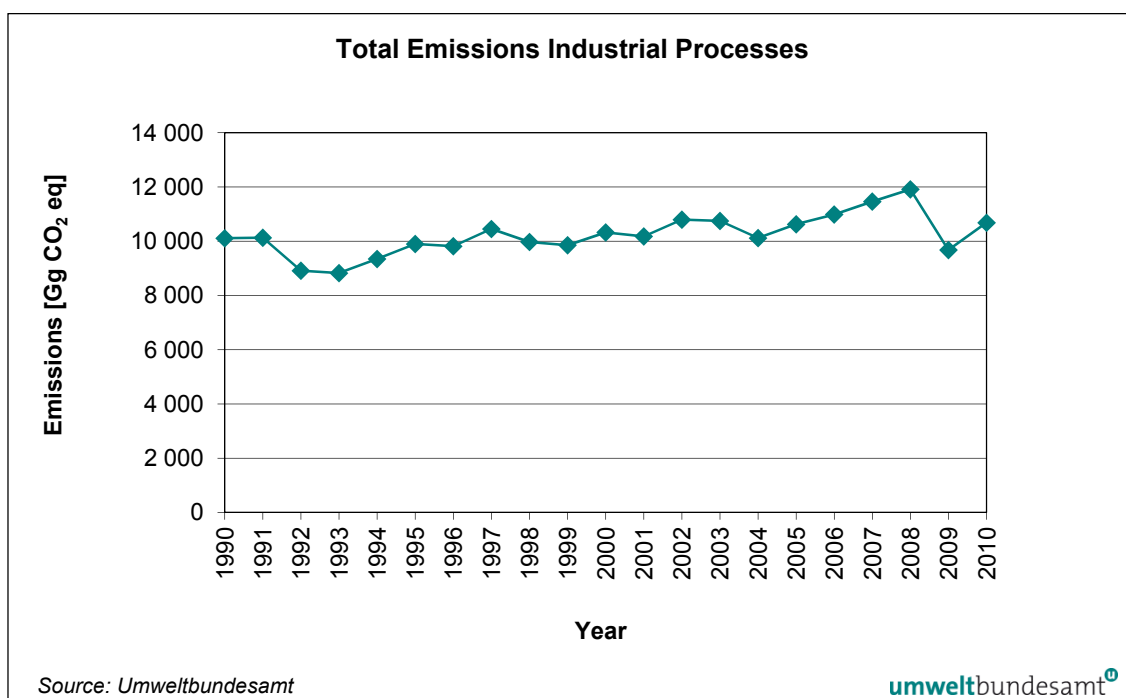


Figure 16: GHG emissions from IPCC Sector 2 Industrial Processes 1990–2010.

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 2010.

Table 96: Greenhouse gas emissions from 2 Industrial Processes by gas in the base year and in 2010.

GHG	Base year*	2010	Base year*	2010
	CO ₂ equivalent [Gg CO ₂ e]		[%]	
Total	10 108.40	10 680.47	100%	100%
CO ₂	7 581.71	9 023.24	75.0%	84.5%
CH ₄	14.83	18.25	0.1%	0.2%
N ₂ O	912.02	63.49	9.0%	0.6%
HFCs	26.32	1 160.63	0.3%	10.9%
PFCs	1 079.24	69.85	10.7%	0.7%
SF ₆	494.28	345.01	4.9%	3.2%

* 1990 for all gases

The most important GHG of the industrial processes sector is carbon dioxide with 84.5% of emissions from this category in 2010, followed by HFCs with 10.9%, SF₆ with 3.2%, PFCs with 0.7%, N₂O with 0.6% and finally CH₄ with 0.2%.

Table 97: Emissions from IPCC Category 2 Industrial Processes by gas from 1990–2010 and their trend.

	GHG emissions [Gg CO ₂ e]						
	Total	CO ₂	CH ₄	N ₂ O	HFCs	PFCs	SF ₆
1990	10 108	7 582	15	912	26	1079	494
1991	10 127	7 424	15	927	30	1087	645
1992	8 912	6 877	14	837	32	462	689
1993	8 824	6 854	15	879	244	53	781
1994	9 344	7 180	15	825	293	58	972
1995	9 897	7 388	14	857	412	71	1154
1996	9 814	7 087	15	874	532	72	1234
1997	10 451	7 677	15	863	652	105	1139
1998	9 972	7 321	15	897	769	56	913
1999	9 852	7 171	15	923	877	79	787
2000	10 325	7 776	15	952	902	85	596
2001	10 177	7 703	14	786	925	96	652
2002	10 794	8 271	15	807	969	98	635
2003	10 747	8 216	15	883	950	116	567
2004	10 116	8 231	15	281	955	137	497
2005	10 623	8 706	16	274	986	134	507
2006	10 984	9 111	19	280	963	146	465
2007	11 460	9 544	19	270	1062	190	375
2008	11 911	9 952	19	326	1058	174	383
2009	9 675	8 051	18	165	1057	35	349
2010	10 680	9 023	18	63	1161	70	345
Trend 1990-2010	6%	19%	23%	-93%	4310%	-94%	-30%

About 51% of GHG emissions (CO₂ equivalent) originate from *Metal Production* (mainly *Iron and Steel Production*) and about 27% from *Mineral Products*. The rest originates from *Chemical Industry* (mainly *Ammonia Production*).

CO₂ emissions

As can be seen in Figure 17 CO₂ emissions from the industrial processes sector fluctuated during the period from 1990 to 2000; since 2001 the emissions trend upwards, except for the year 2009 (economic crisis), mainly due to increasing emissions from metal production. In 2010 CO₂ emissions from *Industrial Processes* amounted to 9 023 Gg, which corresponds to an increase of 19% compared to base year emissions.

CH₄ emissions

As can be seen in Figure 17 CH₄ emissions from Industrial Processes fluctuated over the period from 1990 to 2004, since then they showed an increasing trend until 2006, mainly due to augmented capacity in ethylene production. From 2006 onwards CH₄ emissions were decreasing with a slight increase in 2010 mainly due to the chemical industry. In 2010 emissions were 23% above base year level.

CH₄ emissions from this sector mainly arise from *Chemical Industry (Production of Urea and Fertilizers, Ethylene and Ammonia)*; a minor source for CH₄ emissions is *Metal Production (Electric Furnace Steel Plants, Rolling Mills)*.

N₂O emissions

N₂O emissions from this sector arise from *Nitric Acid Production (Chemical Industry)*. As can be seen in Figure 17 N₂O 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 N₂O decomposition facility in the nitric acid plant. Emissions decreased by 49% between 2008 and 2009, this is due to the introduction of a second catalyst in the nitric acid plant in May 2009. The emission reduction of another 62% between 2009 and 2010 (a reduction of 81% from 2008-2010) is due to the full set up of the second catalyst in the year 2010.

In 2010, N₂O emissions from *Industrial Processes* are 93% below the level of the base year.

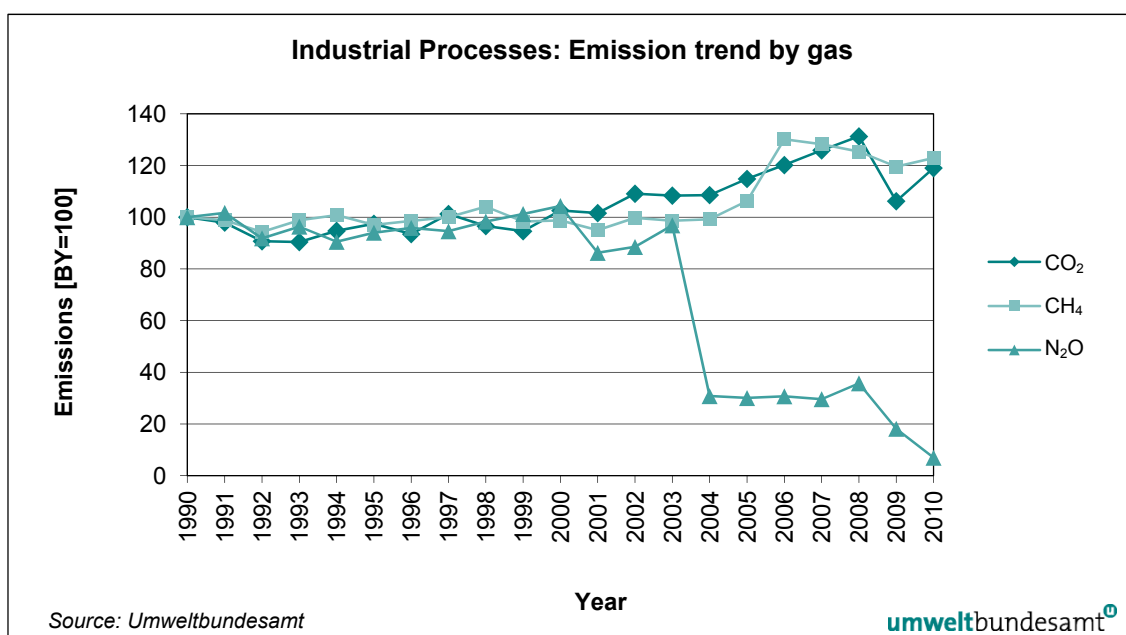


Figure 17: CO₂, CH₄ and N₂O emissions from Industrial Processes 1990–2010 in index form (base year = 100).

HFC emissions

As can be seen in Figure 18, HFC emissions increased remarkably during the period from 1990 to 2010. 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. The increase of HFCs between 2009 and 2010 is due to the effects of the Montreal Protocol and the phase out of certain ODSs.

PFC emissions

As can be seen in Figure 18, PFC emissions decreased remarkably during the period from 1990 to 1993. In 1990 PFC emissions amounted to 1 079 Gg CO₂ equivalent, they decreased until 1993 to around 53 Gg CO₂ equivalent due to the termination of primary aluminium production in 1992 which was the major source for PFC emissions. Since then PFC emissions increased until 2007, when they amounted to 190 Gg CO₂ equivalents (82% below the level of the base year). In 2010 they dropped to 69.85 Gg CO₂ equivalents, which is 94% below the level of the base year (1990). The, compared to 2010, lower emissions in 2009 (35 Gg CO₂ equivalents) are due to the fact that PFC emissions mainly arise from semiconductor manufacture, which was very strongly affected by the economic crisis.

SF₆ emissions

As can be seen in Figure 18, SF₆ emissions increased at the beginning of the period and reached a maximum in 1996, since then SF₆ 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 2010 SF₆ emissions amounted to 345 Gg CO₂ equivalent, this is 30% below the level of the base year (1990). In 2010 SF₆ emissions resulted mainly from semiconductor manufacture, electric equipment and noise insulating windows.

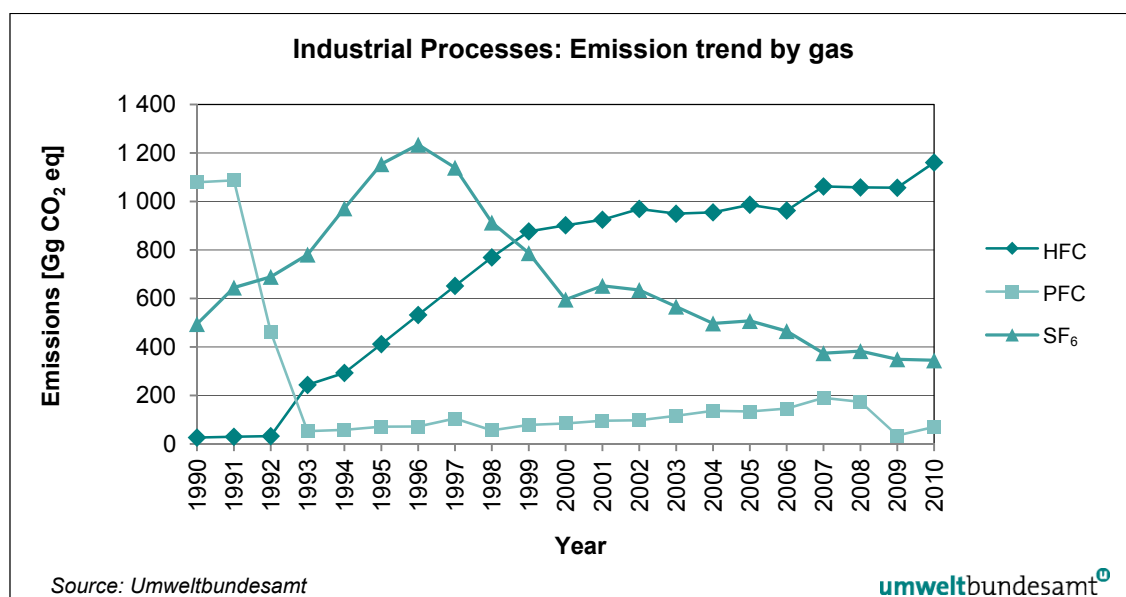


Figure 18: HFC, PFC and SF₆ emissions from Industrial Processes 1990–2010.

Emission trends by sources

The main sources of greenhouse gas emissions in the industrial processes sector are *Metal Production* and *Mineral Products*, which cause 51% and 27%, respectively, of the emissions from this sector in 2010 (see Table 98).

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 98: Greenhouse gas emissions from IPCC Category 2 Industrial Processes by sector, their share and trend for the base year and 2010.

	Emissions [Gg CO ₂ e]		Share [%]		Trend BY–2010
	BY*	2010	BY*	2010	
2 Industrial Processes	10 108	10 680	100%	100%	6%
A Mineral Products	3 274	2 936	32%	27%	-10%
B Chemical Industry	1 509	689	15%	6%	-54%
C Metal Production	5 029	5 480	50%	51%	9%
F Consumption of Halocarbons and SF6	296	1 575	3%	15%	432%

* 1990 for all gases

Figure 19 and Table 99 present greenhouse gas emissions from IPCC Category 2 Industrial Processes by sub category for the years 1990 to 2010.

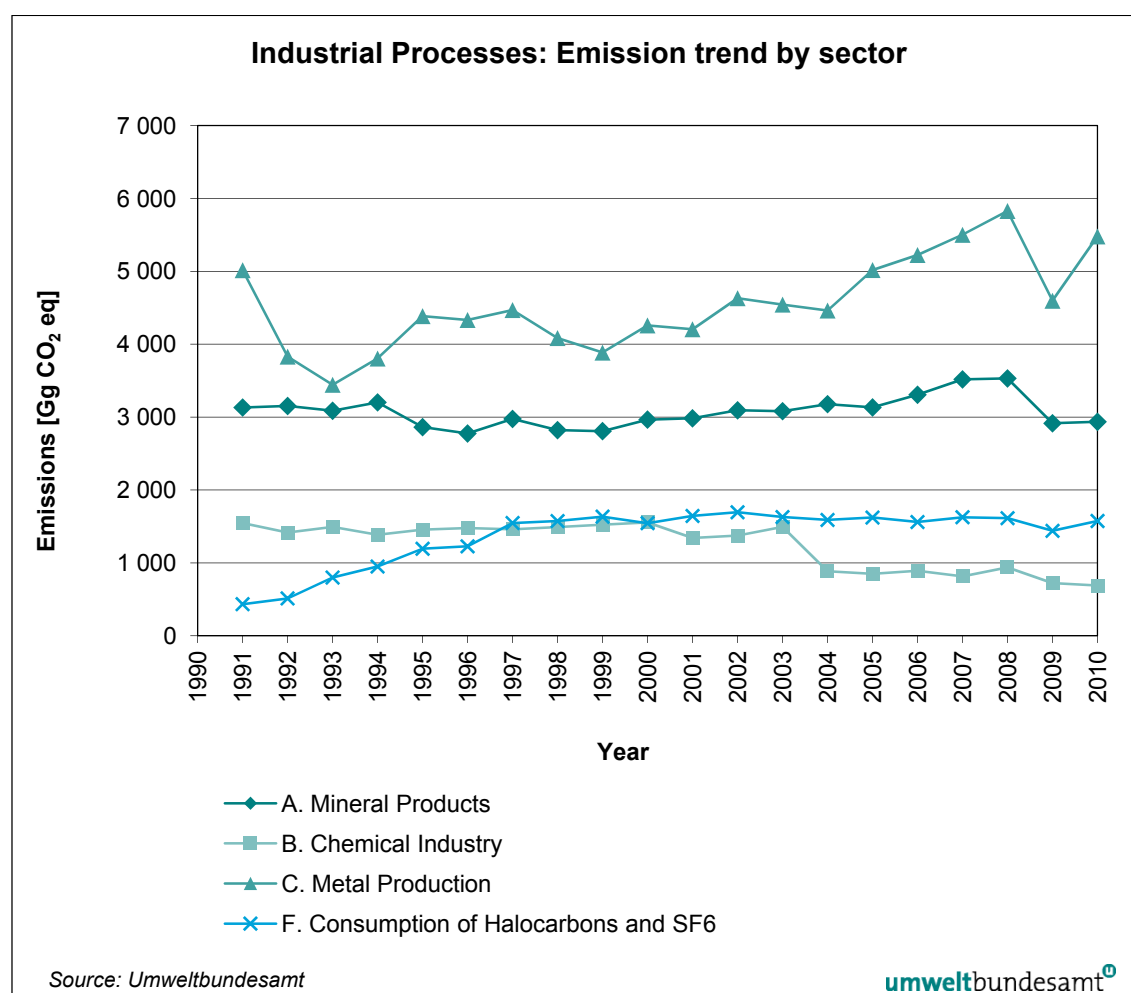


Figure 19: Emissions from IPCC Category 2 Industrial Processes per subcategory 1990–2010.

Table 99: Total greenhouse gas emissions from 1990–2010 by subcategories of Sector 2 Industrial Processes.

	GHG emissions [Gg CO ₂ equivalent]				
	2 Total	2.A	2.B	2.C	2.F
1990	10 108	3 274	1 509	5 029	296
1991	10 127	3 132	1 545	5 016	434
1992	8 912	3 153	1 417	3 830	513
1993	8 824	3 087	1 494	3 443	800
1994	9 344	3 202	1 387	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	9 852	2 807	1 524	3 886	1 634
2000	10 325	2 966	1 556	4 258	1 545
2001	10 177	2 983	1 342	4 206	1 644
2002	10 794	3 093	1 376	4 631	1 695
2003	10 747	3 081	1 493	4 543	1 629
2004	10 116	3 178	885	4 463	1 589
2005	10 623	3 133	849	5 019	1 623
2006	10 984	3 307	892	5 224	1 561
2007	11 460	3 518	814	5 502	1 626
2008	11 911	3 531	938	5 828	1 614
2009	9 675	2 916	722	4 597	1 440
2010	10 680	2 936	689	5 480	1 575

2.A Mineral Products

Greenhouse gas emissions decreased by 10.3% from 1990 to 2010 in this sub-category. In this sub-category emissions from *Magnesia Sinter Production* and *Bricks* decreased between 1990 and 2010. Emissions from *Lime Production*, *Limestone*, *Dolomite* and *Soda Ash Use and Glass Production* increased. Only CO₂ 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 decreased by 41%, because of implemented mitigation techniques in the nitric acid production. In 2010 emissions are 54% below the level of the base year; the decrease between 2008 and 2010 by 26% is mainly due to enhanced mitigation technologies in the nitric acid production.

The main sources of this sub-category are CO₂ emissions from ammonia production and N₂O 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 CO₂ emissions from *Iron and Steel Production* (+54%). The overall trend from 1990 to 2010 shows an increase by 9%, mainly due to increased iron and steel production. The main source of this sector is CO₂ emissions from pig iron production.

2.F Consumption of Halocarbons and SF₆

In 2010 greenhouse gas emissions are nearly 5 times higher than base year emissions for the sub-category *Consumption of Halocarbons and SF₆*. 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 are presented in Chapter 1.5.1. The following table summarizes the key sources in the IPCC Sector 2 *Industrial Processes*.

Table 100: Key categories of Sector 2 Industrial Processes (KCA including LULUCF).

IPCC Category	Source Categories	Key Sources	
		GHG	KS-Assessment
2.A.1	Cement Production	CO ₂	LA; TA
2.A.2	Lime Production	CO ₂	LA; TA
2.A.3	Limestone and Dolomite Use	CO ₂	LA 2010
2.A.7.b	Magnesia Sinter Plants	CO ₂	LA; TA
2.B.1	Ammonia Production	CO ₂	LA
2.B.2	Nitric Acid Production	N ₂ O	LA 1990; TA
2.C.1	Iron and Steel Production	CO ₂	LA; TA
2.C.3	Aluminium production	PFC	LA 1990
2.C.4	SF ₆ used in Al and Mg Foundries	SF ₆	LA 1990, TA
2.F.1/2/3/4/5	ODS Substitutes	HFC, PFC	LA 2010; TA
2.F.9	Other Sources of SF ₆	PFC, SF ₆	TA

LA1990 = Level Assessment 1990

LA2010 = Level Assessment 2010

TA = Trend Assessment BY–2010

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 CO₂ emissions reported under the EU ETS were available for the years 2005–2009. 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 101, explanations see respective subchapters).

Table 101: 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 ₂ O	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.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.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 CO₂ 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 Act³⁵ and the Ordinance regarding Monitoring and Reporting of Greenhouse Gas Emissions³⁶.

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 2009 is presented below:

Update of activity data

2.A.4 Soda Ash Production and use

A minor recalculation of the 2009 emission data (-2.9 Gg CO₂) has been required for this years' submission as a strong decrease in soda ash production due to the economic crises had become apparent by hindsight.

2.A.7 Other

Only minor changes of CO₂ emissions have been made for the year 2009 in sector 2.A.7.c (+0.05 Gg) due to delayed availability of updated information on production data of one facility.

2.B.1 Ammonia Production

Due to a change of the data source (use of plant specific data instead of the energy balance) a recalculation of the time series was necessary. This resulted in an emission decrease (e.g. 1% for the year 2009).

2.C.1 Pig Iron and Electric Furnace Activity

Revised data of the energy balance resulted in a change of split in process and energy related CO₂ emissions for the years 2008 (+3.6 Gg) und 2009 (+167.6 Gg) respectively a shift from 1.A.2.a to 2.C.1 has occurred.

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

³⁵ „Emissionszertifikate-Gesetz“, Federal Law Gazette I No. 46/2004

³⁶ „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

4.1.7 Completeness

Table 102 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 102: 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 ₂ O
2.A	MINERAL PRODUCTS				
2.A.1	Cement Production	040612 Cement (decarbonising)	✓	NA	NA
2.A.2	Lime Production	040614 Lime (decarbonising)	✓	NA	NA
2.A.3	Limestone and Dolomite Use	040618 Limestone and Dolomite Use	✓	NA	NA
2.A.4	Soda Ash Production and Use	040619 Soda Ash Production and Use	✓	NA	NA
2.A.5	Asphalt Roofing	040610 Roof covering with asphalt materials	IE ¹⁾	NA	NA
2.A.6	Road Paving with Asphalt	040611 Road paving with asphalt	IE ¹⁾	NA	NA
2.A.7	Other				
	2.A.7.a Bricks	040617 Bricks (decarbonising)	✓	NA	NA
	2.A.7.b Magnesit Sinter	040617 Other – Magnesit 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	NO ²⁾
2.B.4	Carbide Production	040412 Calcium carbide production	✓	NA ³⁾	NA
2.B.5	Other	040407 NPK fertilisers 040408 Urea	✓	✓	NA
2.B.5	Other	040501 Ethylene production	NA	✓	NA
2.C	METAL PRODUCTION				
2.C.1	Iron and Steel Production	040202 Blast furnace charging 040206 Basic oxygen furnace steel plant 040207 Electric furnace steel plant 040208 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	✓/N O ⁴⁾	✓/N O ⁴⁾	NA
2.C.4	SF ₆ Used in Aluminium and Magnesium Foundries	040301 Aluminium Production – SF ₆ only 040304 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		NA ⁵⁾	NA	NA

IPCC Category		SNAP		HFCs, PFCs, SF ₆
2.E	PRODUCTION OF HALOCARBONS AND SULPHUR HEXAFLUORIDE	0408	Production of halocarbons and sulphur hexafluoride	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⁾ CO₂ emissions from this source are of biogenic origin.

⁶⁾ There is no production of halocarbons or SF₆ 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. Currently there is only one EF available for ferroalloys, which is used for all 3 kinds of alloys produced in Austria. The inventory team is currently working with experts from industry to improve the data.

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: CO₂

Key Source: Yes (CO₂)

CO₂ emissions from cement production is a key category because of its contribution to the level of the greenhouse gas inventory of base year and 2010. In 2010 CO₂ emissions from cement production contributed 1.9% to total greenhouse gas emissions in Austria (see Table 100).

In this category process specific CO₂ emissions are reported, emissions due to combustion are reported in the energy sector (category 1.A.2.f).

Process specific CO₂ is emitted during the production of clinker (calcination process) when calcium carbonate (CaCO₃) 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 CO₂.

Table 103 presents the process-related CO₂ emissions from the production of cement for the period from 1990 to 2010.

Table 103: CO₂ emissions from decarbonising from cement production 1990–2010.

Year	Process specific CO ₂ emissions [Gg]	Clinker [t/a]	IEF [kg/tCl]
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
2009	1 799	3 428 140	525
2010	1 622	3 097 043	524

CO₂ emissions are quite constant from 1990 to 1994; 1995 they drop by 22.4% compared to the previous year, due to a drop in clinker production of almost 23%. This drop is due to an economic downturn 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 2010 is minus 20.2%, due to the decrease of clinker production. In 2009 the cement production dropped as a consequence of the economic crisis that has also affected the level of production in 2010.

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 gypsum.

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 CO₂ emissions and CO₂ 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 2005–2009. For 2005–2010 verified CO₂ 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.

CO₂ emissions from the raw meal calcination (decarbonising) were calculated from the raw meal composition:

$$M_{(\text{CO}_2 \text{ calc})} = \sum_k (m_{(\text{raw meal})})_k \cdot (x_{(\text{MeCO}_3)})_k \cdot M$$

Whereas:

m mass stream [kg/a]

x mass portion

k for the *k*th cement plant

M molecular weight CO₂ / molecular weight Me-carbonate

Me ... Ca, Mg

The raw meal composition was determined at every Austrian plant, considering also the MgCO₃ 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 CO₂ emissions and find that if CO₂ 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 (1.1% – revision due to plant specific data for 2010). According to the IPCC GPG (p. 3.14) the uncertainty of the CO₂ 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 stoichiometric 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 years' submission.

4.2.2 Lime Production (2.A.2)

4.2.2.1 Source Category Description

Emissions: CO₂

Key Source: Yes (CO₂)

CO₂ emissions from lime production is a key category because of its contribution to the total inventory's level in base year and 2010 and to the trend of emissions of the total greenhouse gas inventory. In the year 2010 emissions from this category contributed 0.7% to the total amount of greenhouse gas emissions in Austria (see Table 100).

CO₂ is emitted during the calcination step of lime production. Calcium carbonate (CaCO₃) in limestone and calcium/ magnesium carbonates in dolomite rock (CaCO₃•MgCO₃) are decomposed to form CO₂ and quicklime (CaO) or dolomite quicklime (CaO•MgO) respectively.

Table 104 presents activity data for this category (lime produced) as well as CO₂ emissions from lime production for the period from 1990 to 2010.

Table 104: Activity data and CO₂ emissions for Lime production 1990–2010.

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
2009	507	695 019	730
2010	574	765 231	751

The overall trend for CO₂ emissions from this category is increasing emissions, in the year 2010 emissions were 45% higher than 1990 (see Table 104).

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 2005–2010 verified CO₂ 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 CO₂ 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 CO₂ 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 CO₂ 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 1.6%.

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. CO₂ 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 CO₂, which reacts again to CaCO₃. According to the declarations of the operators this process results even in a CO₂ sink. Thus, the processes in sugar production were considered to be CO₂ 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 years' submission.

4.2.3 Limestone and Dolomite Use (2.A.3)

4.2.3.1 Source Category Description

Emissions: CO₂

Key Source: Yes (CO₂)

CO₂ emissions from limestone and dolomite use is a key category because of its contribution to the total inventory's level for the year 2010. In the year 2010 emissions from this category contributed 0.3% to the total amount of greenhouse gas emissions in Austria (see Table 100).

In this category CO₂ emissions from decarbonising of limestone in the iron and steel industry, limestone use for desulphurization and in chemical industry are considered. CO₂ emissions from decarbonising of limestone and dolomite in glass industry were moved to 2.A.7.c Glass Production.

GHG emissions from this category increased by 45% (CO₂ + 51%) between 1990 and 2010, mainly due to increased limestone use in the iron and steel industries.

Table 105: Activity data and CO₂ emissions for Limestone and Dolomite Use 1990–2010.

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
2009	201	466 405
2010	275	633 632

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 2005–2010 verified CO₂ 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 SO₂ emission declarations from the annual steam boiler database.

For calculation of CO₂ emissions the IPCC default emission factors of 440 kg CO₂/t limestone and 477 kg CO₂/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 CO₂ emission factor is $\pm 2\%$. This derives from the uncertainty about the composition and fractional purity of limestone in CaCO₃ (or of dolomite in CaCO₃-MgCO₃) 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

No recalculations have been required for this years' submission.

4.2.4 Soda Ash Production and Use (2.A.4)

4.2.4.1 Source Category Description

Emissions: CO₂

Key Source: No

In this category CO₂ emissions from soda ash use in metallurgy and other industry is considered. CO₂ 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 CO₂-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 2010 emissions from soda ash use contributed 0.01% to total emissions in Austria. The following table presents CO₂ emissions from this category.

Table 106: Activity data and CO₂ emissions for Soda Use 1990–2010

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
1999	6	15 102

Year	CO ₂ emissions [Gg]	Soda Used [t/a]
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
2009	9	22 269
2010	10	23 325

4.2.4.2 Methodological Issues

Emissions were estimated using the methodology and the default emission factor of the IPCC guidelines (415 kg CO₂/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, as well as for 2009 and 2010. 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 CO₂ calculation.

4.2.4.3 Recalculations

Data on total marketed soda ash use is provided by Solvay Austria GmbH by personal communication. Data for 2009 had to be revised as a strong decrease in soda ash production due to the economic crises had become apparent by hindsight. This leads to a downward revision of emissions for the year 2009 (-2.9 Gg).

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: CO₂

Key Source: No

This category includes CO₂ emissions from the production of bricks where CO₂ is generated through decomposition of the carbonate content of the raw materials.

Table 107 presents CO₂ emissions from bricks production for the period from 1990 to 2010. CO₂ emissions from bricks production had a maximum in 1995/1996, following brick production. In the year 2010 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 CO₂ 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 CO₂ emissions from the stoichiometric ratios (using IPCC default emission factors). For 2005–2009 verified CO₂ 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 107 presents activity data for production of bricks and CO₂ emissions for this category for the period from 1990 to 2010.

Table 107: Activity data and CO₂ emissions for Bricks Production 1990–2010.

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
2009	94	1 729 542	54.15
2010	81	1 789 882	45.49

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.

Despite an increased production compared to 2009, the 2010 CO_2 emissions decreased by 14%. This is due to a reduced (organic and inorganic) carbon content of the basic raw material (clay) taken from a different excavation area in 2010.

Recalculations

No recalculations have been required for this years' submission.

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 2010 and also with regard to the trend assessment. In 2010 it contributed 0.4% to the total amount of greenhouse gas emissions in Austria (see Table 100).

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 108 presents CO_2 emissions from production of magnesia sinter for the period from 1990 to 2010. CO_2 emissions from magnesia sinter plants vary over the period from 1990 to 2010 with an overall decreasing trend. The increase 2010 was due to increased production after the economic crisis. In 2010 emissions are 35% 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 2005-2010 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 108 presents activity data and CO₂ emissions from this category for the period from 1990 to 2010.

Table 108: CO₂ emissions from Magnesite Sinter Production 1990–2010.

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
2009	244	461 482	529
2010	314	627 612	500

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 CO₂ 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 years' submission.

4.2.6.4 Glass Production

Emissions: CO₂

Key Source: no

In this category CO₂ 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 CO₂ emissions from 1990 to 2004 the IPCC default emission factors of 415 kg CO₂/t soda, 440 kg CO₂/t limestone and 477 kg CO₂/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 2005–2010 verified CO₂ 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 109 presents activity data and CO₂ emissions from this category for the period from 1990 to 2010.

Table 109: CO₂ emissions and carbonate use in Glass Production 1990–2010.

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
2009	24 757	26 817	40 731	1 153	41
2010	23.841	26.082	40.527	1 276	40

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

Only minor changes of CO₂ emissions have been made for the year 2009 in sector 2.A.7.c (+0.05 Gg) due to delayed availability of updated information on production data of one facility.

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: CO₂ and CH₄

Key source: Yes (CO₂)

CO₂ 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 2010. In 2010 it contributed 0.6% to the total amount of greenhouse gas emissions in Austria (see Table 100).

Ammonia (NH₃) 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. CO₂ is produced by stoichiometric conversion and is mainly emitted during the primary reforming step.

One half of the methane introduced in the synthesis is CH₄ that is generated in the so called methanator: small amounts of CO and CO₂, remaining in the synthesis gas, are poisonous for the ammonia synthesis catalyst and have to be removed by conversion to CH₄ 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 110 presents CO₂ and CH₄ emissions from ammonia production as well as ammonia production figures and natural gas input for the period from 1990 to 2010.

Emissions vary during the period and follow closely the trend in ammonia production. CO₂ emissions reach a first minimum in 1994, a second in 2001, and a third in 2007, and a fourth in 2009 all due to low production figures. In 2007 and 2009 low production figures are due to a lower demand as raw material for the production of fertilizers. In 2010 CO₂ emissions are 5% less than in the base year.

4.3.1.2 Methodological Issues

Activity data since 1990 and CH₄ 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. CH₄ emissions are calculated from the measured synthesis gas composition and the number and duration of start-ups. The implied emission factor for CH₄ 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.

CH₄ 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. In 2010 emissions increased compared to 2009. This was due to an increase of start-ups and shutdowns in this year.

CO₂ emissions are calculated from the natural gas input – Tier 2 method of the IPCC guidelines – with a standard emission factor (55.4 t/TJ). Until submission 2011 non-energy use data was taken from the national energy balance. In 2011 however, plant specific data on the use of natural gas (1990–2010) became available.

In this methodology it is assumed that the total amount of carbon in natural gas is fully converted to CO₂ and emitted at once. But, according to information from the producer, there are also fugitive CH₄ emissions during start-ups of the ammonia production. Therefore, these CH₄ emissions are reported as CH₄ emissions, they are not converted and are subtracted from total CO₂ emissions to avoid double counting. Furthermore, CO₂ and CH₄ 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 CO₂ emissions from ammonia production to avoid double counting of emissions. CO₂ is directly subtracted and CH₄ is converted to CO₂ 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 CO₂ 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 CO₂ emissions.

Table 110 shows all the relevant parameters for the calculation of CO₂ emissions from ammonia production. The resulting CO₂ IEF (with respect to ammonia) is decreasing over time, because of the increasing melamine production.

Figure 20 shows the trend of melamine production as an index of the base year.

Table 110: Activity data, emissions and implied emission factors for CO₂ and CH₄ emissions from ammonia production 1990–2010.

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	10.193	13.6	514	1 115	62.2
1991	475 000	10.441	10.4	540	1 136	64.1
1992	432 000	9.528	11.2	486	1 125	58.3
1993	469 000	10.321	10.2	534	1 138	63.3
1994	444 000	9.882	13.1	498	1 123	59.9
1995	473 000	10.516	12.2	537	1 135	61.2
1996	484 772	10.779	15.7	539	1 111	59.1
1997	479 698	10.666	15.8	532	1 109	81.1
1998	484 449	10.550	15.9	525	1 084	102.0
1999	490 493	10.689	15.9	533	1 086	54.8
2000	482 333	10.548	17.2	520	1 079	60.0
2001	448 176	9.989	21.2	475	1 060	51.0
2002	464 028	10.380	23.3	489	1 053	68.8
2003	510 887	11.324	26.6	529	1 035	47.3
2004	510 024	11.364	27.1	529	1 038	56.4
2005	478 427	10.719	25.7	499	1 043	93.9
2006	502 286	11.399	25.9	536	1 066	105.1
2007	441 299	10.015	23.4	468	1 060	140.6
2008	489 131	11.137	24.4	526	1 076	87.7
2009	449 395	10.214	23.1	480	1 069	70.9
2010	495 353	11.248	22,9	538	1 086	69.5

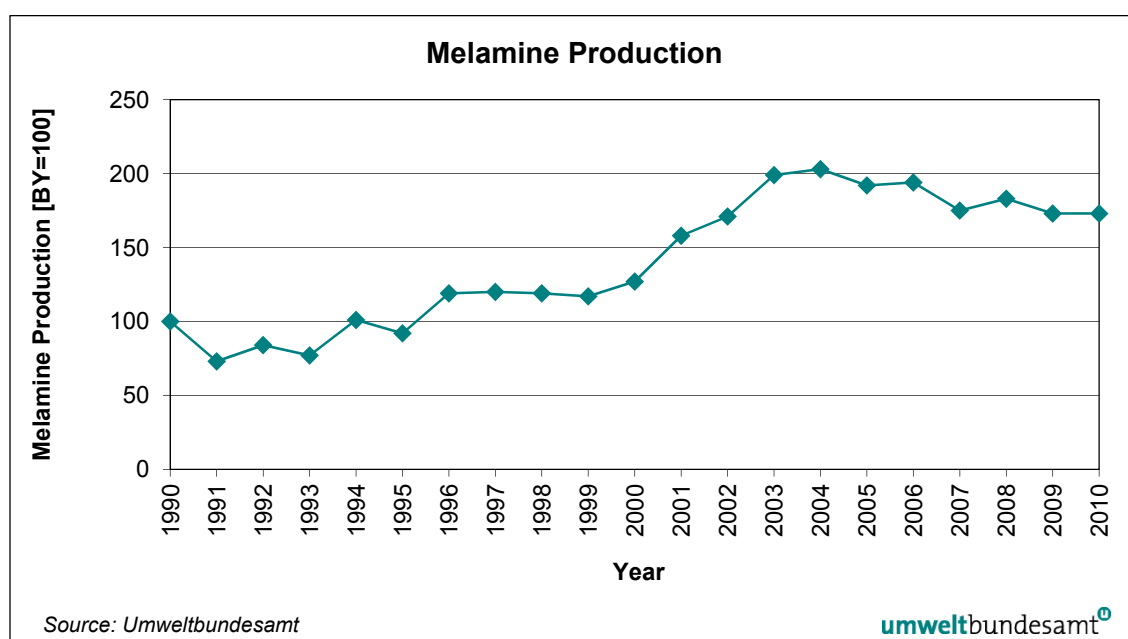


Figure 20: Melamine Production 1990–2010.

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 NH₃. This factor is plant specific, and derived from the natural gas input and ammonia output.

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

As in 2011 plant specific data on the use of natural gas from 1990–2010 became available, a recalculation of the time series was necessary. This resulted in minor changes in emissions for the whole time series (upwards and downwards).

Table 111: Recalculations with respect to previous submission for 2.B.1

Difference	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
CO ₂ [Gg]	-2.54	-6.07	-66.85	-5.33	-8.53	-0.11	-0.11	-0.15	-0.22	2.50	2.43

Difference	2001	2002	2003	2004	2005	2006	2007	2008	2009
CO ₂ [Gg]	2.45	2.44	2.50	61.53	-4.22	-6.25	-5.54	-6.03	-5.66

4.3.2 Nitric Acid Production (2.B.2)

4.3.2.1 Source Category Description

Emission: N₂O, CO₂

Key Source: Yes (N₂O)

N₂O 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 2010 it contributed 0.1% to the total amount of greenhouse gas emissions in Austria.

Nitric acid (HNO₃) is manufactured from ammonia (NH₃). In a first step NH₃ reacts with air to NO and NO₂ and is then transformed with water to HNO₃.

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 CO₂ is produced and leads to CO₂ emissions in the tail gas.

In Austria there is only one producer of nitric acid.

Table 112 presents N₂O and CO₂ emissions from production of nitric acid for the period from 1990 to 2010.

N₂O 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 N₂O emissions per produced HNO₃. 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 N₂O/t nitric acid, to about 5.0 kg N₂O/t nitric acid. From 2003 to 2004 emissions drop by 68% due to the installation of a N₂O decomposition facility in the nitric acid plant; the IEF decreased from an average of 5.0 kg N₂O/t nitric acid, to about 1.6 kg N₂O/t nitric acid. Since 2007 the IEF slightly increased again due to changes in the combustion system of one plant. In 2009 a second catalyst was put into operation in the nitric acid plant, which leads to an additional decrease of N₂O emissions which is especially pronounced in 2010 when the second catalyst was in operation for the whole year. In 2010 emissions are 93% below base year emissions.

CO₂ emissions also varied over the period from 1990–2010 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 112).

4.3.2.2 Methodological Issues

Following the IPCC Guidelines plant specific measurement data was collected.

Activity and emission data of N₂O 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 N₂O per year was calculated.

Activity and emission data of CO₂ emissions from the years 1994 onwards have been reported directly to the Umweltbundesamt by the plant operator and thus represent plant specific data. CO₂ emissions are measured discontinuously in the exhaust gas flow. The implied emission factor that was calculated from activity and CO₂ emission data from 1994 was applied to calculate CO₂ emissions of the years 1990 to 1993 as no CO₂ emission data was available for these years.

Table 112: Activity data, emissions and implied emission factors for N₂O and CO₂ emissions from Nitric Acid Production 1990–2010.

Year	Nitric Acid Produced [t]	N ₂ O Emissions [Mg]	CO ₂ Emissions [Gg]	IEF N ₂ O [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

Year	Nitric Acid Produced [t]	N ₂ O Emissions [Mg]	CO ₂ Emissions [Gg]	IEF N ₂ O [kg/t]	IEF CO ₂ [kg/t]
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
2009	495 711	534	0.35	1.08	0.70
2010	547 699	205	0.40	0.37	0.73

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 N₂O 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 N₂O concentrations changed from discontinuous measurements to online spectroscopic measurements.

4.3.2.5 Recalculations

No recalculations have been required for this years' submission.

4.3.3 Calcium Carbide Production (2.B.4)

4.3.3.1 Source Category Description

Emission: CO₂

Key Source: No

Calcium carbide is made by heating calcium carbonate and subsequently reducing CaO with carbon – both steps lead to emissions of CO₂.

This source is only a minor source of CO₂ emissions in Austria: in 2010, 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 113: Activity data and emissions for CO₂ emissions from Calcium Carbide Production 1990–2010.

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
2009	32 459	42
2010	33 041	43

4.3.3.3 Recalculations

No recalculations have been required for this years' submission.

4.3.4 Chemical Industry – Other: Production of Fertilizers and Urea (2.B.5)

4.3.4.1 Source Category Description

Emission: CH₄, CO₂

Key Source: No

This category includes CH₄ and CO₂ 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 2010, total emissions from this source contribute 0.05% to national total emissions.

CO₂ 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 2010 emissions from this category are 14% lower than in 1990 (see Table 114).

The high CO₂ emissions from urea production in 2010 resulted from repeated shutdown and start up of the urea plant, leading to increased emissions.

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 NH₃ and CO₂; the latter is also formed in the ammonia production. In urea production CO₂ 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 CH₄ that is released when NH₃ reacts to urea. These CH₄ emissions are calculated from the ammonia input in the urea production process and the methane content of the ammonia.

CH₄ emissions from the production of urea were reported for the years 2002–2010. For the years before no data is available; therefore the implied emission factor for the year 2002 was used for all years. CO₂ 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 2009 production data were reported directly by the main producer of fertilizers in Austria.

Emission data for CO₂ emissions from the production of fertilizers for 1994 to 2009 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. CO₂ emissions from fertilizer production were calculated by industry using a mass balance approach.

CH₄ emissions from the production of fertilizers were reported for the years 2002–2010; these data became available due to a measurement programme for CH₄ 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 114 presents activity data, emissions and implied emission factors for CH₄ and CO₂ emissions from *Fertilizer Production* and *Urea Production* for the period from 1990 to 2010.

Table 114: Activity data, emissions and implied emission factors for CO₂ and CH₄ emissions from NPK-fertilizer Production and Urea Production 1990–2010.

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	25.41	24.38	137.9
2009	400 420	0.29	150.8	859 852	16.13	18.75	120.3
2010	419 997	0.49	155.9	1 051 087	26.03	24.76	139.9

4.3.4.3 Recalculations

No recalculations have been required for this years' submission.

4.3.5 Chemical Industry – Other: Ethylene Production (2.B.5)

4.3.5.1 Source Category Description

Emission: CH₄

Key Source: No

Ethylene is made by steam cracking of petrochemical feedstock. This production process leads to fugitive methane emissions.

This source is only a minor source of CH₄ emissions in Austria; in 2009 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 CH₄/kg Ethylene production was used to calculate the emissions that amount to 350 tonnes CH₄ until 2005 and 500 tonnes CH₄ since 2006.

4.3.5.3 Recalculations

No recalculations have been required for this years' submission.

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: CO₂, CH₄

Key Category: Yes (CO₂)

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 CO₂ 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 CO₂ 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 CH₄ emissions from rolling mills and from electric arc furnaces are reported in this category.

CO₂ 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 2010 and because of its contribution to the trend.

In the year 2010, CO₂ emissions from production of iron and steel contributed 6.5% to total greenhouse gas emissions in Austria (see Chapter 1.5).

CH₄ emissions from this category are negligible; the contribution to national total emissions in 2010 was 0.001%.

Table 115 presents total CO₂ and CH₄ emissions from the production of iron and steel for the period from 1990 to 2010. CO₂ emissions from *Iron and Steel Production* decrease from 1990 to 1992 and then increase steadily following the trend of pig iron production. In 2010 emissions were 54% above the level of 1990.

Table 115: Total CO₂ and CH₄ emissions from iron and steel 1990–2010.

Year	CO ₂ [Gg]	CH ₄ [Gg CO ₂ eq]
1990	3 546	0.047
1991	3 509	0.039
1992	3 075	0.045
1993	3 145	0.051
1994	3 411	0.054
1995	3 921	0.057
1996	3 703	0.050
1997	4 100	0.059
1998	3 900	0.063
1999	3 759	0.061
2000	4 202	0.068
2001	4 159	0.069
2002	4 607	0.068
2003	4 523	0.072
2004	4 446	0.077
2005	4 995	0.079
2006	5 193	0.081
2007	5 482	0.089
2008	5 807	0.090
2009	4 412	0.072
2010	5 460	0.081

4.4.1.2 Methodological Issues

General Remark

Total CO₂ 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 emissions³⁷ are calculated by the Umweltbundesamt according to the IPCC good practice guidance; these emissions are subtracted from total CO₂ 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 CO₂ 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 carbonatous ore was considered for calculating the split of process specific and combustion specific CO₂ emissions from

³⁷ Process specific emissions considered are CO₂ emissions resulting from the use of reducing agent in pig iron production in blast furnaces and CO₂ 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 CO₂ emissions from limestone use in blast furnaces. The latter is reported under 2.A.3

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 carbonatous ore).

For the years 2003 and 2004 total CO₂ 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 2005–2010 verified CO₂ emissions, reported under the ETS, were taken for the inventory. These data cover CO₂ emissions from pig iron, basic oxygen and electric arc furnace steel.

CO₂ emissions from blast furnace pig iron production

CO₂ 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:

$$\text{CO}_2 \text{ Emissions} = \text{Mass of reducing agent} * 3.1 \text{ t CO}_2 / \text{t reducing agent} + (\text{Mass of Carbon in the Ore} - \text{Mass of Carbon in the Crude Iron}) * 44/12$$

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 balance³⁸.

This non-energy use is used for calculating CO₂ 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 carbonatous ore was considered for the calculation as no statistical data was available for the amount of other ore³⁹ (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 stoichiometric ratio of carbon in FeCO₃:

$$\text{Mass of Carbon in the Ore} = \text{Mass of ore} * 12/116$$

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 2005–2010 correspond to the background data (for consistency reasons just carbonatous 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.

³⁸ 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.

³⁹ Carbonatous ore is mined in Austria, thus it is reported in the statistical yearbook.

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 2002–2009 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 2005–2010 CO₂ emissions from non-carbonatous 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 CO₂ emissions, but only improves the accuracy of the split made between process and combustion specific emissions.

Activity data, calculated CO₂ emission data as well as the implied emission factor for CO₂ emissions from pig iron production are presented in Table 116. The trend in IEF values from pig iron production fluctuates until 2005, because CO₂ emissions follow closely the coke input (more than 91% of CO₂ 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 extent 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 and 2009 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 116: Activity data, emissions and implied emission factors for CO₂ emissions from pig iron production 1990–2010.

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	1 351	2 032	5 846	4 934	844
2009	1 046	2 054	4 376	3 924	897
2010	1 284	1 984	5 644	4 622	819

CO₂ emissions from basic oxygen furnace steel production

CO₂ 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:

$$\text{CO}_2 \text{ Emissions} = (\text{Mass of Carbon in the Crude Iron used for Crude Steel} - \text{Mass of Carbon in the Crude Steel}) * 44/12$$

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 2010 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%).

CO₂ and CH₄ emissions from electric arc furnace steel production

Emissions were estimated using a country specific methodology.

CO₂ 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 2005–2010 verified CO₂ emissions, reported under the ETS, were taken for the inventory.

The CO₂ emissions and production data are based on data of each electric arc furnace plant (3) in Austria. The IEF depends on the C content of the used scrap. This ratio is varying depending on the composition of the scrap and consequently with changing raw material also the EF can vary between years.

The production of electric furnace steel is a result of various variables:

- a) availability (recycling rate and stocks), price and type of the scrap, which differs in regard to the content of iron and carbon as well as regarding to the content of alloying elements;
- b) area of application;
- c) demand of electric furnace steel in the diversified applications.

The Austrian electric furnace steel satisfies the demand mainly in the following areas of application:

- quality steel division and special steel division where mainly high carbon and high alloyed quality steel is produced (tool steel, high speed steel, aircraft alloys, stainless specialties);
- reinforcing steel division and steel bar and billet division where mainly mild and low carbon steel is produced.

The demand of the respective steel quality is depending on the economical situation of the relevant branch where the electric furnace steel is used. The fluctuation of the markets is reflected therefore finally also in the emission data and IEF. The decrease in 2009 in Austrian steel production as a consequence of the global economic downturn and was induced by a drop in demand in almost all important steel markets.

For calculating CH₄ emissions an emission factor of 5 g CH₄/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% CH₄ and 90% NMVOC (expert judgement Umweltbundesamt).

Activity data were obtained from the *Association of Mining and Steel* and thus represent plant specific data.

CH₄ 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% CH₄ and 90% NMVOC (expert judgement Umweltbundesamt).

Activity data as used for calculating CO₂ emissions from steel production (see above) was applied.

Table 117 presents steel and electric steel production, CO₂ and CH₄ emissions and implied emission factors as well as total CO₂ emissions from this sector.

Table 117: Activity data, emissions and implied emission factors for CO₂ and CH₄ emissions from Steel Production 1990–2010.

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	1.8	2.16	450
1993	3 738	430	115	0.37	411	22	2.05	2.43	451
1994	3 968	465	117	0.4	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	0.4	396	21	1.98	2.38	502
1997	4 718	557	118	0.47	466	25	2.33	2.8	581
1998	4 801	565	118	0.48	503	27	2.51	2.99	592
1999	4 722	548	116	0.47	486	26	2.43	2.9	573
2000	5 183	605	117	0.52	541	29	2.7	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	622	45	3.11	3.76	808
2006	6 487	778	120	0.65	643	49	3.21	3.85	827
2007	6 871	826	120	0.69	708	58	3.54	4.22	884
2008	6 873	820	119	0.69	723	57	3.62	4.31	877
2009	5 077	614	121	0.51	588	42	2.94	3.45	656
2010	6 570	792	120	0.66	637	47	3.19	3.84	839

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 2005–2010 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 CO₂ 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 CO₂ 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 CO₂ emissions of 0.7% (WINIWARTER 2008).

4.4.1.5 Recalculations

Revised data of the energy balance resulted in a change of split in process and energy related CO₂ emissions for the years 2008 (+3.6 Gg) und 2009 (+167.6 Gg) respectively a shift from 1.A.2.a to 2.C.1 has occurred.

Furthermore, revised plant specific activity data on electric arc furnace steel for the years 2005 – 2010 became available, and resulted in a small revision of AD and IEF (as emissions were taken from the ETS, there is no change in emission data).

4.4.2 Ferroalloys Production (2.C.2)

4.4.2.1 Source Category Description

Emissions: CO₂

Key source: No

Ferroalloy production involves a metallurgical reduction process which results in CO₂ emissions.

This source is only a minor source of CO₂ emissions in Austria: in 2010, 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, 2005–2010) Austria produces ferro-molybdenum, ferro-vanadium and ferro-nickel. Activity data from 1995 to 2010 were directly taken from these publications. As no data were available for 1990–1994 the value from 1995 was taken as a proxy for these years.

Data for 2010 are based on personal communication because of the late publication date of the British Geological Survey. As soon as the publication becomes available it will be checked whether the published activity data corresponds with the data used in the inventory.⁴⁰

The emission factor for ferro-nickel of 1.36 t CO₂/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 118: Activity data and emissions from ferroalloy production 1990–2010.

Year	Ferroalloy production [kt]	CO₂ 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	12.8	17.4
2009	12.7	17.3
2010	14.5	19.7

4.4.2.3 Recalculations

No recalculations have been required for this years' submission.

⁴⁰The value for 2009 (submitted 2011) has then been confirmed by the official publication of the British Geological Survey in 2011.

4.4.3 Aluminium Production (2.C.3)

4.4.3.1 Source Category Description

Emissions: PFCs and CO₂

Key Source: Yes (PFCs)

This category includes emissions of CO₂ and PFCs from aluminium production. Primary aluminium production in Austria was terminated in 1992.

The two PFCs, tetrafluoromethane (CF₄) and hexafluoroethane (C₂F₆) are emitted from the process of primary aluminium smelting. They are formed during the phenomenon known as the anode effect (AE).

CO₂ 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 CO₂ emissions due to its trend.

Table 119 presents PFC and CO₂ emissions from primary aluminium production for the period from 1990 to 1992.

Table 119: 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

CO₂ emissions were calculated by applying the IPCC default emission factor of 1.8 t CO₂/t aluminium produced taken from the IPCC guidelines (Table 2.16).

PFC emissions were estimated using the IPCC Tier 3b methodology. The specific CF₄ emissions (and C₂F₆ emissions respectively) of the anode effect were calculated by applying the following formula (BARBER 1996), (GIBBS & JACOBS 1996), (TABERAUX 1996):

$$\text{kg CF}_4/\text{t}_{\text{Al}} = (1.7 \times \text{AE}/\text{pot}/\text{day} \times F \times \text{AE}_{\text{min}})/\text{CE}$$

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 CF₄ in the anode gas (13%)

CE = current efficiency (85%)

1.7 = constant resulting from Faraday's law

In Austria so called "Söderberg" 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 CF₄ formed in percent of the anode gas (F) can be determined as a function of the duration of the anode ef-

fect. 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 (WINWARTER 2008).

4.4.3.5 Recalculations

No recalculations have been required for this years' submission.

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 2010 very low emissions arose from this category (see Table 100).

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 SF₆ in magnesium cover gas will not be destroyed but more or less completely emitted. Recent studies showed that SF₆ 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 SF₆ is added in concentrations of 1–2.5%.

Table 120 presents SF₆ emissions from magnesium and aluminium foundries for the period from 1990 to 2010.

As can be seen in the table below, SF₆ emissions have been fluctuating during the period, but the overall trend has been decreasing SF₆ emissions; from 1990 to 2010 they decreased by nearly 100%. This decreasing trend is explained by technological advances and the replacement of SF₆ by other substances used for surface protection; since 2008 the use of SF₆ per foundry is limited to 850 kg /a in Europe (EC Regulation 842/2006).

Table 120: SF₆ emissions from magnesium and aluminium foundries 1990–2010.

Year	SF₆ 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
2009	0.02
2010	0.01

4.4.4.2 Methodological Issues

Emissions were estimated following the IPCC methodology using annual consumption data of SF₆.

Information about the amount of SF₆ 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 SF₆ suppliers).

Actual emissions of SF₆ equal potential emissions and correspond to the annual consumption of SF₆ for magnesium casting. During the last ten years, two magnesium casting companies existed in Austria which could use SF₆ from the technical process as fire-extinguishing cover gas. One company relied on a N₂/CO₂/SO₂-system. The other company changed over in former times to fluorinated ketone (Novec) as an alternative cover gas system but used SF₆ to quench fire of molten magnesium. SF₆ 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 SF₆ as cleaning gas again from 2006 onwards. For these recent years an EF of 1.5% of SF₆ consumed was applied. This EF is based on measurements in a German aluminium plant that have shown significant destruction of SF₆ (decomposition into sulphur and fluorine) during the process (SCHWARZ & GSCHREY 2009).

4.4.4.3 Source specific QA/QC

The amount of SF₆ used is cross-checked with data from SF₆ suppliers. The IEF for magnesium casting (referred to magnesium cast) range between 0.1 and 7.4 kg SF₆ / 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 SF₆ use data is low (5%).

4.4.4.5 Recalculations

No recalculations have been required for this years' submission.

4.5 Consumption of Halocarbons and SF₆ (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 SF₆ 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 SF₆* greenhouse gas emissions are about five times higher in 2010 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*) (Montreal Protocol).

Potential and actual emissions per substance group is presented in Table 121, emissions by sub sector and gas are presented in Table 122 and Table 123.

In 2005 and 2006 actual SF₆ emissions exceed potential emissions. This is due to emissions from disposal of noise insulating windows. After the recession in 2009 (economic crisis), halocarbon emissions increased again in 2010 due to the increased industrial production (e.g. semiconductor manufacture).

Table 121: Potential and actual emissions of IPCC Category 2 F per substance group [Gg CO₂e] 1990–2010.

Year	HFCs [Gg CO ₂ e]		PFCs [Gg CO ₂ e]		SF ₆ [Gg CO ₂ e]		Total [Gg CO ₂ e]	
	Potential	Actual	Potential	Actual	Potential	Actual	Potential	Actual
1990	31.83	26.32	32.28	1 079.24	835.85	494.28	899.96	1 599.84
1991	44.06	29.56	40.99	1 087.08	1 111.60	644.74	1 196.65	1 761.38
1992	46.16	32.31	49.70	462.32	1 180.96	688.92	1 276.82	1 183.55
1993	296.64	243.56	58.41	52.57	1 271.23	780.89	1 626.28	1 077.02
1994	334.72	293.06	64.77	58.30	1 530.68	971.85	1 930.17	1 323.21
1995	750.52	411.88	78.87	71.27	1 692.59	1154.06	2 521.98	1 637.21
1996	1 038.72	531.93	79.02	71.70	1 589.30	1234.15	2 707.04	1 837.78
1997	1 211.45	651.68	115.87	105.15	1 485.23	1139.26	2 812.55	1 896.09
1998	1 284.08	769.31	122.26	55.95	1 450.40	913.21	2 856.74	1 738.47
1999	1 448.22	876.61	205.58	78.63	1 147.22	787.19	2 801.02	1 742.43
2000	1 725.30	901.85	253.90	84.79	932.27	595.54	2 911.47	1 582.18
2001	1 746.52	924.89	313.85	95.91	919.39	652.28	2 979.76	1 673.08
2002	1 782.43	969.18	316.20	97.70	926.35	634.81	3 024.98	1 701.69
2003	1 692.54	949.51	396.29	116.44	636.16	566.62	2 724.99	1 632.57
2004	1 690.87	955.10	353.30	136.65	652.97	497.35	2 697.14	1 589.10
2005	1 362.69	986.36	360.87	133.82	490.12	507.33	2 213.68	1 627.51
2006	1 239.81	962.57	389.77	145.72	457.20	465.15	2 086.78	1 573.44
2007	1 319.10	1 061.91	458.18	190.12	434.49	374.54	2 211.77	1 626.57
2008	1 152.79	1 057.99	428.30	173.53	446.99	382.84	2 028.08	1 614.36
2009	1 113.07	1 056.61	229.25	35.05	359.89	349.14	1 702.21	1 440.80
2010	1 837.57	1 160.63	349.38	69.85	614.38	345.01	2 801.33	1 575.49

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 SF₆),
- 2.F.8 Electrical Equipment (SF₆) and
- 2.F.9 Other (SF₆, PFC)

Two 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 2010 and to the trend of emissions. In the year 2010 HFC emissions from ODS contributed 1.9% to the total amount of greenhouse gas emissions in Austria, in the base year (1990) 0.0% (see Table 100).

2.F.9 Other (SF₆, PFC) because of its contribution to the total inventory's level in the year 2010. In the year 2010 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. Calculations for 2009 and 2010 are based on the calculations from this study.

Data about consumption of HFC, PFC and SF₆ 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-regulation⁴¹ for users of FCs in the following applications: refrigeration and air-conditioning, foam blowing, semiconductor manufacture, electrical equipment, fire extinguishers and aerosols. Data is either reported electronically with a system set up by the Umweltbundesamt or per mail (electronic or letter) to the Ministry for Environment (these reports are then forwarded to the Umweltbundesamt to be brought together with data from the electronic system).

The first reporting year is 2003, from this year on the end users of FCs are obliged to report annually about the amounts used and recycled. Theoretically, almost the whole activity data used for inventory preparation is covered by the reporting obligation. However, especially the refrigeration sector is very complex, there are numerous small enterprises, and not all of them are organised in an industry association, they are hard to reach and to inform about the reporting obligation. That's why not all enterprises reported their consumption. In the recent study the available data has been used either directly or for verification.

⁴¹ „Industriegas-Verordnung (HFKW-FKW-SF₆-VO)“ Federal Law Gazette II No. 447/2002

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 SF₆ 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 122: Emissions of IPCC Category 2.F by source 1990–2000.

GHG	GWP	Unit	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
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	4.71
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	41.94
HFC-134a	1 300	t	1.35	2.12	2.83	4.14	30.94	57.74	84.54	111.34	138.14	164.94	191.74
HFC-152a	140	t	0.00	0.00	0.00	0.00	0.00	0.06	0.85	1.65	2.44	3.24	4.04
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	43.00
HFC-23	11 700	t	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.18
C3F8	7 000	t	0.00	0.00	0.00	0.00	0.00	0.41	0.83	1.24	1.65	2.06	2.48
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	54.56
Gg CO₂e			1.76	2.75	3.68	5.38	43.33	107.89	205.66	305.87	408.61	514.31	624.08
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	140.25
HFC-152a	140	t	0.00	0.00	0.00	74.75	78.15	81.54	88.34	95.14	101.93	101.93	595.04
Gg CO₂e			0.00	0.00	0.00	207.93	217.37	272.56	295.64	317.62	340.67	343.72	265.64
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	0.00
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	0.17
Gg CO₂e			0.00	0.00	0.00	0.17	0.41	0.64	0.99	1.37	1.81	2.25	0.50
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	18.42
Gg CO₂e			22.17	22.79	23.21	23.28	23.77	24.13	24.63	24.99	25.71	26.40	23.94
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	0.90
Gg CO₂e			0.46	0.94	0.97	0.99	1.00	1.02	1.05	1.07	1.10	1.14	1.17
2.F.7 Semiconductor Manufacture													
HFC- unspecified	Gg CO ₂ e		1.93	3.07	4.44	5.81	7.18	8.53	9.74	9.43	2.96	3.23	3.85
PFC- unspecified	Gg CO ₂ e		29.05	36.89	44.73	52.57	58.30	68.39	65.92	96.48	44.40	64.19	67.46
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	13.92
Gg CO₂e			133.08	215.20	287.79	360.38	430.86	505.68	403.95	593.76	477.80	453.93	403.97
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	0.73
Gg CO₂e			12.28	13.07	13.86	14.65	15.44	15.87	15.40	15.58	18.30	17.11	17.34
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	8.72
C3F8	7 000	t	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Gg CO₂e			126.56	179.20	183.10	187.00	218.19	266.32	279.81	286.65	300.28	275.61	208.40

Table 123: Emissions of IPCC Category 2.F by source 2000–2010.

GHG	GWP	Unit	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010
2.F.1 Refrigeration and Air Conditioning Equipment												
Stationary												
HFC-32	650	t	7.25	7.32	7.43	10.09	10.88	11.33	12.59	12.72	12.74	16.69
HFC-125	2 800	t	46.33	46.59	47.35	53.50	64.98	67.38	79.09	79.40	79.72	104.38
HFC-134a	1 300	t	172.04	172.45	173.37	154.79	155.81	162.57	162.38	174.30	163.21	137.54
HFC-152a	140	t	3.10	3.10	3.10	2.17	1.61	1.61	1.05	1.05	1.10	1.53
HFC-143a	3 800	t	44.34	44.53	45.29	48.53	59.77	62.02	72.94	73.15	73.51	86.10
HFC-23	11 700	t	0.14	0.14	0.14	0.11	1.27	1.27	2.44	2.44	2.44	2.43
C3F8	7 000	t	2.03	2.03	2.03	1.59	1.25	1.25	0.92	0.92	0.92	0.84
Mobile												
HFC-134a	1 300	t	67.74	81.52	94.80	111.27	126.53	149.10	159.96	176.24	186.93	200.27
Gg CO₂e			631.00	650.95	674.52	699.39	807.08	860.77	960.90	999.31	1001.10	1104.00
2.F.2 Foam Blowing												
HFC-134a	1 300	t	142.12	123.88	125.92	128.08	84.65	9.73	9.60	9.52	9.44	9.38
HFC-152a	140	t	608.14	946.24	637.02	428.95	204.55	247.69	248.62	87.10	129.34	134.36
Gg CO₂e			269.89	293.52	252.88	226.56	138.68	47.32	47.29	24.57	30.38	31.00
2.F.3 Fire Extinguishers												
HFC-23	11 700	t	0.28	0.00	0.00	0.18	0.43	0.34	0.41	0.86	0.86	0.86
HFC-227ea	2 900	t	0.00	0.73	0.13	0.54	0.31	0.63	0.11	0.00	0.08	0.00
Gg CO₂e			3.22	2.14	0.38	3.68	5.92	5.85	5.13	10.11	10.34	10.10
2.F.4 Aerosols												
HFC-134a	1 300	t	22.83	24.05	23.29	24.36	30.37	40.29	36.87	17.73	14.99	15.24
Gg CO₂e			29.68	31.26	30.28	31.66	39.48	52.38	47.93	23.04	19.49	19.82
2.F.5 Solvents												
HFC-43-10mee	1 300	t	0.92	1.16	1.39	0.70	0.00	0.00	0.00	0.00	0.00	0.00
Gg CO₂e			1.20	1.50	1.81	0.91	0.00	0.00	0.00	0.00	0.00	0.00
2.F.7 Semiconductor Manufacture												
HFC-unspecified	Gg CO ₂ e		4.14	4.05	3.88	4.06	3.98	5.03	7.07	7.39	1.71	1.62
PFC-unspecified	Gg CO ₂ e		81.67	83.46	102.20	125.49	125.04	135.50	182.55	166.39	28.64	63.93
SF ₆	23 900	t	15.02	15.00	15.82	15.91	7.08	7.04	4.12	4.42	3.12	2.88
Gg CO₂e			444.69	445.89	484.15	509.92	298.17	308.69	288.00	279.51	104.92	134.27
2.F.8 Electrical Equipment												
SF ₆	23 900	t	0.76	0.79	0.79	0.86	0.91	0.94	1.01	1.06	1.14	1.31
Gg CO₂e			18.09	18.92	18.93	20.49	21.86	22.40	24.10	25.41	27.27	31.30
2.F.9 Other												
SF ₆	23 900	t	10.32	10.47	6.95	4.04	13.03	10.96	10.53	10.46	10.32	10.24
C3F8	7 000	t	0.00	0.00	0.00	0.00	0.00	0.21	0.17	0.11	0.00	0.00
Gg CO₂e			246.57	250.33	166.04	96.49	311.53	263.34	252.91	250.71	246.74	244.71

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 came to disposal, from 2009 onwards emissions from disposal equal the amount of imported fridges/freezers (1% of total). 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 NH₃. 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 comparably 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 an update of information regarding life time of equipment, some emissions from disposal starting in 2009 were updated, which led to minor recalculations of emissions in that sector. Also, some reviewed activity data for mobile air conditioning became available, which also led to minor recalculations for 2009.

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 CO₂. 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 m². Consequently these HFC can be found in the stock of XPS in buildings etc. During 2000–2009 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 CO₂ driven XPS foam is not suitable. XPS foam with CO₂ 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 CO₂ 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 CO₂ 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 CO₂ 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

No recalculations have been required for this years' submission.

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 ($2 \pm 1\%$ per year). The mean value of 1.7% was applied to estimate emissions for the years before 2000, for which no detailed data on re-filled amounts were available.

Recalculations

No recalculations have been required for this years' submission.

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 100 t in 2009). 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

No recalculations have been required for this years' submission.

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, SF₆)

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:

- SF₆: Isolation-gas for high-voltage measurement/Process-gas for plasma-etching,
- CF₄, C₂F₆, C₃F₈, C₄F₈: Process-gas for plasma-etching/Cleaning chemical vapor deposition,
- CHF₃: 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 CF₄, C₂F₆ and SF₆ in the other years are due to increasing semiconductor production.

Recalculations

No recalculations have been required for this years' submission.

4.5.2.7 2.F.8 Electrical Equipment (SF₆)

SF₆ 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 SF₆ when imported and are hermetically closed (“sealed for life”). Both categories of equipment have lifetimes of 30–40 years.

Information on SF₆ 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 SF₆ filled equipment since 2004). For the time series information on new equipment per year and the average SF₆ 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

No recalculations have been required for this years' submission.

4.5.2.8 2.F.9 Other Sources of SF₆

Noise insulating windows

Activity data were estimated based on information from experts from industry.

Approximately one-third of the total amount of SF₆ 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 SF₆ 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 SF₆ filled windows were introduced in Austria in 1980. They are calculated by assuming that the remaining quantity of SF₆ in windows produced in 1980 is emitted this year.

Tyres

SF₆ 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 SF₆ as filling gas instead of air. In Austria the national tyre and automotive trade sold tyres with SF₆ as filling gas filled within the country. The gas used for this purpose was supplied by only one SF₆ importer, who reported on the amount of SF₆ sold to the Austrian tyre and automotive trade. As of 2003, the Austrian F-gas regulation stopped abruptly by legal prohibition the usage of SF₆ as filling gas for tyres.

According to IPCC GL 2006 it is assumed that SF₆ completely emits from car tyres with their disposal three years after filling. Filling emissions are regarded to be insignificant. Consumption of SF₆ and disposal emissions three years later are identical.

Shoes

Nike introduced sport shoes with gas cushions filled with SF₆ in the early 1990's. From 2003 to 2006 the company used as alternative PFC (C₃F₈) for the same purpose. Shoes with F-gas cushions are not manufactured in Austria but imported. SF₆ emissions from sport shoe soles occurred in Austria up to 2006, PFC-C₃F₈ 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

SF₆ 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 SF₆ 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 SF₆ 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 SF₆.

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

No recalculations have been required for this years' submission.

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 SF₆ 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.

Trilateral F-gas Peer Review

A trilateral meeting of F-gas sector experts from the UK, Austria and Germany was held in Vienna, February 2011. Although not a formal review, each country reviewed the completeness, consistency and transparency of the parts of the NIRs reporting F-gases. Suggestions for improvements resulting from this informal and voluntary review will be considered for future implementation.

Recalculations Potential Emissions:

A minor error was corrected which led to revised data for the years 2008–2009.

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

The outcome of the informal review showed that new data sources (regarding activity data of 2.F.) should be looked for and considered wherever possible. This can be regarded as an ongoing process and will probably lead to an improvement of the inventory.

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 CO₂.

Estimations for N₂O emissions from other product use (anaesthesia and aerosol cans) are also addressed in this chapter.

5.1.1 Emission Trends

In the year 2010, 0.4% of total GHG emissions in Austria (327.12 Gg CO₂ equivalents) originated from *Solvent and Other Product Use*. 54% of these emissions were indirect CO₂ emissions, 46% were accounted for by N₂O emissions.

The overall trend in greenhouse gas emissions from solvent and other product use shows decreasing emissions, with a decrease of 36% from 1990 to 2010. The main driver is a decreasing use of solvents as a result of legal measures and decreasing N₂O use. From 2009 to 2010 emissions increased considerably by 9% due to a rebound in the economy.

Figure 21 and Table 124 present the trend in total greenhouse gas emissions by subcategories.

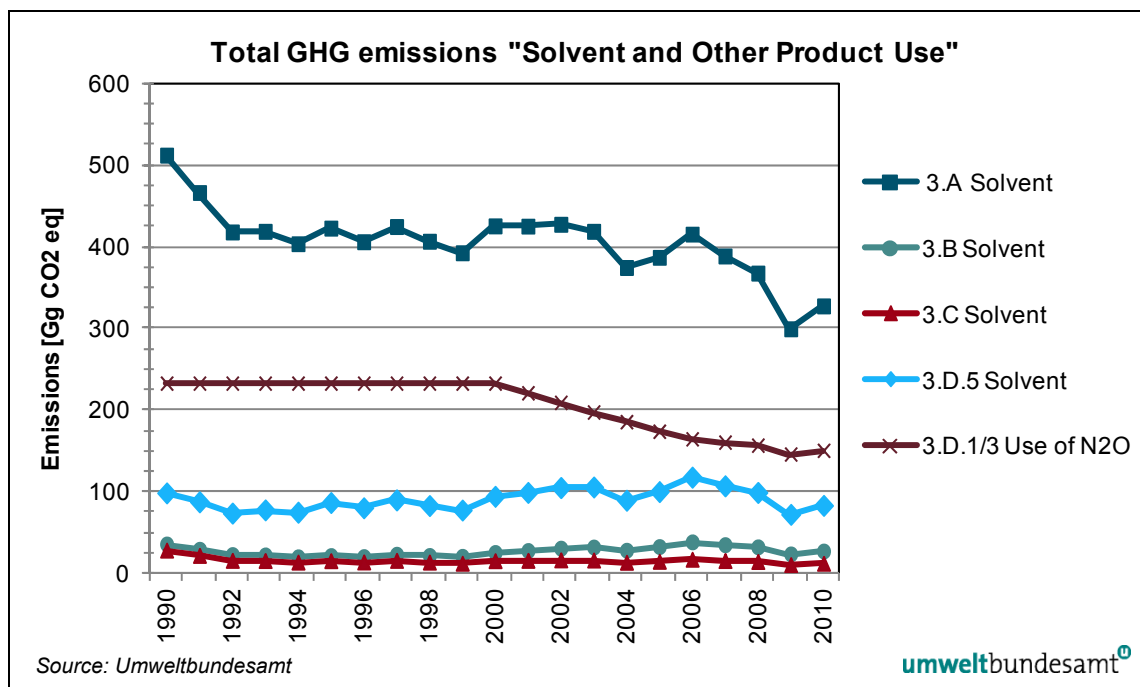


Figure 21: Total greenhouse gas emissions and trend from 1990–2010 by subcategories of Category 3 Solvent and Other Product Use.

Table 124: Total greenhouse gas emissions and trend from 1990–2010 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 ₂ O	Use of N ₂ O	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	427.08	67.05	30.38	16.06	313.60	84.94	124.00	104.66
2003	418.42	68.39	31.76	15.80	302.46	73.16	124.00	105.30
2004	374.23	58.71	27.92	13.07	274.53	61.38	124.00	89.15
2005	386.59	66.59	32.40	14.28	273.33	49.60	124.00	99.73
2006	415.03	78.39	38.14	16.81	281.70	40.30	124.00	117.40
2007	388.34	71.30	34.69	15.29	267.06	36.27	124.00	106.79
2008	367.24	65.87	32.05	14.12	255.20	32.55	124.00	98.65
2009	299.16	47.98	23.34	10.29	217.56	21.70	124.00	71.86
2010	327.12	55.30	26.91	11.86	233.05	26.23	124.00	82.82
<i>Trend 2009–2010</i>	9.3%	15.3%	15.3%	15.3%	7.1%	20.9%	0.0%	15.3%
<i>Trend 1990–2010</i>	-36.1%	-53.0%	-24.2%	-57.6%	-29.5%	-75.8%	0.0%	-15.6%

The significant reduction of greenhouse gas emissions in this sector between 1990 and 2010 is mainly due to decreasing solvent and N₂O 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. 398/2005⁴², amendment of Federal Law Gazette 872/1995⁴³, amendment of Federal Law Gazette 492/1991⁴⁴ (implementation of Council Directive 2004/42/CE);

⁴² 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 873/1995⁴⁵, amendment of Federal Law Gazette 27/1990⁴⁶;
- Federal Ozone Law: establishes by various measures a reduction in emissions of ozone precursors NO_x and NMVOC
Federal Law Gazette 309/1994, amendment of Federal Law Gazette 210/1992⁴⁷;
- 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 865/1994⁴⁸;
- Convention on Long-range Transboundary Air Pollution (LRTAP)⁴⁹, extended by eight protocols from which the following have relevance
 - The 1988 Protocol concerning the Control of Nitrogen Oxides or their Transboundary Fluxes⁵⁰;
 - The 1991 Protocol concerning the Control of Emissions of Volatile Organic Compounds or their Transboundary Fluxes⁵¹;
 - The 1998 Protocol on Persistent Organic Pollutants (POPs)⁵²;
 - The 1999 Protocol to Abate Acidification, Eutrophication and Ground-level Ozone⁵³,

⁴³ Verordnung des Bundesministers für Umwelt über Verbote und Beschränkungen von organischen Lösungsmitteln (Lösungsmittelverordnung 1995 – LMVO 1995), BGBl. 872/1995

⁴⁴ Verordnung des Bundesministers für Umwelt, Jugend und Familie über Verbote und Beschränkungen von organischen Lösungsmitteln (Lösungsmittelverordnung), BGBl. Nr. 492/1991

⁴⁵ 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

⁴⁶ 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

⁴⁷ 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)

⁴⁸ 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

⁴⁹ Entered into force 14 February 1991; ratified by Austria 16 December 1982; See for more information UMWELTBUNDESAMT (2009): Informative Inventory Report. Vienna.

⁵⁰ Entered into force 14 February 1991; ratified by Austria 15 January 1990; BGBl. Nr. 273/1991

⁵¹ 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

⁵² Entered into force on 23 October 2003; ratified by Austria 27 August 2002

⁵³ 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. 301/2002⁵⁴, amended by Federal Law Gazette⁵⁵;
- Council Directive 1999/13/EC⁵⁶ 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/CE⁵⁷ 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. 411/2005⁵⁸.

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.

⁵⁴ 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

⁵⁵ Änderung der VOC-Anlagen-Verordnung – VAV, BGBl. II Nr. 42/2005

⁵⁶ 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

⁵⁷ 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

⁵⁸ 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 N₂O use has significantly decreased due to shorter duration of anaesthesia during operations and more local anaesthetics than general anaesthesia.

Table 125 presents the trend in total greenhouse gas emissions by gas.

Table 125: Trend in greenhouse gas emissions of solvent and other product use 1990–2010.

GHG	CO ₂ emission [Gg CO ₂ equivalent]	N ₂ O 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	218.14	208.94	427.08
2003	221.26	197.16	418.42
2004	188.85	185.38	374.23
2005	212.99	173.60	386.59
2006	250.73	164.30	415.03
2007	228.07	160.27	388.34
2008	210.69	156.55	367.24
2009	153.46	145.70	299.16
2010	176.89	150.23	327.12
Trend 2010–2010	15.3%	3.1%	9.3%
Trend 1990–2010	-36.7%	-35.4%	-36.1%

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. CO₂ emissions of this source have been identified as key category.

Table 126: Key sources of solvent and other product use (KCA including LULUCF).

IPCC Category	Source Categories	Key Sources*	
		GHG	KS-Assessment
3	Solvent and other product use	CO ₂	LA 1990

LA 90 = Level Assessment 1990; TA 10 = Trend Assessment 1990–2010

5.1.3 Completeness

Table 127 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 127: Overview of subcategories of solvents and other product use: transformation into SNAP Codes and status of estimation.

IPCC Category		SNAP		CO ₂	N ₂ O
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, N ₂ O, NH ₃ , PFC and SF ₆	NA	✓

5.2 CO₂ Emissions from Solvent and other product use (Category 3.A, 3.B, 3.C and 3.D.5)

5.2.1 Methodology Overview

CO₂ 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 22 to Figure 24 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.

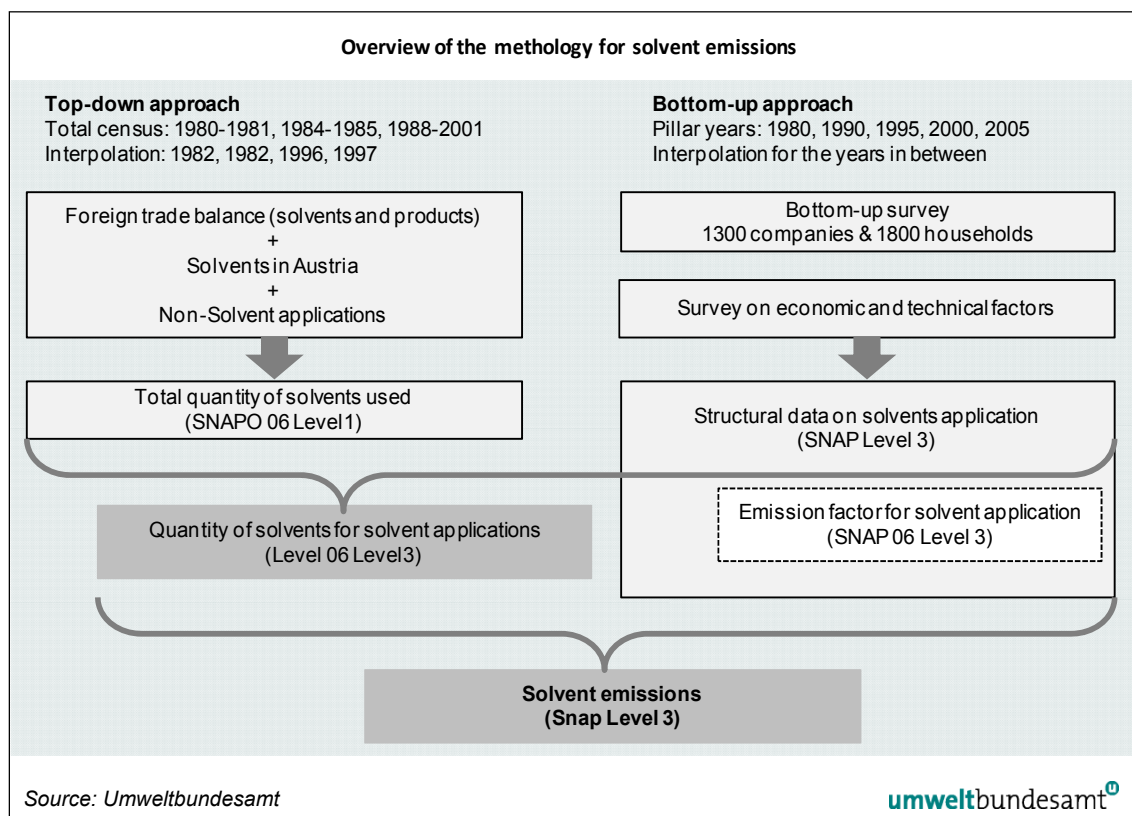


Figure 22: Overview of the methodology for solvent emissions.

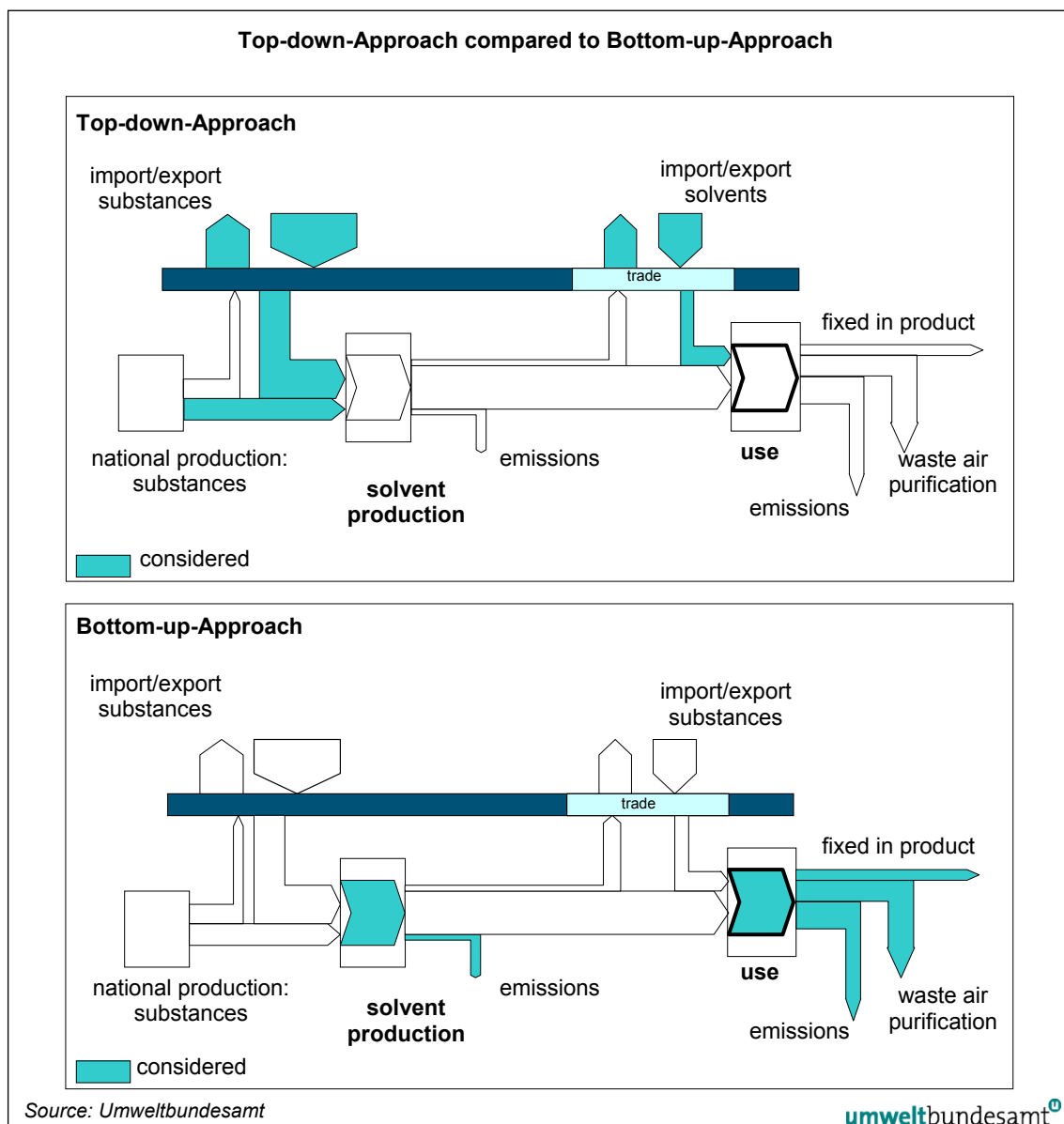


Figure 23: Top-down-Approach compared to Bottom-up-Approach.

Combination of Top-down-Approach compared to Bottom-up-Approach for 2010																					
Top-down							Bottom-up									Combination Top-down to Bottom-up					
CRF Sector 3							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	
Imp/Exp Solvent products	41						3 A, Paint application	060101	Manufacture of automobiles	100%	37%	1.7%	43%	59%	41.5	1.8	18.0	1.1			
								060102	Car repairing			0.7%		88%		0.8		0.7			
								060103	Construction and buildings			3.2%		89%		3.5		3.1			
								060104	Domestic use			1.4%		89%		1.6		1.4			
								060105	Coil coating			3.4%		52%		3.8		2.0			
								060107	Wood coating			3.1%		67%		3.4		2.3			
								060108	Other industrial paint application			23.8%		28%		26.5		7.4			
								Inland Solvent production	108							3 B, Degreasing and Dry Cleaning		060201	Metal degreasing	14%	6.0%
060202	Dry cleaning	0.4%	84%	0.4	0.3																
060203	Electronic components	1.0%	38%	1.1	0.4																
060204	Other industrial cleaning	6.9%	68%	7.7	5.2																
Imp/Exp Organic Substances	214						3 C, Chemical Products, Manufacture and Processing	060305	Rubber processing	10%	0.3%	58%	93%	111.4	0.4	64.3	0.3				
								060306	Pharmaceutical products				5.7%		26%		6.4	1.6			
								060307	Paints manufacturing				0.8%		100%		0.9	0.9			
								060308	Inks manufacturing				0.2%		100%		0.2	0.2			
								060309	Glues manufacturing				0.4%		100%		0.5	0.5			
								060310	Asphalt blowing				0.5%		1%		0.5	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%		1.8	1.8			
								Non-solvent applications	-235						3 D, Other		060403	Printing industry	39%	7.3%	74%
060404	Fat and oil extraction	0.1%	20%	0.1	0.0																
060405	Application of glues and	0.2%	63%	0.3	0.2																
060406	Preservation of wood	0.5%	99%	0.5	0.5																
060407	Treatment & conservation of	0.1%	85%	0.1	0.1																
060408	Domestic solvent use (other)	16.0%	84%	17.8	15.0																
060411	Domestic use of pharma. products	4.4%	94%	4.9	4.6																
060412	Other (preservation of seeds,...)	10.1%	55%	11.3	6.2																

Source: Umweltbundesamt

umweltbundesamt

Additionally the comparison of the top-down and the bottom-up approach helped to identify several quantitatively important applications like windscreens wiper fluids, antifreeze, moonlighting, hospitals, deicing agents of aeroplanes, tourism, cement- respectively pulp industry, which were not considered in the top-down approach.

5.2.2 Top-down Approach

The top-down approach is based on

1. import-export statistics (foreign trade balance)
2. production statistics on solvents in Austria
3. a survey on non-solvent-applications in companies (WINDSPERGER et al. 2004a, WINDSPERGER et al. 2008) and regularly questionnaires
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 and production statistics from 1980 to 2010 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.

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“. These companies were requested to report the quantities of used solvents for the time period 2002–2010 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 128).

Table 128: 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 129: 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 130: 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%
060403	Printing industry	2005			44%	17%
		2000				
		1995			29%	10%
		1990			10%	5%
		1980			0%	0%

SNAP category	description	year	Distribution of used paints		Part of waste gas treatment	
			Solvent based paints	Water based paints	application	purification
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 131: 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%

SNAP		Changes in the number of employees compared to the year 2000				
		1980	1990	1995	2000	2005
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 2012).

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 132). 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 132 shows the range of the differences in the considered pillar years broken down to the 15 substance categories.

Table 132: 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 133 presents activity data and implied emission factors.

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

Table 133: Activity data for solvent and other product use [Mg] 1990–2010.

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	57 849	2 239	1 092	4 852	2 187	5 548	5 215	36 716
2003	59 073	2 398	1 123	4 979	2 229	5 583	5 182	37 579
2004	50 757	2 155	971	4 299	1 913	4 727	4 330	32 361
2005	57 627	2 554	1 110	4 905	2 168	5 289	4 779	36 822
2006	67 838	3 006	1 307	5 774	2 552	6 226	5 626	43 347
2007	61 707	2 734	1 189	5 252	2 322	5 663	5 118	39 430
2008	57 003	2 526	1 098	4 852	2 145	5 232	4 727	36 424
2009	41 522	1 840	800	3 534	1 562	3 811	3 444	26 531
2010	47 860	2 121	922	4 074	1 801	4 392	3 969	30 582

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	21 146	9 352	562	1 825	9 406
2003	21 964	9 545	573	1 786	10 060
2004	19 187	8 197	492	1 469	9 029
2005	22 136	9 301	558	1 594	10 684
2006	26 059	10 949	656	1 876	12 577
2007	23 704	9 960	597	1 706	11 440
2008	21 897	9 201	552	1 576	10 568
2009	15 950	6 702	402	1 148	7 698
2010	18 385	7 725	463	1 323	8 873

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	16 253	631	9 604	1 325	310	910	784	6	58	2 626
2003	16 143	604	9 550	1 327	314	839	786	6	55	2 663
2004	13 486	485	7 986	1 118	268	644	664	5	43	2 273
2005	14 880	513	8 822	1 244	302	646	740	5	44	2 563
2006	17 516	604	10 385	1 464	356	760	871	6	52	3 018
2007	15 933	549	9 447	1 332	324	692	792	6	47	2 745
2008	14 719	507	8 727	1 230	299	639	732	5	44	2 536
2009	10 721	370	6 356	896	218	465	533	4	32	1 847
2010	12 358	426	7 327	1 033	251	536	614	4	37	2 129

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	63 067	12 715	256	567	726	209	26 092	6 911	15 591
2003	63 413	12 493	229	515	751	212	26 210	7 046	15 956
2004	53 648	10 319	169	387	654	181	22 153	6 045	13 740
2005	59 970	11 250	161	378	752	204	24 739	6 852	15 634
2006	70 596	13 243	189	445	885	241	29 123	8 066	18 404
2007	64 216	12 047	172	405	805	219	26 491	7 337	16 741
2008	59 321	11 128	159	374	744	202	24 471	6 778	15 464
2009	43 210	8 106	116	273	542	147	17 825	4 937	11 264
2010	49 806	9 343	133	314	624	170	20 546	5 691	12 984

5.2.5 Calculation of CO₂ 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 134) on the basis of the carbon content and the stoichiometrically formed CO₂.

Table 134: 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
Cyclic Hydrocarbons	3.14	Solvent naphtha	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 135 the carbon dioxide emissions of Category 3 Solvent and Other Product Use for the years 1990 to 2010 are shown.

Table 135: CO₂ emission of Category 3 Solvent and Other Product Use 1990–2010.

IPCC		3.A						
SNAP	Total	060101	060102	060103	060104	060105	060107	060108
Unit	Gg							
1990	117.70	4.67	2.56	9.98	10.68	13.43	17.50	58.90
1991	95.63	3.67	2.30	9.15	8.15	11.19	14.50	46.68
1992	73.70	2.73	1.95	7.91	5.85	8.85	11.40	35.00
1993	71.30	2.53	2.07	8.54	5.23	8.80	11.27	32.85
1994	63.13	2.15	2.01	8.40	4.22	8.02	10.21	28.12
1995	67.29	2.18	2.35	9.92	4.03	8.81	11.15	28.85
1996	59.65	2.07	2.11	9.09	3.77	7.74	9.65	25.23
1997	63.96	2.38	2.29	10.07	4.26	8.23	10.07	26.66
1998	56.38	2.25	2.05	9.19	3.95	7.18	8.63	23.13
1999	50.33	2.15	1.85	8.49	3.72	6.34	7.47	20.30
2000	58.52	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	67.05	3.42	2.55	11.87	5.22	8.13	9.13	26.72
2003	68.39	3.66	2.62	12.18	5.32	8.18	9.07	27.35
2004	58.71	3.29	2.27	10.52	4.57	6.93	7.58	23.55
2005	66.59	3.90	2.59	12.00	5.18	7.75	8.37	26.80
2006	78.39	4.59	3.05	14.13	6.09	9.13	9.85	31.55
2007	71.30	4.18	2.78	12.85	5.54	8.30	8.96	28.70
2008	65.87	3.86	2.56	11.87	5.12	7.67	8.28	26.51
2009	47.98	2.81	1.87	8.65	3.73	5.59	6.03	19.31
2010	55.30	3.24	2.15	9.97	4.30	6.44	6.95	22.26

IPCC		3.B			
SNAP	Total	060201	060202	060203	060204
Unit	Gg				
1990	35.51	22.89	0.50	4.25	7.86
1991	29.10	17.72	0.48	3.33	7.56
1992	22.63	12.94	0.43	2.47	6.79
1993	22.11	11.78	0.48	2.28	7.57
1994	19.79	9.73	0.49	1.92	7.65
1995	21.33	9.57	0.59	1.93	9.24
1996	20.12	8.70	0.56	1.70	9.16
1997	22.94	9.57	0.64	1.81	10.91

IPCC		3.B			
SNAP	Total	060201	060202	060203	060204
Unit	Gg				
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	30.38	10.89	0.83	1.72	16.95
2003	31.76	11.11	0.85	1.68	18.13
2004	27.92	9.54	0.73	1.38	16.27
2005	32.40	10.83	0.82	1.50	19.25
2006	38.14	12.74	0.97	1.76	22.66
2007	34.69	11.59	0.88	1.60	20.61
2008	32.05	10.71	0.81	1.48	19.04
2009	23.34	7.80	0.59	1.08	13.87
2010	26.91	8.99	0.68	1.24	15.99

IPCC		3.C								
SNAP	Total	060305	060306	060307	060308	060309	060310	060311	060312	060314
Unit	Gg									
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
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	16.06	1.75	5.25	3.57	0.55	2.44	0.03	0.01	0.13	2.34
2003	15.80	1.67	5.22	3.57	0.56	2.25	0.03	0.01	0.12	2.38
2004	13.07	1.34	4.36	3.01	0.48	1.73	0.02	0.01	0.09	2.03
2005	14.28	1.42	4.82	3.35	0.54	1.73	0.02	0.01	0.10	2.29
2006	16.81	1.67	5.67	3.94	0.63	2.04	0.03	0.01	0.11	2.69
2007	15.29	1.52	5.16	3.59	0.58	1.86	0.03	0.01	0.10	2.45
2008	14.12	1.40	4.77	3.31	0.53	1.71	0.02	0.01	0.10	2.26
2009	10.29	1.02	3.47	2.41	0.39	1.25	0.02	0.01	0.07	1.65
2010	11.86	1.18	4.00	2.78	0.45	1.44	0.02	0.01	0.08	1.90

IPCC		3.D.5							
SNAP	Total	060403	060404	060405	060406	060407	060408	060411	060412
Unit	Gg								
1990	98.15	29.19	0.34	2.13	1.83	0.41	25.93	10.71	27.62
1991	87.21	24.56	0.29	1.74	1.63	0.38	25.57	10.03	23.00
1992	73.34	19.62	0.24	1.35	1.38	0.33	23.41	8.82	18.19
1993	77.30	19.70	0.25	1.31	1.46	0.37	26.47	9.67	18.07
1994	74.47	18.13	0.24	1.17	1.41	0.36	27.07	9.64	16.45
1995	86.26	20.11	0.27	1.25	1.64	0.43	33.00	11.50	18.05
1996	79.91	17.69	0.23	1.12	1.49	0.38	31.80	10.74	16.47
1997	89.57	18.81	0.24	1.20	1.64	0.41	36.96	12.13	18.18
1998	82.58	16.44	0.20	1.06	1.49	0.36	35.26	11.27	16.51
1999	77.13	14.54	0.17	0.95	1.36	0.32	34.00	10.60	15.19
2000	93.90	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	104.66	17.84	0.17	1.04	1.93	0.42	47.37	14.86	21.02
2003	105.30	17.53	0.15	0.95	1.99	0.43	47.59	15.15	21.52
2004	89.15	14.48	0.11	0.71	1.73	0.37	40.22	13.00	18.53
2005	99.73	15.78	0.11	0.69	1.99	0.41	44.92	14.74	21.08
2006	117.40	18.58	0.13	0.82	2.35	0.49	52.88	17.35	24.82
2007	106.79	16.90	0.11	0.74	2.14	0.44	48.10	15.78	22.57
2008	98.65	15.61	0.11	0.69	1.97	0.41	44.43	14.58	20.85
2009	71.86	11.37	0.08	0.50	1.44	0.30	32.36	10.62	15.19
2010	83.82	13.11	0.09	0.58	1.66	0.34	37.30	12.24	17.51

Table 136: Implied CO₂ Emission factors for Category 3 Solvent and Other Product Use 1990–2010.

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

IPCC		3.A					
SNAP	060101	060102	060103	060104	060105	060107	060108
Unit	[tCO ₂ /t]						
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
2009	1.53	2.34	2.45	2.39	1.47	1.75	0.73
2010	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	
2009	1.16	1.47	0.94	1.80	
2010	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

IPCC		3.C							
SNAP	060305	060306	060307	060308	060309	060310	060311	060312	060314
Unit		[tCO ₂ /t]							
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
2009	2.77	0.55	2.69	1.78	2.68	0.03	2.18	2.19	0.89
2010	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
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
2009	1.40	0.66	1.84	2.65	2.03	1.82	2.15	1.35
2010	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 CO₂ 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 year's results in a constant uncertainty.

In Table 137 and

Table 138 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 137: 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 138: 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 N₂O 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 ₂ O for anaesthesia	3.D.3 Use of N ₂ O in aerosol cans	3.D.2 Use of N ₂ O in fire extinguishers
GHG key category	no	no	not occurring
Gas	N ₂ O emission from the use of anaesthesia	N ₂ O emission from the use of aerosol cans	–
Activity	N ₂ O consumption of anaesthesia Due to new industry inquiries (ÖIGV 2010) the amount of N ₂ O used for anaesthesia was updated for the years 2001–2010.	N ₂ O consumption in aerosol cans It is assumed that the use of N ₂ O for aerosol cans is constant at 400 tons per year. This estimate is based on expert judgement and industry inquiries (ÖIGV 2010).	N ₂ O is not flammable, but has oxidising properties. There is no evidence of this gas being used in fire extinguishers in Austria.
Method	A specific methodology for these activities has not been prepared yet. ⁶¹ 100% of N ₂ O used for anaesthesia is released into atmosphere		–
emission factor	activity data = emission 1.00 Mg N ₂ O/Mg product use		–

Table 139: N₂O-consumption of anaesthesia and N₂O-consumption in aerosol cans.

	3 D	3.D.1	3.D.3
	Total (use of N ₂ O)	use of N ₂ O for anaesthesia	use of N ₂ O 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

⁶¹ 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).

	3 D	3.D.1	3.D.3
	Total (use of N ₂ O)	use of N ₂ O for anaesthesia	use of N ₂ O in aerosol cans
Unit	Gg		
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
2009	0.470	0.070	0.400
2010	0.485	0.085	0.400
<i>Trend 2010–2010</i>	3.1%	20.9%	0%
<i>Trend 1990–2010</i>	-35.4%	-75.8%	0%

5.3.1 Uncertainty Assessment for N₂O Emissions from Solvent and Other Product Use

Direct use of N₂O 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 N₂O is used. In contrast to Ramirez, it is assumed that virtually all of the N₂O actually used is also fully released thus no additional uncertainty is applied.

Table 140: 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 ₂ O	20.0	0	20.0

5.4 Recalculations

Update of activity data

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

The short-term statistics for trade and services and the Austrian foreign trade statistics were updated for 2009.

Activity data concerning non-solvent use and the solvent content of products has been updated by surveys conducted at companies and associations.

The table below shows the recalculation difference of CO₂ 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 N₂O emissions.

Table 141: Recalculation difference with respect to submission 2011.

CO ₂ Emission		Absolute difference [Gg]				Relative difference [Δ%]	
		1990	2000	2008	2009	1990	2009
3	Solvent and Other Product Use	0.00	0.00	0.07	0.41	=	0.3%
3 A	Paint application	0.00	0.00	0.02	0.13	=	0.3%
3 B	Degreasing and dry cleaning	0.00	0.00	0.01	0.06	=	0.3%
3 C	Chemical products, manufacture and processing	0.00	0.00	0.00	0.03	=	0.3%
3 D 5	Other solvent use	0.00	0.00	0.03	0.19	=	0.3%

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 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 NH₃, 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 2012 (UMWELTBUNDESAMT 2012).

To give an overview of Austria's agricultural sector some information is provided below (BMLFUW 2000-2011):

Agriculture in Austria is small-structured: 187 034 farms are managed, 61.5% of these farms manage less than 20 ha, whereas only 4.0% of the Austrian farms manage more than 100 ha cultivated area. 136.742 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 3.19 million hectares that is a share of ~ 42% of the total territory (forestry ~ 44%, other area ~ 14%). The shares of the different agricultural activities are as follows:

- 44% arable land,
- 27% 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 2010 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 2010 shows a decrease of 12.9% for this sector (see Figure 25 and Table 143) due to a decrease in activity data.

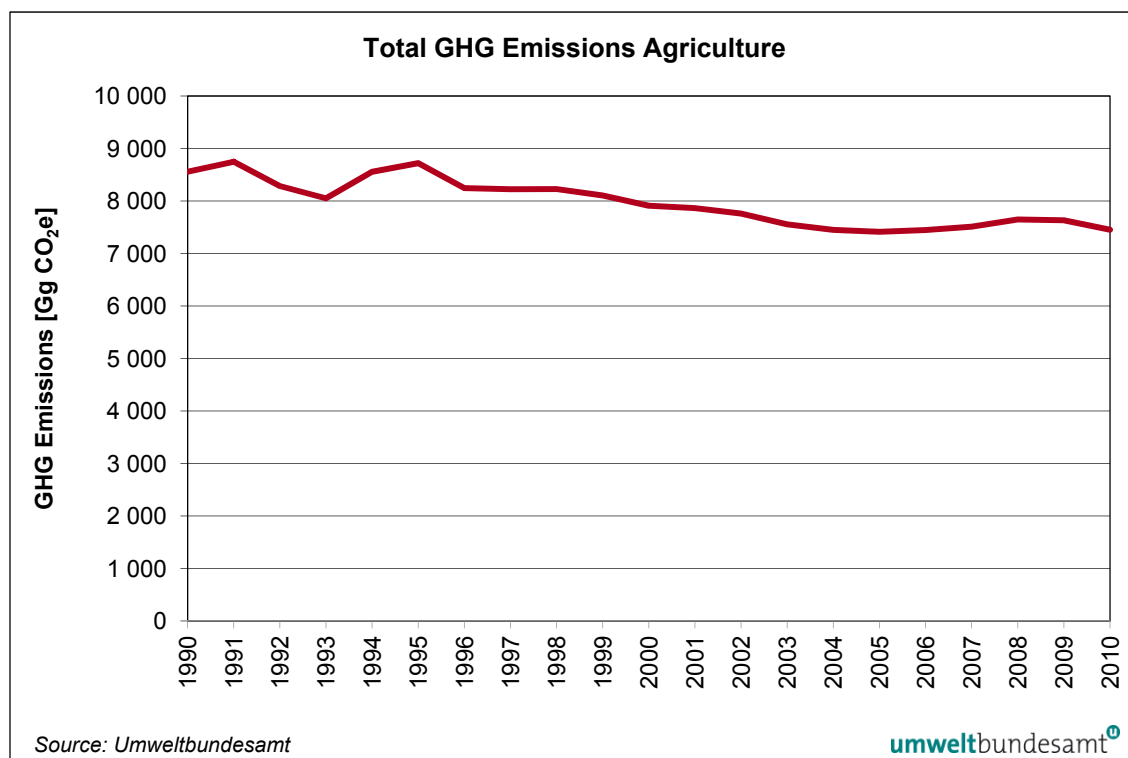


Figure 25: Trend of total GHG emissions from agriculture.

The main drivers for the trend shown in Figure 25 are decreasing livestock numbers and lower amounts of N-fertilizers applied on agricultural soils. 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. From 2009 to 2010 emissions decreased by 2.3%, mainly due to decreased mineral fertilizer application.

Emission trends per gas

From 1990 to 2010 CH₄ emissions from agriculture decreased by 14.2%, N₂O emissions decreased by 11.7%. The trends are presented in Table 142.

Table 142: Emissions of greenhouse gases from 1990–2010 from agriculture.

Year	GHG emissions [Gg]	
	CH ₄	N ₂ O
1990	199.66	14.08
1991	196.70	14.89
1992	188.77	13.94
1993	188.94	13.17

Year	GHG emissions [Gg]	
	CH ₄	N ₂ O
1994	188.83	14.81
1995	192.09	15.12
1996	188.85	13.81
1997	185.59	13.96
1998	184.22	14.06
1999	182.08	13.81
2000	180.64	13.28
2001	178.30	13.29
2002	174.44	13.22
2003	172.66	12.67
2004	172.30	12.36
2005	170.22	12.38
2006	169.56	12.54
2007	170.25	12.70
2008	169.55	13.18
2009	171.77	12.98
2010	171.33	12.43
<i>Trend 90-10</i>	<i>-14.2%</i>	<i>-11.7%</i>

Emission trends per sub category

Table 143 presents total GHG emissions and trend 1990–2010 from agriculture by sub-categories as well as the contribution to the overall inventory emissions. Important categories are 4.A enteric fermentation (3.8%) and 4.D agricultural soils (3.5%) followed by 4.B manure management (1.5%).

Table 143: GHG emissions 1990–2010 of agriculture by categories.

Year	GHG emissions [Gg CO ₂ equivalent] by categories				
	4	4.A	4.B	4.D	4.F
1990	8 557.96	3 753.35	1 366.60	3 436.54	1.47
1991	8 747.51	3 698.38	1 359.41	3 688.29	1.43
1992	8 284.72	3 544.26	1 321.41	3 417.60	1.45
1993	8 050.88	3 542.65	1 333.53	3 173.39	1.31
1994	8 556.67	3 546.97	1 334.93	3 673.35	1.42
1995	8 720.66	3 613.63	1 365.02	3 740.61	1.40
1996	8 246.32	3 555.65	1 344.06	3 345.28	1.32
1997	8 223.84	3 492.76	1 337.89	3 391.80	1.39
1998	8 227.12	3 466.50	1 336.08	3 423.19	1.36
1999	8 104.16	3 436.75	1 315.53	3 350.49	1.39
2000	7 910.93	3 416.88	1 291.83	3 201.00	1.23
2001	7 863.86	3 370.08	1 287.14	3 205.27	1.38
2002	7 761.32	3 301.14	1 262.95	3 195.92	1.31
2003	7 554.56	3 269.81	1 258.40	3 025.14	1.21

Year	GHG emissions [Gg CO ₂ equivalent] by categories				
	4	4.A	4.B	4.D	4.F
2004	7 450.57	3 269.55	1 253.42	2 925.76	1.84
2005	7 412.12	3 228.63	1 243.54	2 938.78	1.18
2006	7 447.12	3 217.91	1 240.55	2 987.57	1.10
2007	7 512.44	3 230.73	1 249.83	3 030.77	1.12
2008	7 647.15	3 223.99	1 242.09	3 179.95	1.12
2009	7 631.63	3 265.35	1 259.99	3 105.25	1.05
2010	7 452.64	3 256.57	1 256.24	2 938.82	1.01
Share in Austrian Total 2010	8.8%	3.8%	1.5%	3.5%	0.0%
Trend 1990-2010	-12.9%	-13.2%	-8.1%	-14.5%	-31.2%

As can be seen in Figure 26 and Table 143 the overall trend concerning emissions from all categories is decreasing. The reason for the decrease of emissions from enteric fermentation and manure management is the decrease in livestock numbers (cattle and swine). Fluctuations of emissions from agricultural soils are mainly due to varying underlying activity data (sales figures of mineral fertilizers).

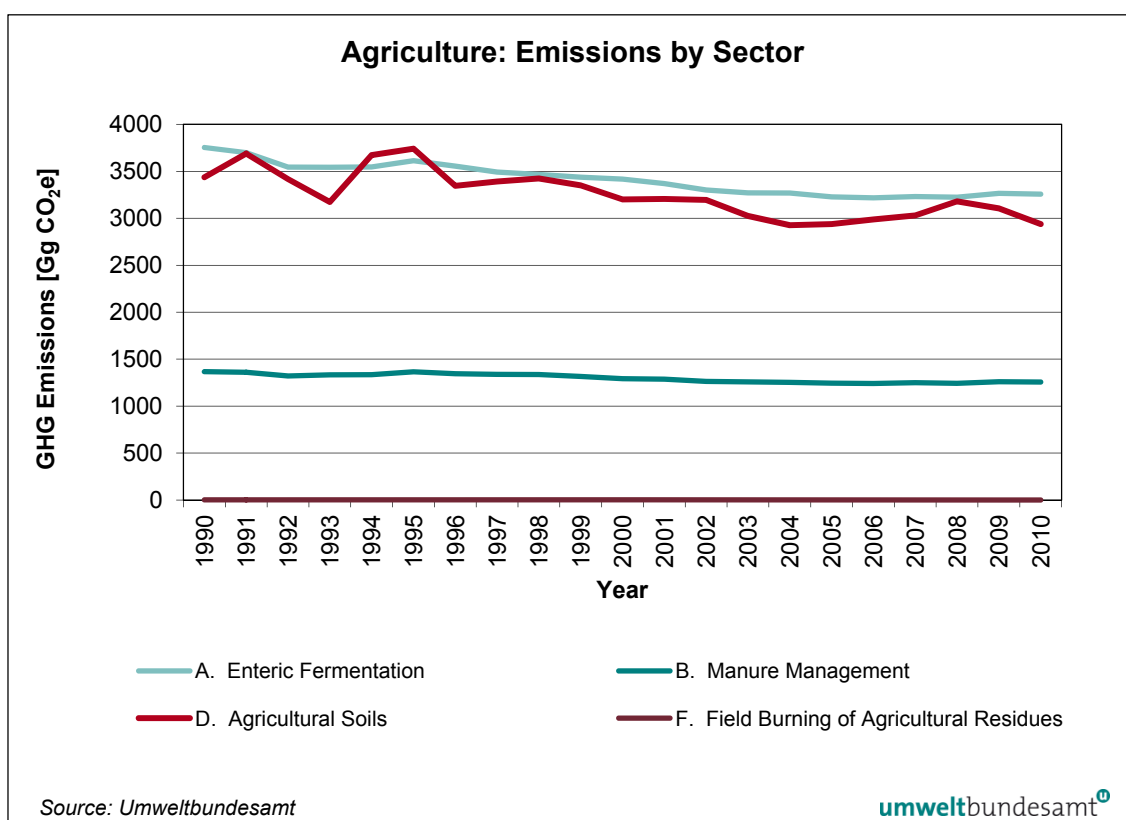


Figure 26: Emission trends of agriculture by categories.

As can be seen in Table 144, in 2010 about 44% of emissions from agriculture originate from enteric fermentation and 39% from agricultural soils. Manure management contributes 17% and field burning of agricultural wastes contributes only a negligible part (0.01% in 2010).

Table 144: Share of categories of agriculture, 1990 and 2010.

Year	GHG emissions [%] by sub categories				
	4	4.A	4.B	4.D	4.F
1990	100.0%	43.9%	16.0%	40.2%	0.0%
2010	100.0%	43.7%	16.9%	39.4%	0.0%

6.1.2 Key Categories

The key category analysis is presented in Chapter 1.5. This chapter includes information about the key sources of the agriculture sector. Key sources within this category are presented in Table 145.

Table 145: Key sources of agriculture (KCA including LULUCF).

IPCC Category	Source Categories	Key Sources	
		GHG	KS-Assessment*
4.A.1	Cattle	CH ₄	LA; TA
4.B.1	Cattle	N ₂ O	LA
4.B.1	Cattle	CH ₄	LA 1990
4.D.1	Direct Soil Emissions	N ₂ O	LA; TA
4.D.3	Indirect Emissions	N ₂ O	LA; TA

LA1990 = Level Assessment 1990

LA2010 = Level Assessment 2010

TA = Trend Assessment BY–2010

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 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. In response to an encouragement of the ERT in the Centralized Review 2010, Austria provided a refined estimate on the basis of relevant crops.

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 2000–2011),
 - ✓ 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 characterization,
 - ✓ 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 N₂O and CH₄ 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 ($\pm 10\%$) 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 $\pm 10\%$.

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 $\pm 20\%$ (AMON & HÖRTENHUBER 2010).

Activity data and emission factors

Animal numbers have been estimated at 10% uncertainty and considered statistically independent (WINIWARTER 2008). Uncertainties of emission factors for CH_4 emissions of enteric fermentation were considered 20% for cattle and sheep (representing ruminants) and 30% for all other animals (AMON et al. 2002). 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 146 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 146: *Uncertainties of emissions and emission factors (key categories agriculture).*

Categories		CH ₄ Emissions	N ₂ O Emissions	EF CH ₄	EF N ₂ O
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.B Manure management – CH₄

In response to a question raised by the ERT during the Centralized Review 2011, the estimations now consider methane losses from anaerobic digesters. In submission 2012, the methane conversion factor (MCF) of anaerobic digesters was increased from 0% to 2%, resulting in higher CH₄ emissions.

The number of biogas plants under contract for electricity supply has been taken for the calculation of the amount of digested manure as this is the most robust figure available.

6.1.7 Completeness

Table 147 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 147: Overview of sub-categories of agriculture: transformation into SNAP Codes and status of estimation.

IPCC Category		SNAP		CH ₄	N ₂ O
4.A	ENTERIC FERMENTATION	1004	ENTERIC FERMENTATION	✓	NA
4.A.1	Cattle	–	–	✓	NA
4.A.1.a	Dairy Cattle	100401	Dairy cows	✓	NA
4.A.1.b	Non-Dairy Cattle	100402	Other cattle	✓	NA
4.A.2	Buffalo	100414	Buffalos	NO	NO
4.A.3	Sheep	100403	Ovines	✓	NA
4.A.4	Goats	100407	Goats	✓	NA
4.A.5	Camels and Lamas	100413	Camels	NO	NO
4.A.6	Horses	100405	Horses	✓	NA
4.A.7	Mules and Asses	100406	Mules and asses	IE ¹⁾	NA
4.A.8	Swine	100404	Fattening pigs	✓	NA
4.A.9	Poultry	100408 /09/10	Laying hens, broilers, other poultry	✓	NA
4.A.10	Other	100415	Deer	✓	NA
4.B.	MANURE MANAGEMENT	1005	MANURE MANAGEMENT REGARDING ORGANIC COMPOUNDS	✓	NO
		1009	MANURE MANAGEMENT REGARDING NITROGEN COMPOUNDS	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, geese,...)	✓	✓
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	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	✓ ⁴⁾	✓
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	✓

IPCC Category		SNAP		CH ₄	N ₂ O
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⁾ CH₄ emissions included in 4.B.1 to 4.B.10

⁴⁾ CH₄ emissions from sewage sludge spreading

6.1.8 Planned Improvements

No further improvements are planned.

6.2 Enteric fermentation (CRF category 4.A)

This chapter describes the estimation of CH₄ emissions from enteric fermentation. In 2010 90.5% of agricultural CH₄ emissions arose from this category.

6.2.1 Source Category Description

CH₄ emissions amounted to 178.7 Gg in the 'Kyoto' base year and have decreased by 13.2% to 155.1 Gg in 2010. Almost all emissions of category 4.A (93.5% in 2010) are caused by cattle farming, thus CH₄ 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 39.8% in 2010.

Table 148: Greenhouse gas emissions from enteric fermentation by sub-categories 1990–2010.

Year	CH ₄ emissions [Gg] per Livestock Category								
	4.A total	4.A.1 a Dairy	4.A.1.b Non-Dairy	4.A.3 Sheep	4.A.4 Goats	4.A.6 Horses	4.A.8 Swine	4.A.9 Poultry	4.A.10 Other
1990	178.73	87.84	81.24	2.48	0.19	0.89	5.53	0.27	0.30
1991	176.11	85.11	81.12	2.61	0.20	1.04	5.46	0.28	0.30
1992	168.77	82.28	76.56	2.50	0.20	1.11	5.58	0.26	0.30
1993	168.70	81.08	77.23	2.67	0.24	1.17	5.73	0.28	0.30
1994	168.90	80.07	78.47	2.74	0.25	1.20	5.59	0.27	0.30
1995	172.08	72.70	88.73	2.92	0.27	1.30	5.56	0.27	0.32
1996	169.32	72.04	86.56	3.05	0.27	1.32	5.50	0.25	0.33

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-Dairy	Sheep	Goats	Horses	Swine	Poultry	Other
1997	166.32	75.03	80.35	3.07	0.29	1.34	5.52	0.28	0.45
1998	165.07	76.64	77.52	2.89	0.27	1.36	5.72	0.28	0.40
1999	163.65	74.20	79.14	2.82	0.29	1.47	5.15	0.28	0.31
2000	162.71	66.90	85.79	2.71	0.28	1.47	5.02	0.23	0.31
2001	160.48	65.46	84.98	2.56	0.30	1.47	5.16	0.24	0.31
2002	157.20	64.99	82.50	2.43	0.29	1.47	4.96	0.24	0.31
2003	155.71	62.33	83.48	2.60	0.27	1.57	4.87	0.25	0.33
2004	155.69	60.91	85.05	2.62	0.28	1.57	4.69	0.25	0.33
2005	153.74	60.42	83.54	2.61	0.28	1.57	4.75	0.25	0.33
2006	153.23	60.21	83.41	2.50	0.27	1.57	4.71	0.25	0.33
2007	153.84	60.32	83.33	2.81	0.30	1.57	4.93	0.25	0.33
2008	153.52	61.29	82.51	2.67	0.31	1.57	4.60	0.25	0.33
2009	155.49	61.65	83.89	2.76	0.34	1.57	4.71	0.25	0.33
2010	155.07	61.78	83.22	2.87	0.36	1.57	4.70	0.25	0.33
Share 2010	100%	39.8%	53.7%	1.8%	0.2%	1.0%	3.0%	0.2%	0.2%
Trend 90–10	-13.2%	-29.7%	2.4%	15.7%	92.2%	77.0%	-15.0%	-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 and the connected gross energy intake since 1990).

Following a recommendation of the centralized review 2008 CH₄ emissions from *Non-Dairy Cattle* are reported separately:

Table 149: Greenhouse gas emissions from non-dairy cattle (4.A.1.b) by sub-categories 1990–2010.

Year	CH ₄ emissions [Gg] of Non-Dairy Cattle (4.A.1.b) sub-categories					
	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

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
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
2009	83.89	25.25	20.86	12.71	16.14	8.93
2010	83.22	24.90	20.53	12.12	16.57	9.10
<i>Share 2010</i>	<i>100%</i>	<i>29.9%</i>	<i>24.7%</i>	<i>14.6%</i>	<i>19.9%</i>	<i>10.9%</i>
<i>Trend 1990–2010</i>	<i>2.4%</i>	<i>472.1%</i>	<i>-33.0%</i>	<i>-27.8%</i>	<i>-17.3%</i>	<i>-3.3%</i>

The steady rise in suckling cow numbers (see Table 150) 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 1990-2010. 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*' (4.A.10) corresponds to furred game. This category includes mainly deer, but no further data on the exact composition of this animal category is available. As the contribution to the overall emissions is very small, a simple approach has been chosen by applying the default emission factor of sheep because sheep is the most similar animal category to deer.

For the calculation of CH₄ 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. The agricultural practices related to poultry in Switzerland are very similar to those in Austria: Both countries have a small structured agriculture due to similar alpine conditions, comparable traditions and culture. In both countries more than 60% of the farms manage less than 20 ha. No IPCC default values are available.

Activity data

The Austrian official statistics (STATISTIK AUSTRIA 2010) provides national data of annual live-stock numbers on a very detailed level. These data are based on livestock counts held in December each year⁶².

In Table 150 and Table 151 applied animal data are presented. Background information to the data is listed below:

From 1990 onwards: The continuous decline of dairy cattle numbers is connected with the increasing milk yield per cow: For the production of milk according to Austria's milk quota every year a smaller number of cows is needed.

1991: A minimum counting threshold for poultry was introduced. Farms with less than 11 poultry were not considered any more. However, the contribution of these small farms is negligible, both with respect to the total poultry number and to the trend.

The increase of the soliped population between 1990 and 1991 is caused by a better data collection from riding clubs and horse breeding farms.

1993: New characteristics for swine and cattle categories were introduced in accordance with Austria's entry into the European Economic Area and the EU guidelines for farm animal population categories. In 1993 part of the "Young cattle < 1 yr" category was included in the "Young cattle 1–2 yr" category. This shift is considered to be insignificant: no inconsistency in the emission trend of "Non-Dairy Cattle" category was recorded.

In the same year "Young swine < 50 kg" were shifted to "Fattening pigs > 50 kg" (before 1993 the limits were 6 months and not 50 kg which led to the shift) causing distinct inconsistencies in time series. Following a recommendation of the Centralized Review 2003, the age class split for swine categories of the years 1990–1992 was adjusted using the split from 1993.

1993: For the first time other animals e.g. deer (but not wild living animals) were counted. Following the recommendations of the Centralized Review 2004, to ensure consistency and completeness animal number of 1993 was used for the years 1990 to 1992.

1995: The financial support of suckling cow husbandry increased significantly in 1995 when Austria became a Member State of the European Union. The husbandry of suckling cows is used for the production of veal and beef; the milk yield of the cow is only provided for the suckling calves. Especially in mountainous regions with unfavourable farming conditions, suckling cow husbandry allows an extensive and economic reasonable utilisation of the pastures. Suckling cow husbandry contributes to the conservation of the traditional Austrian alpine landscape.

1996–1998: The market situation affected a decrease in veal and beef production, resulting in a declining suckling cow husbandry. Farmers partly used their former suckling cows for milk production. Thus, dairy cow numbers slightly increased at this time. Reasons are manifold: Changing market prices, BSE epidemic in Europe and change of consumer behavior, milk quota, etc.

1998–2000; 2006–2009: 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.

⁶² 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).

Table 150: Domestic livestock population and its trend 1990–2010 (I).

Year	Population size [heads] * Livestock category						
	Dairy	Non-Dairy	Suckling Cows	Young Cattle < 1 yr	Breeding Heifers 1–2 yr	Fattening Heifers, Bulls, Oxen 1–2 yr	Other Cattle > 2 yr
1990	904 617	1 679 297	47 020	925 162	255 464	305 339	146 312
1991	876 000	1 658 088	57 333	894 111	253 522	301 910	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
2009	532 976	1 493 284	264 547	643 441	196 476	249 486	139 334
2010	532 735	1 480 546	260 883	634 052	187 386	256 266	141 959
<i>Trend 1990–2010</i>	-41.1%	-11.8%	454.8%	-31.5%	-26.6%	-16.1%	-3.0%

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

The FAO agricultural data base (FAOSTAT) provides worldwide harmonized data (FAO AGR. STATISTICAL SYSTEM 2001). In the case of Austria, these data come from the national statistical system (Statistik Austria). However, there are inconsistencies between these two data sets. Analysis shows that there is often a time gap of one year between the two data sets. FAOSTAT data are seemingly based on the official Statistik Austria data but there is an annual attribution error. In the Austrian inventory Statistik Austria data is used, they are the best available.

Table 151: Domestic livestock population and its trend 1990–2010 (II).

Year	Population size [heads] * Livestock category					
	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

Population size [heads] * Livestock category						
Year	Swine	Young & Fattening Pigs > 20 kg	Breeding Sows > 50 kg	Piglets < 20 kg	Sheep	Goats
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
2009	3 136 967	2 083 459	293 901	759 607	344 709	68 188
2010	3 134 156	2 084 923	284 691	764 542	358 415	71 768
<i>Trend 1990–2010</i>	-15.0%	-11.2%	-25.5%	-20.2%	15.7%	92.2%

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

Table 152: Domestic livestock population and its trend 1990–2010 (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
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

Population size [heads] * Livestock category					
Year	Poultry	Chicken	Other Poultry	Horses	Other **
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
2009	13 027 145	12 354 358	672 787	87 072	41 190
2010	13 027 145	12 354 358	672 787	87 072	41 190
<i>Trend 1990–2010</i>	<i>-5.7%</i>	<i>-6.0%</i>	<i>-1.3%</i>	<i>77.0%</i>	<i>11.0%</i>

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

** *furred game, mainly deer.*

Information about the extent of organic farming in Austria was provided in the Austrian INVEKOS⁶³ 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.

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 ministry of agriculture (BMLFUW 2000–2011) 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.

Table 153 shows the results of the shares of organic farming in the relevant livestock categories for 1990, 1997–2000 and 2010:

⁶³ 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 153: Share of cattle population under organic farming systems (calculations based on INVEKOS data).

IPCC Category	% organic	% organic	% organic
	1990	1997–2000	2010
CATTLE	1%	15%	19%
Dairy Cattle > 2 yr	1%	15%	18%
Suckling Cows > 2 yr	2%	25%	33%
Other Cattle > 2 yr	1.5%	20%	17%
Young Cattle < 1 yr	1%	13%	17%
Young Cattle 1–2 yr	1%	12%	17%

6.2.2.1 Cattle (4.A.1)

Key Source: Yes (CH₄)

CH₄ 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 2010, emissions from enteric fermentation – cattle contributed 3.6% to total greenhouse gas emissions in Austria.

CH₄ emissions were calculated using the IPCC Tier 2 methodology. Activity data were obtained from national statistics and are presented in Table 150 and Table 151.

Emission factors

Country specific emission factors were used. They were calculated from the specific gross energy intake and the methane conversion rate (GPG, Equation 4.14).

$$EF = (GE * Y_m * 365 \text{ days/yr}) / 55.65 \text{ MJ/kg}$$

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 154: Energy intake data for dairy 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	6 500
energy intake	MJ NEL* (kg dry matter) ⁻¹	5.6	5.7	5.7	5.8	5.9	6.0	6.0	6.1
forage intake	kg dry matter day ⁻¹	13.9	14.0	14.0	13.9	13.8	13.8	13.8	14.1
concentrate intake	kg dry matter day ⁻¹	0.4	0.7	0.9	1.3	1.8	2.3	2.8	3.1
net energy intake	MJ NEL* day ⁻¹	80.3	82.8	85.3	88.5	91.7	95.8	99.8	103.9
gross energy intake	MJ GE day ⁻¹	235.2	242.5	249.8	259.2	268.7	280.7	292.3	304.2

* net energy lactation

Austrian dairy cattle show average milk yields from 3 791 kg/cow (1990) to 6 100 kg/cow (2010). The time series of average milk yields per dairy cow was taken from national statistics and are presented in Table 155. For dairy cattle there was a 19.4% increase of GE intake between 1990 and 2010 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 155: Annual milk yield, gross energy intake and emission factors of dairy cattle 1990–2010.

Year	Milk Yield [kg/cow*yr]	Gross Energy Intake [MJ/head*day]	Emission Factor [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
2009	6 068	293.93	115.67
2010	6 100	294.69	115.97

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 154).

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 154).

Other non dairy cattle categories:

Gross energy intake for all other cattle categories were calculated from typical Austrian diets. Animal nutrition expert Andreas Steinwider worked out animal diets as shown in Table 156 and Table 157 (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 156: 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 157: 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 1990–2010, 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 158: 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 (1990)	con/org	235	93
Suckling Cows > 2 yr (2010)	con/org	243	95
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 148, CH₄ emissions from sheep, goats, horses, swine, poultry and 'other' (furred game/deer) are only minor emission sources of enteric fermentation. Together they contributed 6.4% to total emissions from this category in 2010. The most important sub- category is swine, with a contribution of 3.0%, followed by sheep (1.8%), horses (1.0%) and 'other' (furred game/deer), goats, poultry with each about 0.2% (figures are also presented in Table 148).

The IPCC Tier 1 methodology and default emission factors have been used (see Table 159):

Table 159: 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.

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 Y_m 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 150 and Table 151.

The agricultural practices related to poultry in Switzerland are very similar to those in Austria: Both countries have a small structured agriculture due to similar alpine conditions, comparable traditions and culture. In both countries more than 60% of the farms manage less than 20ha.

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: 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 146.

6.2.5 Recalculations

No recalculations have been carried out.

6.3 Manure management (CRF category 4.B)

This chapter describes the estimation of CH₄ and N₂O emissions from animal manure. In 2010 9.2% of the agricultural CH₄ emissions and 24.0% of the agricultural N₂O emissions were caused by this category.

6.3.1 Source Category Description

From 1990 to 2010 CH₄ emissions from manure management decreased by 23.3% to 15.75 Gg.

Table 160: CH₄ emissions from manure management 1990–2010.

	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
1990	20.54	7.90	5.56	0.06	0.00	0.07	5.88	1.08	0.01
1991	20.21	7.65	5.57	0.06	0.00	0.08	5.72	1.12	0.01
1992	19.63	7.37	5.27	0.06	0.00	0.08	5.76	1.07	0.01
1993	19.72	7.27	5.32	0.06	0.01	0.09	5.83	1.13	0.01
1994	19.48	7.11	5.46	0.07	0.01	0.09	5.64	1.10	0.01
1995	19.51	6.25	6.44	0.07	0.01	0.10	5.56	1.08	0.01
1996	19.04	6.17	6.28	0.07	0.01	0.10	5.40	1.00	0.01
1997	18.77	6.37	5.73	0.07	0.01	0.10	5.34	1.14	0.01
1998	18.65	6.45	5.49	0.07	0.01	0.10	5.42	1.10	0.01
1999	17.92	6.18	5.64	0.07	0.01	0.11	4.80	1.11	0.01
2000	17.43	5.51	6.26	0.06	0.01	0.11	4.58	0.89	0.01
2001	17.33	5.33	6.21	0.06	0.01	0.11	4.66	0.95	0.01
2002	16.82	5.25	6.01	0.06	0.01	0.11	4.43	0.94	0.01
2003	16.50	4.98	6.06	0.06	0.01	0.11	4.30	0.98	0.01
2004	16.16	4.81	6.19	0.06	0.01	0.11	4.00	0.97	0.01
2005	16.06	4.77	6.11	0.06	0.01	0.11	4.03	0.97	0.01
2006	15.87	4.71	6.10	0.06	0.01	0.11	3.91	0.96	0.01
2007	15.94	4.69	6.11	0.07	0.01	0.11	3.99	0.96	0.01
2008	15.57	4.74	6.04	0.06	0.01	0.11	3.65	0.96	0.01

CH₄ 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
2009	15.83	4.79	6.16	0.07	0.01	0.11	3.72	0.97	0.01
2010	15.75	4.79	6.11	0.07	0.01	0.11	3.68	0.97	0.01
<i>Share 2010</i>	<i>100%</i>	<i>30.4%</i>	<i>38.8%</i>	<i>0.4%</i>	<i>0.1%</i>	<i>0.7%</i>	<i>23.4%</i>	<i>6.2%</i>	<i>0.0%</i>
<i>Trend 1990–2010</i>	<i>-23.3%</i>	<i>-39.3%</i>	<i>10.0%</i>	<i>15.7%</i>	<i>92.2%</i>	<i>63.1%</i>	<i>-37.3%</i>	<i>-9.9%</i>	<i>11.0%</i>

From 1990 to 2010 the N₂O emissions from manure management decreased by 1.0% to 2.99 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 161: N₂O Emissions from manure management 1990–2010.

N₂O 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
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	3.05	1.11	1.32	0.08	0.01	0.09	0.27	0.17	0.01
1997	3.04	1.17	1.24	0.08	0.01	0.09	0.27	0.19	0.01
1998	3.05	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	2.99	1.07	1.34	0.07	0.01	0.09	0.23	0.16	0.01
2001	2.98	1.06	1.33	0.07	0.01	0.09	0.24	0.18	0.01
2002	2.93	1.06	1.30	0.06	0.01	0.09	0.23	0.18	0.01
2003	2.94	1.02	1.33	0.07	0.01	0.10	0.22	0.19	0.01
2004	2.95	1.01	1.36	0.07	0.01	0.09	0.21	0.19	0.01
2005	2.92	1.01	1.33	0.07	0.01	0.09	0.21	0.20	0.01
2006	2.93	1.01	1.34	0.06	0.01	0.09	0.20	0.20	0.01
2007	2.95	1.02	1.34	0.07	0.01	0.09	0.21	0.20	0.01
2008	2.95	1.05	1.33	0.07	0.01	0.09	0.19	0.21	0.01
2009	2.99	1.05	1.36	0.07	0.01	0.09	0.19	0.21	0.01
2010	2.99	1.05	1.35	0.07	0.01	0.09	0.19	0.21	0.01
<i>Share 2010</i>	<i>100%</i>	<i>35.3%</i>	<i>45.1%</i>	<i>2.5%</i>	<i>0.5%</i>	<i>3.2%</i>	<i>6.3%</i>	<i>7.0%</i>	<i>0.3%</i>
<i>Trend 1990–2010</i>	<i>-1.0%</i>	<i>-15.5%</i>	<i>12.2%</i>	<i>15.7%</i>	<i>92.2%</i>	<i>60.1%</i>	<i>-34.2%</i>	<i>40.5%</i>	<i>11.0%</i>

6.3.2 Methodological Issues

The IPPC-Tier 2 methodology has been applied to estimate CH₄ emissions from manure management of cattle (identified as key category) and swine. 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 CH₄ 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 N₂O emissions a Tier 1 methodology is used. N₂O emissions are calculated on the basis of N excretion per animal and waste management system.

Animal Waste Management Systems (AWMS)

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 year 1990 AWMS data based on (KONRAD 1995) is available. 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.

For the creation of a plausible time series 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 2005–2008 were derived by linear extrapolation. From 2008 onwards the AWMS distribution is held constant in order to prevent implausible trends by the end of the commitment period. It is not planned to have another survey before the end of the commitment period. Data on anaerobic digestion were derived from data provided by the Austrian Energy Regulator E-Control in the ÖKOSTROMBERICHT 2010 (E-CONTROL 2010). 1990 data are based on (AMON 2002).

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.

Within the revision of submission 2010 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 revised data show an increased share of solid storage systems and a decreased share of pasture.

The new AWMS data (see Table 162 to Table 165) reflect the situation in Austria much better than the IPCC default AWMS distribution and the distribution from the study by (KONRAD 1995) used before.

Table 162: 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 163: 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
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. The 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.

Table 164: Manure Management System distribution in Austria 2010.

Livestock category	Liquid/ Slurry	Solid Storage	Pasture/Range/ Paddock	Other Systems
	[%]	[%]	[%]	[%]
Dairy cattle	31.9	49.1	2.9	16.1
Non-dairy cattle	22.9	44.3	4.8	28.0
Suckling cows	14.4	40.1	14.3	31.2
Cattle < 1 year	15.1	48.1	1.9	34.9
Breeding heifers 1-2 years	30.3	44.5	5.8	19.5
Fattening heifers, bulls and oxen 1-2 years	43.4	38.9	0.2	17.5
Non-dairy cattle > 2 years	26.7	44.1	7.1	22.0
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	51.5	21.6	0.0	26.9
Young and fattening pigs	84.6	1.7	0.0	13.8
Swine (Total)	80.6	4.1	0.0	15.4
Chicken	3.9	91.5	0.0	4.6
Other poultry	0.0	95.4	0.0	4.6
Other animals	0.0	50.0	50.0	0.0

Table 165: Other systems 2010 in detail.

Livestock category	Yard	Composting	Deep Litter	Aerobic Treatment	Anaerobic Digestion
	[%]	[%]	[%]	[%]	[%]
Dairy cattle	2.0	7.4	1.4	4.6	0.7
Non-dairy cattle	1.8	6.3	16.0	3.3	0.7
Suckling cows	2.3	6.0	20.0	2.2	0.7
Cattle < 1 year	1.8	7.2	22.5	2.7	0.7
Breeding heifers 1-2 years	1.7	6.5	7.5	3.0	0.7
Fattening heifers, bulls and oxen 1-2 years	1.5	4.2	6.8	4.3	0.7
Non-dairy cattle > 2 years	2.1	6.3	7.0	5.9	0.7
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

Livestock category	Yard	Composting	Deep Litter	Aerobic Treatment	Anaerobic Digestion
	[%]	[%]	[%]	[%]	[%]
Breeding sows	2.5	3.5	13.9	3.3	3.6
Young and fattening pigs	1.2	0.2	5.0	3.7	3.6
Swine (Total)	1.4	0.6	6.1	3.6	3.6
Chicken	0.0	0.0	0.0	0.0	4.6
Other poultry	0.0	0.0	0.0	0.0	4.6
Other animals	0.0	0.0	0.0	0.0	0.0

Deep litter dominates the other system category for non-dairy cattle and breeding sows.

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 166: 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 150, Table 151, Table 152). 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.

6.3.2.1 Estimation of CH₄ Emissions

CH₄ 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):

$$EF_i = VS_i * 365 [\text{days yr}^{-1}] * B_{oi} * 0.67 [\text{kg m}^{-3}] * \sum_{jk} MCF_{jk} * MS\%_{ijk}$$

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_{oi} = maximum methane producing capacity (m^3 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: 2%),
- Composting (MCF: 0.5%),
- Aerobic Treatment (MCF: 0.1%),
- Yard: the MCF of Pasture, Range, Paddock was applied (MCF: 1%).

According to 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 anaerobic digesters

In Austria, safety regulations for the building and operation of agricultural biogas plants are rather strict. Investment costs for the building of the biogas plants are only granted, if the farmer proves that the strict safety regulations have been followed. The safety regulations have been developed and documented in the frame of the EU-ALTENER standard for the building and operation of agricultural biogas plants. The safety regulations do not suggest that there is a significant probability for substantial CH₄ losses through leakage.

Anyhow, there is no national study available that estimates CH₄ leakage losses from Austrian biogas plants. A study worked out in Germany (FNR 2010) shows that CH₄ losses of biogas plants are about 1-2% of the gas produced under cold climate conditions.

In response to a question raised by the ERT during the Centralized Review 2011, the estimations now consider methane losses from anaerobic digesters. Following the results of the study mentioned above and national expert judgment (THOMAS AMON 2011) the methane conversion factor (MCF) for anaerobic digesters was increased from 0% to 2%, resulting in higher CH₄ emissions (see chapter 6.3.5).

Operators of biogas plants reported the amount of digested manure to the Austrian Energy Regulator E-Control (E-CONTROL 2011). On the basis of these data the share of manure digested in biogas plants in 2010 was derived. Data for 1990 were obtained from (AMON et al 2002).

The number of biogas plants under contract for electricity supply has been taken for the calculation of the amount of digested manure as this is the most robust figure available.

The different shares of AWMS are presented in Table 163 and Table 165.

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 167: 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 167). 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 temperature 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 2010.

Table 168: average MCFs for liquid systems 1990 and 2010.

Animal Category	1990 [%]	2010 [%]
Dairy Cattle	8.7	8.7
Other Cattle	8.7	8.4
Swine	3.4	3.4

The following table presents the average MCFs for other systems for the years 1990 and 2010.

Table 169: average MCFs for other systems 1990 and 2010.

Animal Category	1990 [%]	2010 [%]
Dairy Cattle	3.3	1.9
Other Cattle	12.3	10.0
Swine	14.7	9.4

As a result of the comprehensive survey on animal husbandry (AMON et al. 2007) in submission 2010 deep litter systems were introduced to the Austrian AWMS distribution. Bearing the new study results of Austrian measurements on liquid systems in mind (see above), it is unlikely that the IPCC default MCF of 39% for deep litter systems would be applicable to Austrian conditions. Austrian measurements showed that CH₄ emissions from farmyard manure were always lower than CH₄ emissions from liquid manure. It would contradict latest scientific results to apply a higher MCF to deep litter systems than to liquid manure systems. In the IPCC guidelines the default MCF for deep litter systems equals the default MCF for liquid systems. Hence, for Austria the chosen MCF of 17% (IPCC 2006) is a conservative estimate.

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 (CH₄, N₂O)

Volatile solid (VS) excretion – dairy cows

Austrian specific values for dairy cows are calculated dependent on annual milk yields and corresponding feed intake data (gross energy intake, feed digestibility, ash content, see Table 154 and Table 170). Within the revision of Austrian N excretion values (following a recommendation 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 170: 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 171).

Table 171: VS excretion of Austrian dairy cows for the period 1990–2010.

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	2001	5 394	4.17
1991	3 800	4.03	2002	5 487	4.18
1992	3 905	4.04	2003	5 638	4.20
1993	3 948	4.06	2004	5 802	4.21
1994	4 076	4.06	2005	5 783	4.21
1995	4 619 ¹⁾	4.10	2006	5 903	4.22
1996	4 670	4.10	2007	5 997	4.23
1997	4 787	4.11	2008	6 059	4.24
1998	4 924	4.12	2009	6 068	4.24
1999	5 062	4.13	2010	6 100	4.25
2000	5 210	4.15			

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 170). 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 3 500 kg has been assumed, resulting in a daily VS excretion of 3.98 kg (see Table 170).

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 156).

As no major changes in diets of *Non-Dairy Cattle* occurred in the period from 1990–2010, 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 172 presents data for the calculation of VS excretion of the livestock categories *Non-Dairy Cattle*.

Table 172: 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: No.

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 173: 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 (4.B.10)

Key Source: No

CH₄ emissions from manure management for sheep, goats, horses, poultry and other (furred game) are estimated with the Tier 1 approach.

Default emission factors were taken from the IPCC guidelines (Table 4-5 of the Reference Manual). CH₄ emissions were estimated multiplying these emission factors by national animal numbers.

Table 174: CH₄ 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 (furred game)	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, CH₄ 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 furred game were estimated applying the default emission factor of sheep because sheep is the most similar animal category to deer (which dominates this category).

Digested manure

Data on the average amount of digested manure per biogas plant was obtained from (E-CONTROL 2011). On the basis of these data for 2010 the share of anaerobic manure digestion 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. Following (FNR 2010) and expert judgement (THOMAS AMON 2011), about 2% of CH₄-emissions get lost in Austrian biogas plants. Emissions were calculated as follows:

$$CH_4\text{-emissions}_{4.B(i)} = Population_{(i)} * EF_{IPCC\ default\ (i)} * (1 - share_{dig\ (i)}) + Population_{(i)} * EF_{IPCC\ default\ (i)} * share_{dig\ (i)} * leakage(\%)$$

(i) = horses (4.B.6) and poultry (4.B.9)

share_{dig} = % of manure digested

leakage = 2%, see also chapter 6.3.2.1.

The different shares of AWMS are presented in Table 163 and Table 165.

6.3.2.2 Estimation of N₂O Emissions

Key Source: 4.B.1

Following the guidelines, all emissions of N₂O taking place before the manure is applied to soils are reported under manure management.

For the estimation of N₂O emissions from manure management systems only a Tier 1 approach is available. The IPCC Guidelines method for estimating N₂O 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

N₂O emission per animal waste management system:

$$N_2O_{(AWMS)} = \sum [Nex_{(AWMS)} \times EF_{3(AWMS)}]$$

N₂O_(AWMS) = N₂O 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)} = N₂O emissions factor for an AWMS [kg N₂O-N per kg of Nex in AWMS]

AWMS

The animal waste management systems distribution data applied to estimate N₂O emissions from *Manure Management* is the same as used for the estimation of CH₄ emissions from *Manure Management* (see Table 162–Table 165).

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 175).

Table 175: Austria specific N excretion values of dairy cows for the period 1990–2010.

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	2001	5 394	91.05
1991	3 800	76.70	2002	5 487	91.89
1992	3 905	77.64	2003	5 638	93.24
1993	3 948	78.03	2004	5 802	94.72
1994	4 076	79.18	2005	5 783	94.55
1995	4 619 ¹⁾	84.07	2006	5 903	95.63
1996	4 670	84.53	2007	5 997	96.48
1997	4 787	85.58	2008	6 059	97.03
1998	4 924	86.82	2009	6 068	97.11
1999	5 062	88.06	2010	6 100	97.40
2000	5 210	89.39			

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 175 and Table 176 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 176: 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⁾ (2010)	74.0
cattle 1–2 years	53.6
cattle < 1 year	25.7
cattle > 2 years	68.4
breeding sows	29.1
fattening pigs	10.3
sheep	13.1
goats	12.3
horses	47.9
chicken ³⁾	0.52
other poultry ⁴⁾	1.1
other livestock/ furred game 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, geese)

⁵⁾ N-ex value of sheep applied

Livestock numbers per category can be found in Table 150, Table 151 and Table 152. Data on manure management system distribution is presented in Table 162, Table 163, Table 164 and Table 165.

Emission factors

N₂O 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 177: Emission factors for N₂O from manure management

Animal Waste Management System	Emission factor [kg N ₂ O-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 162 to Table 165). Thus, the implied N₂O emission factor of all systems (except pasture) has been used.

Table 178: N₂O emission factors used for the calculation of N₂O from yards 1990–2010.

Year	Dairy	Non-Dairy	Swine
[kg N ₂ O-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
2009	0.013	0.012	0.005
2010	0.013	0.012	0.005

For the calculation of the losses of gaseous N species (NH₃-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 NH₃ 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 Resources 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: 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 146.

6.3.5 Recalculations

In response to a question raised by the ERT during the UNFCCC centralized review 2011 regarding methane losses from anaerobic digesters, the estimation of methane emissions from anaerobic digestion was recalculated (see chapter 6.3.2.1).

The following revisions have been carried out:

- MCF for anaerobic digesters increased from 0% to 2%,
- only plants under contract for electricity supply considered,
- share of digested manure per animal category recalculated.

Table 179: Difference to submission 2011 of CH₄ emissions from manure management.

	CH ₄ Emissions [Gg]				
	4.B	4.B.1 a	4.B.1.b	4.B.8	4.B.9
	Total	Dairy	Non-Dairy	Swine	Poultry
1990	0.01	0.01	0.00	0.00	0.00
1991	0.02	0.01	0.00	0.00	0.00
1992	0.02	0.01	0.01	0.00	0.00
1993	0.03	0.01	0.01	0.01	0.00
1994	0.08	0.04	0.02	0.02	0.00
1995	0.09	0.04	0.03	0.02	0.00
1996	0.10	0.04	0.03	0.02	0.00
1997	0.13	0.06	0.04	0.03	0.00
1998	0.16	0.08	0.05	0.04	0.00
1999	0.23	0.11	0.07	0.05	0.00
2000	0.27	0.12	0.09	0.06	0.00
2001	0.33	0.14	0.12	0.07	0.00
2002	0.38	0.16	0.13	0.09	0.00
2003	0.43	0.18	0.15	0.09	0.00
2004	0.47	0.19	0.17	0.10	0.00
2005	0.50	0.20	0.19	0.11	0.00
2006	0.54	0.22	0.20	0.12	0.00

CH ₄ Emissions [Gg]					
	4.B	4.B.1 a	4.B.1.b	4.B.8	4.B.9
	Total	Dairy	Non-Dairy	Swine	Poultry
2007	0.56	0.23	0.21	0.12	0.00
2008	0.58	0.24	0.22	0.12	0.00
2009	0.57	0.23	0.21	0.12	0.01

Table 180: Difference to submission 2011 of N₂O emissions from manure management.

N ₂ O Emissions [Gg]					
	4.B	4.B.1 a	4.B.1.b	4.B.8	4.B.9
	Total	Dairy	Non-Dairy	Swine	Poultry
1990	0.00	0.00	0.00	0.00	0.00
1991	0.00	0.00	0.00	0.00	0.00
1992	0.00	0.00	0.00	0.00	0.00
1993	0.00	0.00	0.00	0.00	0.00
1994	0.00	0.00	0.00	0.00	0.00
1995	0.00	0.00	0.00	0.00	0.00
1996	0.00	0.00	0.00	0.00	0.00
1997	0.00	0.00	0.00	0.00	0.00
1998	0.00	0.00	0.00	0.00	0.00
1999	0.00	0.00	0.00	0.00	0.00
2000	0.00	0.00	0.00	0.00	0.00
2001	0.01	0.00	0.00	0.00	0.00
2002	0.01	0.00	0.00	0.01	0.00
2003	0.01	0.00	0.00	0.01	0.00
2004	0.01	0.00	0.00	0.01	0.00
2005	0.01	0.00	0.00	0.01	0.00
2006	0.01	0.00	0.00	0.01	0.00
2007	0.01	0.00	0.00	0.01	0.00
2008	0.01	0.00	0.00	0.01	0.00
2009	0.02	0.00	0.00	0.01	0.00

The recalculation resulted in higher CH₄ and N₂O emissions from manure management.

6.4 Agricultural soils (CRF category 4.D)

6.4.1 Source Category Description

N₂O emissions from the source categories 4.D.1 direct soil emissions and 4.D.3 indirect soil emissions are key categories.

In 2010 76.0% of total N₂O emissions from agriculture (56.8% of total Austrian N₂O 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 (N₂O and CH₄) contributed 3.5% (2 938.82 Gg CO₂ equivalents) to Austria's total greenhouse gas emissions in the year 2010. This is 39.4% of total GHG emissions of the sector agriculture.

The trend of N₂O emissions from this category is decreasing: in 2010 emissions were 14.6% below 1990 levels.

Table 181 presents N₂O emissions of agricultural soils by sub-category as well as their trends and their share in total N₂O emissions.

Table 181: N₂O emissions from agricultural soils, 1990–2010.

Year	N ₂ O emissions [Gg]										
	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	9.45	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	2.20	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	0.77
2009	9.99	5.88	2.08	2.20	1.15	0.42	0.03	0.31	3.81	3.02	0.79
2010	9.45	5.61	1.67	2.20	1.26	0.46	0.03	0.31	3.53	2.76	0.78
Share 2010	100%	59.3%	17.6%	23.3%	13.3%	4.8%	0.3%	3.3%	37.4%	29.2%	8.2%
Trend 1990–2010	-14.6%	-8.9%	-36.4%	-7.1%	53.0%	38.1%	40.5%	-43.5%	-19.0%	-22.2%	-4.7%

CH₄ emissions from agricultural soils originate from sewage sludge spreading on agricultural soils. They contribute only a negligible part of Austria's total methane emissions (0.17% or 0.46 Gg CH₄ 2010). This is about 0.27% of total CH₄ from the agriculture sector.

Table 182: CH₄ emissions from agricultural soils, 1990–2010.

Year	CH ₄ emissions [Gg] IPCC Category	
	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
2009	0.42	0.42
2010	0.46	0.46
Share 2010	100.0%	100.0%
Trend 1990–2010	40.5%	40.5%

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 183: N₂O emissions factors for agricultural soils.

Category	Emission Factor [t N ₂ O-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 CH₄ emissions were estimated (country specific method).

Activity Data

Data for necessary input parameters (activity data) were taken from the following sources:

Table 184: 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 2000-2011) ¹⁾ ; urea application in Austria: expert judgement based on sales data (RWA 2006-2011) ²⁾
Animal waste applied to soils	Calculations within source category 4.B
N-fixing crops	Cropped area legume production: (BMLFUW 2000-2011) ¹⁾
Crop residue	Harvested amount of agricultural crops: (BMLFUW 2000-2011) ¹⁾
Sewage sludge spreading	Water Quality Report 2000 (PHILIPPITSCH et al. 2001), Report on sewage sludge (UMWELTBUNDESAMT 1997), Austrian report on water pollution control (BMLFUW 2002), National Austrian Waste Water Database, data query December 2011 (UMWELTBUNDESAMT 2011b)
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 2000-2011)
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 N₂O 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 185.

Table 185: Mineral fertilizer N consumption in Austria 1990–2010 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

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]
2007	103 300	11 500	GB, RWA	103 500	11 405
2008	134 400	9 568	GB, RWA	118 850	10 534
2009	86 300	18 400	GB, RWA	110 350	13 984
2010	90 629	6 500	GB, RWA	88 465	12 450

GB: (BMLFUW 2000-2011): www.gruenerbericht.at

RWA: Raiffeisen Ware Austria, sales company

Values of Table 185 differ from the numbers given in CRF table 4.D 'Nitrogen input from application of synthetic fertilizers'. In the CRF table 4.D $\text{NH}_3\text{-N}$ and $\text{NO}_x\text{-N}$ 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 2000-2011).

Table 186: Cropped area legume production, 1990–2010.

Year	Areas [ha]			
	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	88 974
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
2009	15 168	25 321	2 819	101 073
2010	13 562	34 378	4 154	106 080

Harvest Data

Harvest data were taken from (BMLFUW 2000-2011) and the datapool of (BUNDESANSTALT FÜR AGRARWIRTSCHAFT 2011) and are presented in Table 187.

Table 187: *Harvest Data I, 1990–2010.*

Year	Harvest [1 000 t]								
	corn	wheat	rye	barley	oats	maize (corn)	potato	sugar beet	fodder beet
1990	5 290	1 404	396	1 521	244	1 620	794	2 494	171
1991	5 045	1 375	350	1 427	226	1 571	790	2 522	173
1992	4 323	1 325	278	1 342	185	1 118	738	2 605	119
1993	4 206	1 018	292	1 100	191	1 524	886	2 994	129
1994	4 436	1 255	319	1 184	172	1 421	594	2 561	103
1995	4 452	1 301	314	1 065	162	1 474	724	2 886	85
1996	4 493	1 240	156	1 083	153	1 736	769	3 131	62
1997	5 009	1 352	207	1 258	197	1 842	677	3 012	59
1998	4 771	1 342	236	1 212	164	1 646	647	3 314	72
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
2009	5 105	1 523	184	835	109	2 169	722	3 083	13
2010	4 776	1 518	161	778	98	1 956	672	3 132	11

Table 188: *Harvest Data II, 1990–2010.*

Year	Harvest [1 000 t]								
	silo-green maize	clover-hey	rape	Sun-flower	soja bean	horse-/fodder bean	peas	vegetables	oil pumpkin
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

Year	Harvest [1 000 t]								
	silo-green maize	clover-hey	rape	Sun-flower	soja bean	horse-/fodder bean	peas	vegetables	oil pumpkin
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
2009	3 789	1 597	171	71	71	7	35	449	8
2010	3 557	1 624	171	66	95	11	31	457	15

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 (BMLFUW 2002). For 2001 to 2010 data from the National Austrian Waste Water Database operated by the Umweltbundesamt was used (data query December 2011, UMWELTBUNDESAMT 2011b).

Table 189: Amount of sewage sludge (dry matter) produced in Austria, 1990–2010.

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	241 364	39 369	16.3

Year	Total [t dm]	agriculturally applied [t dm]	agriculturally applied [%]
2007	245 202	40 713	16.6
2008	248 169	39 247	15.8
2009	252 181	39 945	15.8
2010	262 805	44 354	16.9

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. 59.3% (5.61 Gg in 2010) of N_2O emissions from agricultural soils arise from this sub-category (see Table 181).

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).

$$F_{SN} = N_{FERT} * (1 - \text{Frac}_{GASF})$$

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 185)

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 $\text{NH}_3\text{-N}$ 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 $\text{NH}_3\text{-N}$ per ton of fertilizer-N is applied for fertilizers other than urea (STREBL et al. 2003).

For the calculation of $\text{NO}_x\text{-N}$ 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 $\text{NO}_x\text{-N}$ 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 ($\text{NH}_3\text{-N}$, $\text{NO}_x\text{-N}$, $\text{N}_2\text{O-N}$). 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 $\text{NH}_3\text{-N}$, $\text{NO}_x\text{-N}$ and $\text{N}_2\text{O-N}$ losses that depend on the amount of manure N. 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 $\text{Frac}_{\text{GASM}}$.

From total N excretion by Austrian livestock, the following losses were subtracted:

- N excreted during grazing,
- $\text{NH}_3\text{-N}$ losses from housing,
- $\text{NH}_3\text{-N}$ losses during manure storage,
- $\text{NO}_x\text{-N}$ losses from manure management,
- $\text{N}_2\text{O-N}$ losses from manure management,
- The remaining N is applied to agricultural soils.

$\text{NH}_3\text{-N}$ and $\text{NO}_x\text{-N}$ losses from housing and storage were calculated following the CORINAIR EMEP – methodology. The CORINAIR detailed methodology was applied for the calculation of $\text{NH}_3\text{-N}$ emissions from cattle and swine, for the estimation of $\text{NO}_x\text{-N}$ emissions the CORINAIR simple methodology was applied.

Table 190: Animal manure left for spreading on agricultural soils per livestock category 1990–2010 (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	142 519	52 125	3 828	47 457	9 158	19 993
1994	142 635	51 914	4 975	47 102	9 128	19 536
1995	145 579	48 244	11 644	46 696	9 274	19 465
1996	143 425	48 060	11 776	45 224	9 203	19 112
1997	143 009	50 428	9 449	43 851	9 177	19 283

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
1998	143 280	51 929	8 553	43 048	8 907	20 351
1999	140 271	50 617	9 802	42 821	7 923	18 460
2000	137 763	45 879	14 034	42 562	7 699	17 931
2001	137 471	45 153	14 317	41 684	8 061	18 451
2002	134 949	45 036	13 614	40 901	7 846	17 856
2003	134 521	43 436	13 519	42 016	7 687	17 694
2004	133 541	42 692	14 551	42 030	7 285	16 801
2005	132 669	42 478	14 990	40 336	7 250	17 445
2006	132 311	42 546	14 978	40 308	7 386	17 019
2007	133 924	42 828	14 921	40 364	7 302	18 151
2008	132 563	43 692	14 595	40 261	6 827	16 931
2009	134 423	43 953	14 491	41 453	6 737	17 432
2010	134 097	44 064	14 290	41 310	6 526	17 445

Table 191: Animal manure left for spreading on agricultural soils per livestock category 1990–2010 (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	142 519	5 095	2 076	276	2 281	231
1994	142 635	4 981	2 128	290	2 346	235
1995	145 579	4 870	2 272	316	2 548	251
1996	143 425	4 533	2 369	317	2 574	258
1997	143 009	5 138	2 386	340	2 607	350
1998	143 280	4 968	2 244	316	2 649	313
1999	140 271	5 008	2 191	338	2 868	243
2000	137 763	4 113	2 110	327	2 869	239
2001	137 471	4 358	1 993	346	2 870	239
2002	134 949	4 356	1 893	337	2 870	239
2003	134 521	4 506	2 025	318	3 064	256
2004	133 541	4 504	2 035	324	3 065	256
2005	132 669	4 502	2 026	321	3 065	256
2006	132 311	4 499	1 943	310	3 066	256
2007	133 924	4 497	2 185	353	3 067	256
2008	132 563	4 495	2 072	364	3 067	256
2009	134 423	4 494	2 144	397	3 065	256
2010	134 097	4 493	2 229	418	3 065	256

Values of Table 190 differ from the numbers given in CRF table 4.D 'Nitrogen input from manure applied to soils'. In the CRF table 4.D additionally $\text{NH}_3\text{-N}$ and $\text{NO}_x\text{-N}$ 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 2012 – Submission under the UNECE Convention on Long-range Transboundary Air Pollution" (UMWELTBUNDESAMT 2012). Austria's Informative Report 2012 will be published in spring 2012. 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 ($\text{NH}_3\text{-N}$) occur during animal housing (1), the storage of manure (2) and the application of organic fertilizers on agricultural soils (3). Losses of nitric oxide ($\text{NO}_x\text{-N}$) were considered for manure management and field spreading of manure (4).

1) NH_3 emissions from housing (cattle and swine)

Table 192 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 192: Emission factors for NH_3 emissions from animal housing.

Manure management system	CORINAIR Emission factor [$\text{kg NH}_3\text{-N (kg N excreted)}^{-1}$]
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 $\text{NH}_3\text{-N}$ losses from housing (see above) are subtracted. The remaining N enters the store.

Cattle and swine

NH₃-N losses are estimated with CORINAIR default emission factors given in Table 193.

Table 193: NH₃ 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 NH₃ nitrogen (TAN) when calculating emissions. TAN content for Austrian cattle and swine manure is given in SCHECHTNER 1991.

Table 194: 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 195 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 EAGER⁶⁴ group and published in (REIDY et al. 2008, 2009).

⁶⁴ European Agricultural Gaseous Emissions Inventory Researchers Network (EAGER)

Table 195: Correction factors (CF) for NH₃ 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 live-stock category. Table 196 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.

Table 196: 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 NH₃ 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 NH₃ 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 NH₃ emission factor of sheep is used.

3) NH₃-N volatilization losses occurring during manure application

CORINAIR default NH₃ emission factors for spreading of slurry and farmyard manure (expressed as share of TAN) have been applied:

Table 197: Emission factors for NH₃ 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 198 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 198: Correction factors for NH_3 emissions from animal waste application

Application technique	[CF]
Broadcast spreading	1
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 1990–2010 can be found in Table 186.

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). 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 187)

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 2000–2011) and the datapool of (BUNDESANSTALT FÜR AGRARWIRTSCHAFT 2011) and are presented in Table 187. The other parameters used are presented in the following table:

Table 199: 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 (Ministry 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 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_{NCR0}) 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_{NCR0}).

Nitrogen input through use of sewage sludge

N₂O emissions

The method applied for the calculation of the emissions is IPCC Tier 1b with a default emission factor of 1.25% N₂O-N per kg N input to agricultural soils, corrected for volatilisation. NH₃-N and NO_x-N volatilisation losses were calculated following the CORINAIR EMEP methodology.

In Austria fertilisation by sewage sludge is very small. In 2010 N₂O emissions from sewage sludge contributed only 0.3% of N₂O 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 189)

Annual agricultural consumption of sewage sludge, nitrogen and volatilization losses are presented in the following table.

Table 200: 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
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	1 535.37	230.31	15.35	1 289.71	0.16
2007	1 587.80	238.17	15.88	1 333.75	0.16
2008	1 530.62	229.59	15.31	1 285.72	0.16
2009	1 557.85	233.68	15.58	1 308.59	0.16
2010	1 729.80	259.47	17.30	1 453.03	0.16

NH₃-N and NO_x-N volatilization losses from sewage sludge application

For the calculation of NH₃-N emissions the CORINAIR default emission factor for slurry spreading (0.15 kg NH₃-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).

CH₄ 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 CH₄. 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: No

Following the IPCC Guidelines, N₂O 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*.

$$F_{\text{GRAZ}} = N_{\text{exGRAZ}} * EF_{\text{GRAZ}}$$

F_{GRAZ} = N₂O emissions induced by nitrogen excreted from grazing animals, expressed as N₂O-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 201

EF_{GRAZ} = A constant emission factor for N₂O from manure of grazing animals has been used [t N₂O-N/t N], – 0.02 (IPCC GUIDELINES 1997), workbook table 4-8

Table 201: Nitrogen excreted during grazing (N_{exGRAZ}) 1990–2010.

Year	N excretion grazing [Mg]	Year	N excretion grazing [Mg]
1990	17 312	2001	12 625
1991	16 832	2002	11 864
1992	15 757	2003	11 608
1993	15 699	2004	11 360
1994	15 364	2005	10 854
1995	15 751	2006	10 308
1996	15 298	2007	10 157
1997	14 848	2008	9 604
1998	14 047	2009	9 728
1999	13 608	2010	9 785
2000	13 303		

6.4.2.3 Indirect soil emissions (4.D.3)

Key Source: Yes (N₂O)

According to IPCC definition, indirect N₂O emissions are caused by atmospheric deposition of nitrogen and by nitrogen leaching from soils.

N₂O 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} = N₂O emissions from atmospheric deposition, expressed as N₂O-N [t N]

N_{FERT} = Nitrogen in mineral fertilizers applied on soils [t N] (see Table 185)

$Frac_{GASF}$ = Fraction of nitrogen lost from mineral fertilizer application through gaseous emissions of NH₃ 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 175 and Table 176)

$Frac_{GASM}$ = Fraction of animal manure that is volatilized as NH₃ or NO_x [t/t] (adopted from calculations of NH₃ and NO_x emissions following the CORINAIR methodology)

EF_{AD} = N₂O emission factor (constant over the time series) for emissions from atmospheric deposition: tons of N₂O-nitrogen released per ton of volatilized nitrogen – 0.01 [t/t] (IPCC GUIDELINES 1997)

N_{SEWSL} = nitrogen in agriculturally applied sewage sludge [t N] (see Table 200)

$Frac_{GASSEWSL}$ = Fraction of sewage sludge N that is volatilized as NH₃ or NO_x [t/t] (adopted from calculations of NH₃ and NO_x emissions following the CORINAIR methodology) (see Table 200)

Total N excretion by livestock that volatilizes ($Frac_{GASM}$) includes:

- NH₃-N losses from housing, storage, grazing,
- NO_x-N losses from manure management,
- NH₃-N and NO_x-N losses from animal waste application.

Table 202: $\text{NH}_3\text{-N}$ and $\text{NO}_x\text{-N}$ volatilisation losses of mineral fertilizers and livestock N excretion 1990 to 2010.

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	45 425	0.27
2008	4 103	0.03	44 957	0.27
2009	4 356	0.04	45 580	0.27
2010	3 653	0.04	45 460	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 2012 – Submission under the UNECE Convention on Long-range Transboundary Air Pollution' (UMWELTBUNDESAMT 2012). Austria's Informative Report 2012 will be published in spring 2012.

N₂O 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. N₂O 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 $N_2O\text{-}N$ [t N]

F_{FERT} = Annual amount of nitrogen in synthetic fertilizers (mineral and urea) applied on soils [t N] (see Table 185)

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 190)

N_{exGRAZ} = Annual amount of animal manure nitrogen produced by grazing animals and directly dropped on agricultural soils during grazing [t N] (see Table 201)

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 $N_2O\text{-}N$ (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:

- ✓ $NH_3\text{-}N$ and $NO_x\text{-}N$ losses calculated in compliance to the obligations under UNECE/CLRTAP,
- ✓ Methods and emission factors reviewed by the EAGER⁶⁵ 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 146.

6.4.5 Recalculations

The following recalculations resulted in a slight increase of emissions (+29 Mg N_2O in 2009).

- The reduced amount of digested manure resulted in slightly higher emissions from animal manure applied to soils.
- The updated amount of sewage sludge applied to soils resulted in lower emissions 2008 and 2009.

⁶⁵ European Agricultural Gaseous Emissions Inventory Researchers Network (EAGER)

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 2010 total emissions from this category amounted to 1.01 Gg CO₂ equivalent, this is a share of 0.01% in total GHG emissions from sector agriculture. CH₄ and N₂O emissions for the years from 1990 to 2010 are presented in Table 203.

Table 203: Emissions from field burning (4.F) 1990–2010.

	CH ₄	N ₂ O
1990	0.06	0.001
1991	0.06	0.001
1992	0.06	0.001
1993	0.05	0.001
1994	0.05	0.001
1995	0.05	0.001
1996	0.05	0.001
1997	0.05	0.001
1998	0.05	0.001
1999	0.05	0.001
2000	0.05	0.001
2001	0.05	0.001
2002	0.05	0.001
2003	0.05	0.001
2004	0.07	0.001
2005	0.05	0.001
2006	0.04	0.001
2007	0.04	0.001
2008	0.04	0.001
2009	0.04	0.001
2010	0.04	0.001
<i>Trend 1990–2010</i>	<i>-30.5%</i>	<i>-34.0%</i>
<i>Share in Agriculture</i>	<i>0.02%</i>	<i>0.00%</i>

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. In response to questions raised during the UNFCCC centralized review 2010, the estimate has been improved by providing a breakdown of the emissions on a crop by crop basis. The values of the carbon fraction were taken from IPCC GPG Table 4-16. For fraction oxidised a default value of 0.90 was used. Dry matter fraction and residue/crop product ratio are presented in section 'crop residues' (see Table 199).

According to the *Presidential Conference of the Austrian Chambers of Agriculture* (personal communication to Mag. Längauer), in Austria about 1 710 ha were burnt in 2010. This value corresponds to about 0.3% of the relevant cereal area in 2010.

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 ($\text{Emission} = \text{Activity} \times \text{Emission Factor}$) 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 2000-2011). According to an expert judgement from the *Federal Association of Viniculture* (Bundesweinbauverband Österreich) the amount of residual wood per hectare viniculture is 1.5 to 2.5 t residual wood and the part of it that is burnt is estimated to be 1 to 3%. For the calculations the upper limits (3% of 2.5 t/ha) have been used resulting in a factor of 0.075 t burnt residual wood per hectare viniculture area.

Table 204: Activity data for field burning of agricultural residues 1990–2010.

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
2009	49 842	3 738
2010	49 842	3 738

The emission factors (4 828 g CH₄ /Mg and 49.7 g N₂O/Mg burnt wood) were calculated by multiplying the emission factors of 7 kg N₂O/ TJ and 680 g CH₄ /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.

6.5.4 Recalculations

No recalculations have been carried out.

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 205: Emissions and removals from Sector 5 LULUCF by sub-categories¹⁾ in Gg CO₂ 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	-10 023	-11 862	245	257	191	281	866
1991	-15 740	-17 612	244	252	206	288	882
1992	-10 942	-12 869	265	247	220	295	899
1993	-11 378	-13 355	282	242	235	302	916
1994	-10 246	-12 196	284	252	242	286	886
1995	-11 597	-13 143	294	53	241	211	747
1996	-8 492	-10 012	305	66	249	190	709
1997	-17 157	-18 652	318	78	256	170	672
1998	-15 262	-16 725	324	91	264	150	634
1999	-18 136	-19 592	325	97	275	140	619
2000	-15 036	-16 452	331	103	286	91	606
2001	-16 923	-18 353	336	110	296	95	592
2002	-10 978	-12 651	412	303	314	164	479
2003	-931	-2 613	422	306	324	171	458
2004	-5 989	-7 696	443	308	335	179	442
2005	-7 395	-9 148	440	310	329	249	425
2006	-1 583	-3 334	452	309	332	250	408
2007	-519	-2 306	488	312	347	250	391
2008	385	-1 411	514	312	346	250	374
2009	-3 644	-5 459	566	288	347	252	361
2010	-3 611	-5 411	568	281	356	248	347
Trend By-2010	-64.0	-54.4	132.3	9.2	86.2	-11.7	-59.9

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 submission 2012 contains for the first time estimates based on the results of the new NFI 2007/09. The previously reported biomass increment and drain rates, dead wood stock changes and land-use-change areas to and from forests for the years after 2002 were based on the means of the NFI 2000/02 results. These were updated now by the values of the new NFI results. The NFI 2007/09 showed a significant increase in the harvest rates after 2002. As a consequence, the net sink of forest biomass decreased significantly in the years after 2002. Furthermore, the results of the whole time series were impacted by the revision of single biomass

functions, by a slight change in the interpolation procedure, by estimating/reporting the litter and soil C stock changes for subcategory 5.A.1 for the first time and by a more stratified estimate of the soil C stocks and related changes for land-use-change lands to and from forests.

As a consequence of all these improvement and updating steps, the net sink of Land use, land-use change and forestry is for the years before 2002 on average about 23 % lower as in previous submissions. But still, each of these years had a significant LULUCF net sink. For the years after 2002 the new NFI results with a significant increase in biomass drain show a clear decrease in the net sink of the biomass of the subcategory “forest land remaining forest land (5.A.1) compared to the reported figures in previous submissions.

Table 205 shows that land use, land use change and forestry is a net sink in Austria, with an exception in 2008.

The most important sub category is forest land, in particular its subcategory forest land remaining forest land. This category is the only net sink for CO₂, whereas the other sub categories are sources of GHG emissions. Total emissions arising from the other sub categories amount to 7–77% of removals from forest land in most years. However, in the years 2003, 2007 and 2008 also the subcategory forest land remaining forest land represents a net emission source according to the recent updates and improvement steps in the estimates.

7.1.1 Emission Trends

In 2010, net removals from sector 5 amount to 3 611 Gg CO₂ equivalents which corresponds 4% of total GHG in Austria (without LULUCF), compared to 13% in the base year. The removals of sector 5 decreased by 64 % from the base year to 2010.

The most important sub-category is forest land (5.A) with net removals of 5 411 Gg CO₂ in 2010. The total emissions from the other sub-categories amount to 1 800 Gg CO₂ equivalents in 2010.

The net carbon stock changes in forest biomass (category 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 (e.g. very low increment in 2003, very high harvest rates in 2007 and 2008). These reasons for different growth and different harvest in single years explain the high annual variations as well as single outlier years in the CO₂ net removals of this sector. The rather constant values from 2009 on are due the use of averages of the last NFI (2007/09) for the forest biomass gains and losses for the estimates of the years after 2008. For submission 2012, the results of the NFI 2007/09 have been used for the first time. They show that the annual harvest in the years after 2002 has been much (on average 38%) higher than in the period of NFI 2000/02. Consequently, the reported net sink of the sector for the years after 2002 is much lower than reported in previous submissions where the average for the NFI 2000/02 was used for the estimates.

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 Key Categories

The key category analysis is presented in Chapter 1.5. This chapter includes information about the key sources of the LULUCF sector. Key sources within this category are presented in Table 206.

Table 206: Key sources of LULUCF.

IPCC Category	Source Categories	Key Sources	
		GHG	KS-Assessment*
5.A.1	Forest land remaining forest land	CO ₂	LA1990; LA2010,TA
5.A.2	Land converted to forest land	CO ₂	LA1990; LA2010,TA
5.B.2	Land converted to cropland	CO ₂	LA1990; LA2010
5.C.2	Land converted to grassland	CO ₂	LA1990; LA2010
5.D.2	Land converted to wetlands	CO ₂	LA2010, TA
5.E.2	Land converted to settlements	CO ₂	LA1990; LA2010
5.F.2	Land converted to other land	CO ₂	LA1990; LA2010,TA

LA1990 = Level Assessment 1990

LA2010 = Level Assessment 2010

TA = Trend Assessment BY–2010

7.1.3 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.

7.1.3.1 Activity data

For a complete time series from 1990 to 2010 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 main characteristics 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-categories
- 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.

Data for the total cropland area are available annually from STATISTIK AUSTRIA (STATISTIK AUSTRIA 1990–2010). Based on the Austrian farm structure surveys (e.g. 1993, 1995, 1999) 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.

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. The remaining increases in other land across the time series are assumed to origin from grassland.

By expert judgement certain land use changes were considered not to occur in Austria:

- wetlands, settlements or other land converted to cropland or grassland - the total area of cropland and grassland is decreasing, whereas the areas of settlement and wetland increase over the time period (see Table 207). Furthermore, from an economical and practical point of view any re-conversion of settlements and wetlands to cropland or grassland are considered as very unlikely. Other land is not suited for cropland and grassland use.
- cropland or settlements converted to wetlands - it is assumed that LUC to water bodies occur close to existing water bodies, which are mainly from grasslands
- 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 207 presents land use data and data for land use changes for the year 1990 and 2010 for the total area of Austria as used for the calculations. For the submission 2012, the results of NFI 2007/09 were for the first time available. On basis of these results the forest land area and all LUC areas to and from forests for the years from 2002 on were revised. Furthermore, for area consistency reasons also the LUC areas from other categories to wetlands, settlements and other land had to be revised due to the new NFI results.

Table 207: Land use and LUC data for Austria for the years 1990 and 2010.

Area in ha	1990	2010	Diff. 1990–2010
5.A Forest land – total area	3 891 333	3 999 857	108 524
1 Forest land remaining forest land – total area	3 504 743	3 780 840	276 097
1.1a Forest land remaining forest land: coniferous	2 432 897	2 557 136	124 239
1.1b Forest land remaining forest land: deciduous	737 690	984 604	246 914
1.1c Forest land remaining forest land: forest not in yield	334 156	239 100	-95 056
2. Land converted to forest land	386 591	219 018	-167 573
2.1 Cropland converted to forest land	60 661	31 884	-28 777
2.2 Grassland converted to forest land	225 828	129 101	-96 727
2.3 Wetland converted to forest land	17 528	9 386	-8 142
2.4 Settlement converted to forest land	54 258	25 576	-28 683
2.5 Other Land converted to forest land	28 315	23 071	-5 244
5.B Cropland – total area	1 507 533	1 434 409	-73 124
1. Cropland remaining cropland	1 424 651	1 332 948	-91 703
1a Annual remaining annual and perennial remaining perennial	1 394 507	1 304 241	-90 266
1b Annual converted to perennial	16 722	15 817	-904
1c Perennial converted to annual	13 423	12 890	-533
2. Land converted to cropland	82 882	101 461	18 579
2.1 Forest Land converted to cropland	9 652	8 675	-978
2.2 Grassland Land converted to cropland	73 229	92 786	19 557
2.2a Grassland converted to perennial cropland	1 548	1 962	413
2.2b Grassland converted to annual cropland	71 681	90 824	19 143
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	-

Area in ha	1990	2010	Diff. 1990–2010
5.C. Grassland – total area	1 992 765	1 796 168	-196 597
1. Grassland remaining grassland	1 878 598	1 710 925	-167 673
2. Land converted to grassland	114 167	85 243	-28 924
2.1 Forest land converted to grassland	99 259	61 712	-37 546
2.2 Arable land converted to grassland	14 908	23 530	8 622
2.2a annual cropland converted to grassland	14 780	23 328	8 548
2.2b perennial cropland converted to grassland	128	202	74
2.3 Wetland land converted to grassland	NO	NO	-
2.4 Settlement converted to grassland	NO	NO	-
2.5 Other land converted to grassland	NO	NO	-
5 D Wetlands – total area	133 068	146 123	13 055
1. Wetlands remaining wetlands	124 114	123 682	-433
2. Land converted to wetlands	8 953	22 442	13 488
2.1 Forest land converted to wetlands	5 055	3 356	-1 699
2.2 Arable land converted to wetlands	NO	NO	-
2.3 Grassland converted to wetlands	3 899	19 085	15 187
2.4 Settlement converted to wetlands	NO	NO	-
2.5 Other land converted to wetlands	-	-	-
5 E Settlements – total area	384 065	529 188	145 123
1. Settlements remaining settlements	193 218	358 112	164 894
2. Land converted to settlements	190 847	171 076	-19 771
2.1 Forest land converted to settlements	29 872	19 048	-10 824
2.2 Arable land converted to settlements	156 883	138 385	-18 498
2.3 Grassland converted to settlements	4 093	13 644	9 550
2.4 Wetlands converted to settlements	NO	NO	-
2.5 Other land converted to settlements	-	-	-
5 F Other land – total area	478 236	481 255	3 019
1. Other land remaining other land	389 027	438 267	49 240
2. Land converted to other land	89 209	42 988	-46 221
2.1 Forest land converted to other land	49 170	20 508	-28 662
2.2 Arable land converted to other land	NO	NO	-
2.3 Grassland converted to other land	40 039	22 480	-17 559
2.4 Wetlands converted to other land	NO	NO	-
2.5 Other land converted to other land	NO	NO	-
Total area	8 387 000	8 387 000	

Table 208 shows the reported data as land-use change matrix for the years 1990 and 2010.

Table 208: Land use and land-use change matrix for Austria 1990 – 2010

in 1 000 ha	Forest land	Cropland	Grass-land	Wetlands	Settlements	Other land	Total 2010
Forest land	3 781	32	129	9	26	23	4 000
Cropland	8	1 329	97	NO	NO	NO	1 434
Grassland	61	24	1 711	NO	NO	NO	1 796
Wetlands	3	NO	19	124	NO	NO	146
Settlements	19	138	14	NO	358	NO	529
Other land	20	NO	23	NO	NO	439	482
Total 1.1.1990	3 892	1 523	1 993	133	384	462	8 387

7.1.3.2 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-categories 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 categories “settlement” and “other land”.

7.1.4 Quality Assurance and Quality Control (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 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

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

1.1.2) 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 implausible differences. Documentation of this further check.

7.1.5 Uncertainty Assessment

For submission 2012 a complete uncertainty analysis for the whole LULUCF sector and time series was carried out by using Monte-Carlo-simulations with the @Risk-Software. For that purpose, the uncertainties of all activity data, emission factors and input parameters for the emission factors were defined. Previously estimated uncertainties on such parameters (as included in previous submissions) were undertaken a critical reassessment and partly revised using related information in the used statistics/literature, in the IPCC GPG and by consultations of experts. For each subcategory a bottom-up analysis of the uncertainties of the estimated emission/removal figures for the subcategory were carried out. All pools and gases were included in this analysis. Only the source of wildfires in forests was not included in the uncertainty analysis. It has only a negligible share in the total LULUCF emissions/removals of Austria, so any uncertainty of this source will not contribute in a visible way to the total uncertainty of the LULUCF sector. Correlations between the parameters were taken into consideration during the simulations. Each simulation was run with 10 000 to 100 000 iteration steps.

All single uncertainties of the LULUCF subcategories estimates were merged then to the uncertainty of the total LULUCF sector emissions/removals by Monte-Carlo-simulations.

Uncertainty values in the LULUCF chapter represent (cover) always the range of the 95 % confidence interval (the distance of twice the standard deviation from the mean) which is in line with the IPCC GPG.

The uncertainty of the total LULUCF sector emissions/removals is approx. $\pm 19\,000$ Gg CO₂. This represents on average ± 150 % of the total LULUCF emissions/removals in the years 1990 to 2002 which were years with a significant net sink of the LULUCF sector. In the years after 2002 with a much smaller net sink or source, the relative uncertainty of the total LULUCF emissions/removals is in minimum ± 260 % up to maximum $\pm 4\,850$ %. Very high relative uncertainties of more than $\pm 1\,000$ % resulted for the years 2003, 2006, 2007 and 2008 with rather low LULUCF net sinks/sources.

It is important to note that the majority (70 %) of this total LULUCF uncertainty can be attributed to the C stock changes of two pools of one sub category, namely to the results of the litter/soil pool of forest land remaining forest land (5.A.1). If the uncertainties of the C stock changes of the pools of subcategory 5.A.1 are deleted from the uncertainty simulation, the following average uncertainties for the single years of the total LULUCF emissions/removals remain: approx. $\pm 5\,600$ Gg CO₂ (with higher absolute uncertainties in the 90ies due to more uncertain input data in previous years). This represents on average ± 53 % of the total LULUCF emissions/removals in the years 1990 to 2002. In the years after 2002 with very low net LULUCF emissions/removals the relative uncertainty of the total LULUCF emissions/removals lies accordingly higher, between ± 62 % and ± 775 %.

So, the inclusion of the litter/soil C pool of 5.A.1 with its high uncertainty impairs significantly the quality of the estimated totals for LULUCF. Austria uses very good tools to estimate the changes of these pools: litter input data on basis of a detailed forest inventory, results from two forest soil surveys and an internationally approved model to simulate the C stock changes (Yasso). So, no improvement of these estimates can be achieved in the short run; however, significant improvements are very likely after decades, when repeated soil inventories allow a significant assessment of the soil C stock changes.

It is important to note that half of Austria is forest land and that the change of the litter/soil C pool of sub-category 5.A.1 (which represents emissions of about $2\,600$ Gg CO₂ per year) constitutes a significant share in the total LULUCF emissions/removals of Austria.

The biomass of 5.A.1 has in most years the highest impact on the total emissions/removals of the LULUCF sector, at least in the years 1990 to 2002. As a consequence, the uncertainty of these emissions/removals (around 40 %) has also a significant impact on the uncertainty of the total emissions/removals of the LULUCF sector.

All other subcategories contribute to a clearly smaller extent to the results and, hence, uncertainty of the LULUCF totals, despite their partly extremely high relative uncertainties (in %) of their total emissions/removals (e.g. grasslands, settlements and other land).

7.1.6 Recalculations

For the submission 2012 the results of the new NFI 2007/09 were available for the first time. The previously reported biomass increment and drain rates, dead wood stock changes, forest land areas, land-use-change areas to and from forests for the years after 2002 were based on the means of the NFI 2000/02 results. These were updated now by the values of the new NFI results.

For area consistency reasons also the LUC areas from other categories to wetlands, settlements and other land and, as a consequence, the related emissions/removals had to be revised due to the new NFI results.

Furthermore, single forest biomass functions were improved and the whole time series was estimated with these improved functions.

A slight change of the interpolation procedure in the forest land category was carried out.

The litter and soil C stock changes for subcategory 5.A.1 were estimated for the first time.

A more stratified estimate of the soil C stocks and the related soil C stock changes at land-use-change lands to and from forests according to five forest growth regions was carried out.

Further details of these recalculations are given in the chapters of the subcategories.

7.1.7 Completeness

Table 209 gives an overview of the new IPCC categories included in this chapter and the corresponding sub-divisions for which the 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 CO₂ emissions/removals are estimated.

Table 209: IPCC categories according to the IPCC-Good Practice Guidance for Land-Use, Land-Use Change and Forestry.

IPCC categories ⁶⁶ / 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	✓	

⁶⁶ IPCC categories – applied according to the “Good Practice Guidance for LULUCF (2003)”

IPCC categories ⁶⁶ / Sub division for calculation	Description	Status for CO ₂	Other GHG
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	✓	
	<i>Carbon stock change in biomass</i>	✓	
	<i>Carbon stock change in soils</i>	✓	
5.A.2.2	Grassland converted to forest land	✓	
	<i>Carbon stock change in biomass</i>	✓	
	<i>Carbon stock change in soils</i>	✓	
5.A.2.3	Wetlands converted to forest land	✓	
	<i>Carbon stock change in biomass</i>	✓	
	<i>Carbon stock change in soils</i>	✓	
5.A.2.4	Settlements converted to forest land	✓	
	<i>Carbon stock change in biomass</i>	✓	
	<i>Carbon stock change in soils</i>	✓	
5.A.2.5	Other land converted to forest land	✓	
	<i>Carbon stock change in biomass</i>	✓	
	<i>Carbon stock change in soils</i>	✓	
5.B	Cropland	✓	
5.B.1	Cropland remaining cropland	✓	
<i>Annual remaining annual</i>	<i>Carbon stock change in living biomass</i>	✓	
<i>Annual remaining annual</i>	<i>Carbon stock change in soils</i>	✓	
<i>Perennial remaining perennial</i>	<i>Carbon stock change in living biomass</i>	✓	
<i>Perennial remaining perennial</i>	<i>Carbon stock change in soils</i>	✓	
<i>Annual converted to perennial</i>	<i>Carbon stock change in living biomass</i>	✓	
<i>Annual converted to perennial</i>	<i>Carbon stock change in soils</i>	✓	
<i>Perennial converted to annual</i>	<i>Carbon stock change in living biomass</i>	✓	
<i>Perennial converted to annual</i>	<i>Carbon stock change in soils</i>	✓	
5.B.2	Land converted to cropland	✓	
5.B.2.1	Forest land converted to cropland	✓	
	<i>Carbon stock change in biomass</i>	✓	
	<i>Carbon stock change in soils</i>	✓	✓ N ₂ O
5.B.2.2	Grassland converted to cropland	✓	
	<i>Carbon stock change in living biomass</i>	✓	
	<i>Carbon stock change in soils</i>	✓	✓ N ₂ O
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	✓	

IPCC categories ⁶⁶ / Sub division for calculation	Description	Status for CO ₂	Other GHG
5.C.1	Grassland remaining grassland	✓	
	<i>Carbon stock change in soils</i>	✓	
5.C.2	Land converted to grassland	✓	
5.C.2.1	Forest land converted to grassland	✓	
	<i>Carbon stock change in biomass</i>	✓	
	<i>Carbon stock change in soils</i>	✓	
5.C.2.2	Cropland converted to grassland	✓	
	<i>Carbon stock change in living biomass</i>	✓	
	<i>Carbon stock change in soil</i>	✓	
5.C.2.3	Wetland converted to grassland	NO	
5.C.2.4	Settlements converted to grassland	NO	
5.C.2.5	Other land converted to grassland	NO	
5.D	Wetlands	✓	
5.D.2.1	Forest land converted to wetlands	✓	
	<i>Carbon stock change in living biomass</i>	✓	
	<i>Carbon stock change in soil</i>	✓	
5.D.2.2	Cropland converted to wetlands	NO	
5.D.2.3	Grassland converted to wetlands	✓	
	<i>Carbon stock change in living biomass</i>	✓	
	<i>Carbon stock change in soil</i>	✓	
5.D.2.4	Settlements converted to wetlands	NO	
5.D.2.5	Other land converted to wetlands	NO	
5.E	Settlements		
5.E.2.1	Forest land converted to settlements	✓	
	<i>Carbon stock change in living biomass</i>	✓	
	<i>Carbon stock change in soil</i>	✓	
5.E.2.2	Cropland converted to settlements	✓	
	<i>Carbon stock change in living biomass</i>	✓	
	<i>Carbon stock change in soil</i>	✓	
5.E.2.3	Grassland converted to settlements	✓	
	<i>Carbon stock change in living biomass</i>	✓	
	<i>Carbon stock change in soil</i>	✓	
5.E.2.4	Wetlands converted to settlements	NO	
5.E.2.5	Other land converted to settlements	NO	
5.F	Other Land		
5.F.2.1	Forest land converted to other land	✓	
	<i>Carbon stock change in living biomass</i>	✓	
	<i>Carbon stock change in soil</i>	✓	
5.F.2.2	Cropland converted to other land	NO	
5.F.2.3	Grassland converted to other land	✓	
	<i>Carbon stock change in living biomass</i>	✓	
	<i>Carbon stock change in soil</i>	✓	

IPCC categories ⁶⁶ / Sub division for calculation	Description	Status for CO ₂	Other GHG
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⁾ CO₂ 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.

7.1.8 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:

- Recalculations of biomass and dead wood data for LUCs from and to forest land for on basis of the results of NFI (2007/09) and the ARD NFI 2011/13.
- Improvement of the values for biomass C-stocks in viticulture and horticulture

7.2 Forest land (5.A)

7.2.1 Category description

3.99 Mio ha (47.6%) of Austria are forest land (BFW 2011). The sustaining of the Austrian forests in the past helped to restore an important carbon stock in the Austrian landscape and to avoid net CO₂ 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 CO₂ equivalent emissions of the greenhouse gases CO₂, CH₄ and N₂O in the year 1990 (UMWELTBUNDESAMT 2000).

Emission/Removal trends of forest land

With regard to forest land the annual net CO₂ removals under sector 5 of the reported period 1990–2010⁶⁷ range from 1 411 Gg CO₂ to 19 592 Gg CO₂ (mean: 10 993 Gg CO₂). 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 CO₂ balance.

⁶⁷ For the years 2009 and 2010 the means for the last period (2007 to 2009) of the National Forest Inventory (NFI) have been reported.

2008 is the media year of the last national forest inventory period, which was carried out between 2007 and 2009. For the years since 2008 the means for the last period (2007 to 2009) of the National Forest Inventory (NFI) have been reported.

For the submission 2012 several improvements and updating steps were carried out that had a significant impact on the results of the whole time series of forest land:

- 1) For the submission 2012, the results of NFI 2007/09 were for the first time available. On basis of these results, biomass increment and drain, changes in dead wood stocks, forest land area and all LUC areas to and from forests for the years from 2002 on were revised. In previous submissions the average results of the NFI 2000/02 were reported for these years. The results of the NFI 2007/09 show that the annual harvest in the years after 2002 has been much (on average 38%) higher than in the period of NFI 2000/02. Consequently, the net sink of the category for the years after 2002 is much lower than reported in previous submissions where the means of the NFI period 2000 to 2002 were used for reporting of the years after 2002. This trend is also supported by the Austrian records of timber harvest, which is a further statistic of timber harvested, derived bottom-up on the basis of harvest data provided by the Austrian forest holders (see chapter 7.2.4.1.1).
- 2) The whole time series was recalculated on basis of partly new biomass functions. The use of the new functions leads to approximately 12 % lower net biomass removals of category 5.A.1 for the whole time series compared to the estimates of previous submissions.
- 3) The CO₂ emissions from forest soils (litter and mineral soil) of the category forest land remaining forest land are reported in this submission for the first time. According to the modelling results using Yasso and the estimates of soil C pool losses due to forest road construction, the litter plus soil pool of forest land remaining forest land was an emission source in the time period 1990 to 2010 of about 2 600 Gg CO₂ per year. Removals by the dead wood stock in general have a minor influence on the totals of Sector 5 (about 600 Gg CO₂).
- 4) More stratified estimates of the soil C stock changes were estimated for all land-use-change subcategories to and from forests for submission 2012. These further stratified estimates have also a significant impact on the soil C stock changes of the LUC-subcategories to forest lands compared to previous estimates. The sink of the mineral soil C pool of subcategory 5.A.2 is 40 % lower, those of the litter pool 60 % higher compared to previous submissions.

As a consequence of all these improvements and updating steps, the net sink of Forest land is for the years before 2002 on average about 24 % lower than in previous submissions. But still, each of these years had a significant LULUCF net sink. For the years after 2002 the new NFI results with a significant increase in biomass drain show a clear decrease in the net sink of the biomass of the subcategory “forest land remaining forest land” (5.A.1). This leads, together with the new estimates of the soil C changes (emissions) for 5.A.1, even to net emissions of category 5.A.1 in the years 2003, 2007 and 2008.

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 11 081 Gg CO₂ (from 4 324 Gg CO₂ to 16 385 Gg CO₂). Between 1990 and 2008 the net carbon sink of this category ranges between 2% and 32% of the total CO₂ equivalent emissions without LULUCF of the GHGs CO₂, CH₄ and N₂O in this period.

According to the reporting tables for *Land Use, Land Use Change and Forestry* increments and losses at areas of land use change to and from forests (incl. forest out of yield) 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 2010 the total annual net CO₂ removals (biomass and soil) from land use changes to forest range from about 2 443 Gg CO₂ to 4 643 Gg CO₂. The total annual emissions (biomass and soil) from land use changes from forests vary between 1 332 Gg CO₂ and 2 056 Gg CO₂ (Table 210).

The net carbon stock changes of category 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 (e.g. very low increment in 2003, very high harvest rates in 2007 and 2008). The forest biomass changes in category 5.A.1 have a major impact on the overall results in category 5.A (and total sector 5). Therefore, such reasons for different growth and different harvest in single years explain the high annual variations as well as single outlier years in the CO₂ net removals of this sector. The rather constant values from 2009 on are due the use of averages of the last NFI (2007/09) for the estimates of the years after 2008.

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.

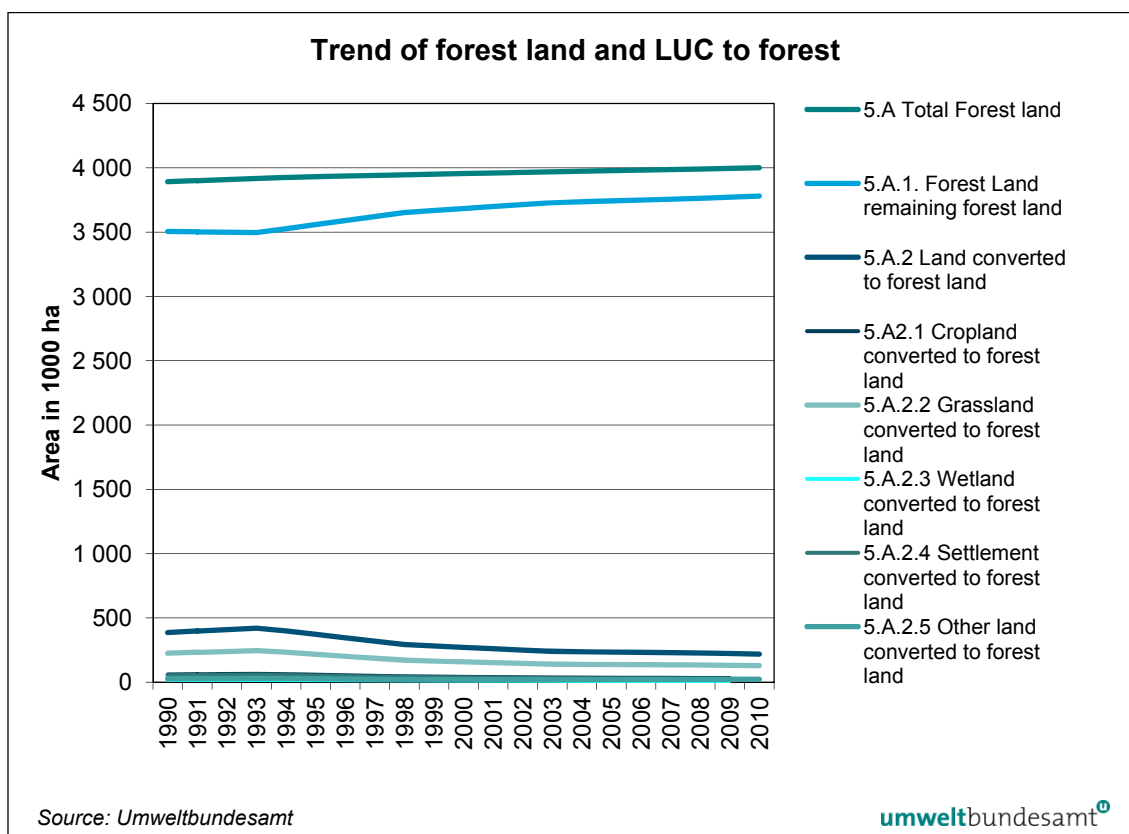


Figure 27: Trend of forest land and LUC to forest (covering a conversion period of 20 years) from 1990 to 2010 in 1 000 ha (Total forest land includes also forest out of yield).

Table 210: CO₂ removals/emissions from IPCC Category 5 A Forest Land and Forest land conversions from 1990–2010 (Gg CO₂ resp. Gg CO₂ 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	-11 862	-7 617	-4 246	-785	-1 703	-436	-700	-622	IE	0.582	0.135	1 987
1991	-17 612	-13 234	-4 378	-808	-1 753	-449	-728	-640	IE	0.154	0.036	2 010
1992	-12 869	-8 359	-4 510	-831	-1 803	-462	-756	-659	IE	0.384	0.089	2 033
1993	-13 355	-8 712	-4 643	-854	-1 853	-475	-784	-677	IE	0.326	0.076	2 056
1994	-12 196	-7 805	-4 392	-810	-1 758	-451	-731	-642	IE	0.169	0.039	2 014
1995	-13 143	-8 977	-4 166	-756	-1 641	-421	-748	-599	IE	0.093	0.022	1 551
1996	-10 012	-6 154	-3 858	-703	-1 525	-391	-683	-557	IE	0.084	0.020	1 499
1997	-18 652	-15 102	-3 550	-649	-1 408	-361	-618	-514	IE	0.058	0.014	1 448
1998	-16 725	-13 484	-3 242	-595	-1 291	-331	-554	-472	IE	0.271	0.063	1 396
1999	-19 592	-16 476	-3 116	-573	-1 243	-319	-527	-454	IE	0.023	0.005	1 375
2000	-16 452	-13 461	-2 991	-551	-1 196	-306	-501	-437	IE	0.122	0.028	1 354
2001	-18 353	-15 488	-2 865	-529	-1 148	-294	-474	-419	IE	0.070	0.016	1 332
2002	-12 651	-9 846	-2 806	-503	-1 099	-290	-498	-416	IE	0.559	0.130	1 545
2003	-2 613	73	-2 686	-477	-1 050	-285	-461	-413	IE	0.533	0.124	1 518
2004	-7 696	-5 038	-2 658	-467	-1 035	-289	-443	-423	IE	0.049	0.011	1 496
2005	-9 148	-6 519	-2 630	-457	-1 021	-294	-425	-433	IE	0.090	0.021	1 474
2006	-3 334	-732	-2 602	-447	-1 007	-298	-408	-442	IE	0.215	0.050	1 452
2007	-2 306	268	-2 574	-437	-992	-303	-390	-452	IE	0.108	0.025	1 430
2008	-1 411	1 135	-2 546	-427	-978	-307	-372	-462	IE	0.146	0.034	1 408
2009	-5 459	-2 965	-2 495	-413	-955	-309	-350	-468	IE	0.163	0.038	1 392
2010	-5 411	-2 968	-2 443	-399	-931	-311	-327	-475	IE	0.143	0.033	1 376

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 – (BFW 2011; GSCHWANTNER et al. 2010, SCHIELER et al. 1995; WINKLER 1997)). The NFI was carried out in the periods 1961–70, 1971–80, 1981–85, 1986–90, 1992–96, 2000–02 and 2007–09. The NFI uses a permanently below ground marked 4 x 4 km grid across all of Austria with four permanent sample plots of 300 m² size at each grid point. 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 category 5.A and the areas of the subcategories 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% (see Figure 23 in UMWELTBUNDESAMT 2010d or at BFW 2005, <http://www.bfw.ac.at/rz/bfwcms.web?dok=2384>). Each grid point is terrestrially inspected during each NFI assessment for a potential aff-/re-forestation except grid points that are not suited to cover forests (e.g. grid points at glaciers or at permanent surface water bodies).

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, 2000/02 and 2007/09. 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.

7.2.2.1 Methods used to derive annual data of FL remaining FL, on the basis of the existing NFI datasets.

The NFIs provide for each NFI period data on the area of productive forests and non-productive forests (forests out of yield) - those sum up to the total forest area in Austria and represent averages for the NFI assessment period.

By linear interpolation (area according to NFI is located in the mean year of NFI period) annual figures for these areas are estimated. Furthermore the NFIs provide information on the ratio of area covered by coniferous and deciduous trees.

The calculation of the annual data for **FL remaining FL** is then based on the following data (all based on NFI assessments), steps and considerations:

- 1) Total annual area of productive forests (forests in yield) is reduced by the area of LUC to productive FL (as sum of 20 years LUC transition period).
- 2) LUC to forests not in yield takes also place and is assessed by the NFIs – after 20 years of transition period those areas are considered as FL remaining FL and added to the result of step 1. (The sum of step 1 plus step 2 for 1990: 3 171 kha. This is the sum of the figures of 1.1a and 1.1b in Table 207)
- 3) The result of step 2 is split according to the area-distribution of coniferous and deciduous trees, e.g. for 1990: coniferous 738 kha + deciduous 2 433 kha = 3 171 kha (see Table 207 and CRF table)
- 4) Remaining forests not in yield under forest land remaining forest land is calculated from the total forest area based on the NFI results (e.g. 3 891 kha) minus the sum area of step 1 + 2 (e.g. 3 171 kha) minus LUC to forests (e.g. 386 kha). For 1990: 334 kha (see 1.1c in Table 207).
- 5) Total forest land remaining forest land in CRF table is the sum of step 3 and 4 = 3 505 kha.

The result of step 5 and the LUC to forest sum up to the total forest area according to NFI (e.g. in 1990: 3 505 kha + 386 kha = 3 891 kha).

The calculations of C-losses and C-gains for FL remaining FL consider only the area of **productive forest (forest in yield)**.

7.2.2.2 Estimation of the annual LUC from and to FL, and their splitting into the different subcategories.

LUC areas to and from forests are available from the individual NFIs. A division of these areas by the NFI assessment period leads to data for the annual LUCs. By means of the NFI, which follows a regular grid of 4 x 4 km land use changes to and from forests 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 have a significantly higher uncertainty compared to the uncertainty for the total forest land.

The specific shares of individual land use categories of these LUCs were assessed in the NFIs 2000/02 and 2007/09 (which represent the observation periods between the years of the NFI periods 1992/96 to 2000/02 and 2000/02 to 2007/09). The various past/previous LU categories as assessed by the NFI were summed up according to the IPCC-GPG LU categories (Table 211).

Table 211: LU-classification systems (IPCC-GPG and NFI 2000/02).

Land use categories in the IPCC GPG	LU classifications for LUC from and to forests according to the NFI (2000/02 and 2007/09)
Cropland	Annual cropland Perennial cropland Fallow, agricultural land
Grassland	Grassland (intensive, extensive use) Pastures (inkl. slopes)
Wetlands	Water bodies Bogs, peatland Reed area
Settlements	Industry, mining Traffic area Land fills, dumps Urban, residential zone
Other land	Unmanaged alpine dwarf shrub heaths Scree Rock Others

In case a land use change has been observed at an inventory point of the NFIs the type of the neighbouring non-forest land was recorded. For the NFI 2000/02 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. For the NFI 2007/09 the detection of LUC area was accurate to a tenth at each plot and evaluated for all NFI points. The results are also shown in Table 212 and

Table 213.

The total increase of forest area between the NFI 1992/96 and 2000/02 was 68 000 ha, between the NFI 2000/02 and 2007/09 72 000 ha (for the total forest area). The loss of forest area for the same periods was calculated to be about 32 000 ha and 42 000 ha leading to a net increase of the total forest area of about 36 000 ha and 40 000 ha (between these NFIs). The productive forest area increased by 19 000 ha between the NFIs 1992/96 and 2000/02 and decreased by 4 000 ha between the NFIs 2000/02 and 2007/09.

Table 212: Land use changes to forest (% , ha) observed for the NFI periods 2000/02 and 2007/09; based on BFW (2011).

Categories of land use changes according to the IPCC GPG 2003	NFI 2000/02		NFI 2007/09	
	Land use changes to forest land (% of total conversion to forest land)	Land use changes to forest land [1000 ha]	Land use changes to forest land (% of total conversion to forest land)	Land use changes to forest land [1000 ha]

Categories of land use changes according to the IPCC GPG 2003	NFI 2000/02		NFI 2007/09	
	Land use changes to forest land (% of total conversion to forest land)	Land use changes to forest land [1000 ha]	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)	15.7	10.7	13.0	9.3
Grassland (5 A.2.2)	58.4	39.9	59.7	42.7
Wetlands (5 A.2.3)	4.6	3.1	3.9	2.8
Settlements (5 A.2.4)	14.0	9.6	8.4	6.0
Others (5 A.2.5)	7.3	5.0	15.0	10.7
Total	100.0	68.3	100.0	71.6

Table 213: Land use changes from forest (% , ha) observed for the NFI periods 2000/02 and 2007/09; based on BFW (2011).

Categories of land use changes according to the IPCC GPG 2003	NFI 2000/02		NFI 2007/09	
	Land use changes from forest land (% of total conversion to forest land)	Land use changes from forest land [1000 ha]	Land use changes from forest land (% of total conversion to forest land)	Land use changes from forest land [1000 ha]
Cropland (5 B.2.1)	5.0	1.6	10.6	4.4
Grassland (5 C.2.1)	53.0	16.4	57.9	24.1
Wetlands (5 D.2.1)	3.0	0.8	3.4	1.4
Settlements (5 E.2.1)	15.0	4.9	18.3	7.6
Others (5 F.2.1)	24.0	8.1	9.8	4.1
Total	100.0	31.8	100.0	41.6

As shown in Table 212 and

Table 213 the land use changes to and from forests mainly appear from/to grassland sites (58-60% or 53-58%, respectively). The land use changes from or to other categories are far below this value.

For the years before 1997 back to 1970 it was assumed that the land use changes between two NFI observation periods show the same ratio of distribution between land use types as in the NFI period 1992/96 and 2000/02. For the NFI periods 1986/90 and 1992/96 the total areas of LUC to forests and the total areas of LUC from forests are available. So, the ratios of changes from and to FL from/to individual other land use categories according to NFI 2000/02 could be applied directly to split the whole time series of available LUC area data from/to FL from these NFIs to individual past/previous LUC categories. For the years before the NFI period 1986/90 back to 1970 only the net changes of the total forest area according to older NFIs (1961/70, 1971/80, 1981/85) is available. These figures plus the information on LUC areas from/to forest according to the more recent NFIs were used to estimate the LUC areas from and to forests for these years: It was assumed that the detected net forest area changes between two NFI periods are based on the same ratio in LUC distribution (LUC to forests vs. LUC from forests) as between the more recent NFI periods. The ratio was always related to the total increase or loss of forest area between two consecutive previous NFIs. Thus, also for the years back to 1970 annual LUC areas from and to forest could be estimated.

Figure 28 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.

For the estimates of changes in litter and soil carbon stocks the LUC area was further stratified according to five forest growth regions (Bohemian Massif, Inner Alps, Calcareous Alps, Foothills and Alpine ridge). The area information for these LUC is also based on the NFI results 2000/02 and 2007/09. The results are finally summed up according to the areas of LUC as shown in Table 212 and

Table 213. The specific carbon stocks for litter and soil for each forest growth region are shown in Table 276.

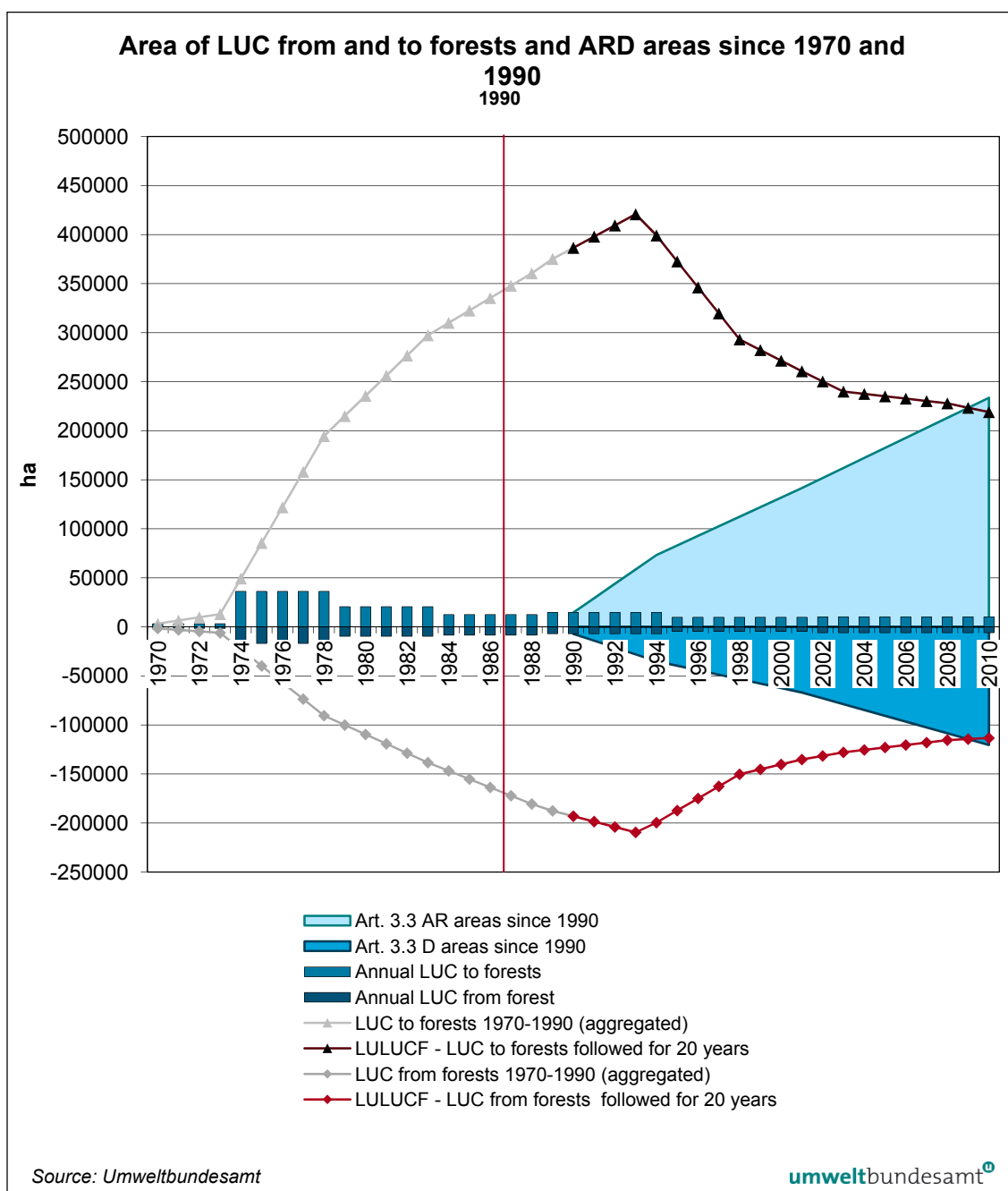


Figure 28: Areas of LUC from and to forests and ARD areas since 1970 and 1990, respectively.

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, stemwood volume increment and drain (harvest and other losses) of the growing stock (for both stemwood over bark with a diameter at breast height > 5 cm) according to the Austrian National Forest Inventory (NFI – (BFW 2011; GSCHWANTNER et al. 2010, SCHIELER et al. 1995; WINKLER 1997)). The NFI was carried out in the periods 1961–70, 1971–80, 1981–85, 1986–90, 1992–96, 2000–02 and 2007–09. An additional NFI, that is limited to ARD plots, is ongoing and will be finished 2013 (assessment period 2011/13).

In addition to the NFI harvest data, which are based on measurements in the forests, further harvest statistics exist: the annually reported records of timber harvest and the Austrian wood balance (BITTERMANN & GERHOLD 1995, BMLFUW 1964–2011). These statistics are not based on measured data. Therefore, it is assumed that the NFI provides more accurate figures on the stemwood drain and for this reason the estimates are based on NFI drain figures. However, the results of the other statistics are used to derive “relative harvest indices for individual years” (see below). Table 214 gives an overview of the different harvest statistics in Austria.

Table 214: Overview of the different harvest statistics in Austria.

Statistics	Characteristics/methodological approach	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.	m ³ total stemwood over bark
National annual records of timber harvest (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).	m ³ extracted stemwood under bark
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	m ³ extracted stemwood under bark

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 land use changes 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 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 according to NFI results. The approaches on calculating CO₂ 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 NFI observation 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 between a NFI period and the NFI period before, and not the NFI assessment period).

A previous additional intermediate interpolation step for increment and drain for further periods located in years around the changes of NFI observation periods was deleted for the submission 2012. There is no logic for the validity of such interpolation steps since increment and drain do not change linearly across time. So, only the real average annual NFI increment and drain results are taken as a basis for the full NFI observation period. The single year values are estimated then from these average annual NFI results for the single NFI observation periods with the help of related annual indices (see next paragraph).

In a next step, these NFI means are converted with relative indices⁶⁸ 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 timber harvest (BMLFUW 1964–2011) and the wood balance (BITTERMANN & GERHOLD 1995). For increment, representative Austrian sets of tree ring cores (HASENAUER et al. 1999a, b; BFW 2011a, pers. comm.) are used to calculate the relative indices. These indices are available until 2010. This method allows accurate estimates for individual years for the category 5 A 1. The figures for annual growth and for annual drain may differ significantly year by year thus the net carbon stock changes between single years vary considerable and outliers exist (e.g. very low increment in 2003, very high harvest rates in 2007 and 2008). 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 CO₂ 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 m³ stemwood 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

⁶⁸ Values for the relative variation in the individual years of the time series

given mean wood densities are based on the species composition of increment and harvest in Austria and on country specific values for the shrinkage and wood densities for all individual tree species (Austrian Standard ÖNORM B3012) (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%) because the shares of the tree species change very slowly.

Further details on the approach and methodology are given in (UMWELTBUNDESAMT 2000).

Table 215: Conversion factors for the stemwood o.b. of the Austrian forests; mean of several NFIs (UMWELTBUNDESAMT 2000, updated).

Conversion factors	Coniferous	Deciduous
m ³ o.b. to t dm (stemwood)	0.38	0.54
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 and then extrapolated for the whole Austrian forests at the Austrian Federal Research and Training Centre for Forests, Natural Hazards and Landscape. 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, age	(WIRTH et al. 2004), (OFFENTHALER & HOCHBICHLER 2006)

The use of these biomass functions leads to the following average biomass expansion ratios for total tree biomass/stemwood biomass. These expansion factors are not used for the calcula-

tions but are provided as additional information for transparency reasons. The estimates of increment and harvest of the other tree compartments are based on the biomass functions shown in Table 216.

The whole time series was recalculated on basis of partly new biomass functions. We used slightly improved functions for the branch biomass and a different function for the root biomass. It was realized that the previously used function for the root biomass from Wirth et al. (2004) leads to unrealistic high root biomasses for dimensions with higher DBH due to an extreme rise of the shape of the curve at larger DBHs. This had a significant impact on the results for increment biomass, but also on the results for drain biomass. So, a different root function from WIRTH et al. (2004) was selected which includes besides DBH also the tree age as explaining parameter and leads to more realistic estimates for the root biomass. The use of the new functions leads to approximately 12 % lower net biomass removals of category 5.A.1 for the whole time series compared to the estimates of previous submissions. The changes of the average expansion ratios due to the use of the improved functions for submission 2012 is given in Table 217 (old vs. new).

Table 217: Average expansion ratios total tree biomass/stemwood biomass derived from the applied biomass functions for the Austrian forests for the period 1990–2008(based on BFW 2011b, pers. comm.).

Expansion ratio t dm stemwood → t dm whole tree (incl. also below ground biomass)	Coniferous		Deciduous	
	old	new	old	new
increment	1.75	1.62	1.77	1.63
harvest	1.62	1.60	1.63	1.59

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 2009. For the years since 2008 the mean values for the last inventory period (2007/09) 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 likely 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, the area of forests out of yield is reported. 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 $4.5 \text{ m}^3 \text{ ha}^{-1}$ for the inventory period 1992/96, $6.1 \text{ m}^3 \text{ ha}^{-1}$ for the inventory period 2000/02 and $8.4 \text{ m}^3 \text{ ha}^{-1}$ for the inventory period 2007/09. 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 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 range between 228 Gg CO_2 and 844 Gg CO_2 , which is only a minor part of the total C-balance of sector 5.

7.2.4.1.3 Litter and soil

For submission 2012 litter and soil C stock changes of category 5.A.1 were estimated and reported for the first time. The dynamics of soil carbon in Austrian forest ecosystems were estimated with the simulation model Yasso07 (see FINNISH ENVIRONMENT INSTITUTE 2011 for details and references). This model was selected because the data for its parameterization are available in countries conducting national forest inventories (NFI).

Yasso simulates the stock of soil carbon, changes in this stock and the release of carbon from soil on an annual basis. It needs estimates of aboveground and belowground influx of carbon to the soil, the chemical quality of the carbon input and basic data on climate (air temperature and precipitation) to run. The core of Yasso is a decomposition model of soil organic material. It is based on field measurements in a wide range of climatic conditions and has been applied to site conditions in Nordic and Central European countries and to a pan-European data set.

The model simulation for Austria was based on data from two monitoring programs, the Austrian National Forest Inventory and the Austrian Forest Soil Survey. The Austrian NFI comprises 11 000 permanent sampling plots that are located on a regular grid. The soil monitoring network is part of this grid and comprises 529 sites. Soil sampling was repeated at 130 sites within the EU wide BioSoil project. These data were used to validate the model results.

The aboveground and belowground influx of carbon to the soil and the chemical quality of the carbon input was estimated on basis of the results of the Austrian NFIs (standing stock and harvest at the plots) and with tools for the conversion of stemwood to total tree biomass (see chapter 7.2.4.1.1). The estimated aboveground and belowground litter input was verified on basis of information from Austrian long-time monitoring sites. The needed meteorological parameters for the simulation sites (temperature and precipitation for the time series of the used NFIs) were taken from the regionalization of the results of the Austrian Hydrographic Service for the NFI plots. For the Austrian simulation Yasso was run 10 times for each used NFI data set (1986/90, 1992/96, 2000/02 and 2007/09) in order to account for the uncertainty about the parameter values. All estimates were carried out at the Austrian Federal Research and Training Centre for Forests, Natural Hazards and Landscape.

The output of Yasso is a time series of the total soil C pool, which is divided into carbon woody matter, non-woody matter and the acid-, water-, ethanol- and insoluble fractions. Yasso does not distinguish between soil horizons and accounts for the litter layer and the total soil C pool.

In addition to the Yasso simulations for the soils of forests in yield, the C losses in those soils of category 5.A.1 were estimated that were converted from stocked forest to non-stocked forest land for forest management operations (particularly forest roads). These areas account as forest land according to the Austrian and FAO forest definition (see chapter 7.2.3). The Austrian NFIs provide detailed information on the area of forest roads and a further specific study on forest roads in Austria was used (WINKLER 2003). The estimates give an average area of approx. 700 ha per year that is converted from stocked forests to fortified macadam or gravel forest roads in the period covered by NFIs. According to WINKLER (2003), 50 % of these fortified forest roads have vegetation (beside the wheel ruts) and the other half has no vegetation. For those without vegetation, 0 t C and for those with vegetation 60 t C per ha was assumed as equilibrium soil C stock (0-50 cm). The estimate method for the annual soil C losses at such forest land follows completely the method as provided by the IPCC GPG for soil C losses in land use change lands with a discounting of the soil C stock differences of the previous land use and the final land use across 20 years (see for instance chapter 7.2.4.2).

According to the Yasso model results plus the estimates of the soil C losses due to the increase in forest roads the litter plus soil of category 5.A.1 was an emission source in the whole time series since 1990 with an annual average C stock loss of 0.2 t C per ha and year and, in total, of 2 600 Gg CO₂ per year. About 10 % of these emissions are caused by the increase in forest roads.

7.2.4.1.4 Biomass burning

The controlled burning of managed forest is not carried out in Austria. CO₂ emissions caused by biomass burning due to wildfires are included in category 5.A.1 *Forest land remaining forest land*, as already reported in previous reports. Estimates of emissions from non-CO₂ gases from this category are reported. According to the IPCC (GPG 2003) a TIER 1 method following the equation 3.2.20 was applied.

$$L_{\text{fire}} (\text{t GHG}) = A * B * C * D * 10^{-6}$$

A area burnt (ha)

B mass of available fuel, kg dm ha⁻¹

C combustion efficiency

D emission factor

Data on the annual area affected by wildfires are available for the years 1990 to 2010 from the statistics of the Forest Ministry (BMLFUW) and range between 8 and 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 N₂O and CH₄ were taken from table 3.A.1.16 (IPCC GPG 2003).

However, the amounts of N₂O and CH₄ emissions caused by biomass burning due to wildfires are negligible, as they range between 0.005 and 0.58 Gg CO₂ equivalents. This is due to the small area concerned.

7.2.4.1.5 Consequences of the improvements on accounting for Forest Management in the second commitment period

In accordance with the conclusions and recommendations of the “Report of the technical assessment of the forest management reference level (FMRL) submission of Austria submitted in 2011” (UN-FCCC 2011), the improvements and updates in the forest land remaining forest land category as described in the previous chapters have impacts on accounting for Forest Management in the second commitment period which require following adjustments:

1) Inclusion of the litter and soil pools:

According to Paragraph 30 of the “Report of the technical assessment of the forest management reference level submission of Austria submitted in 2011” (UN-FCCC 2011) Austria indicated to make a technical correction to its FMRL as soon as national estimates for the litter and soil pools are available. The new estimates for the 5.A.1 litter and soil C pool changes represent an increase in emissions of about 2 600 Gg CO₂ per year, which requires a technical correction to ensure consistency in the treatment of pools between the FMRL and the national reporting of the Austrian GHG inventory under the UN-FCCC and Kyoto Protocol.

2) Updated expansion ratios:

The expansion ratios from stemwood to total tree biomass have been improved resulting in following changes (Table 217). The expansion ratios for increment decreased by around 8 %, those for harvest by around 2 %. As a result of these new expansion ratios the net removals of the historic time series decreased significantly in comparison to previous submissions. This adjustment leads to a decrease in FMRL removals of around 2 400 Gg CO₂ which requires a technical correction to ensure methodological consistency between the FMRL and the national reporting of the Austrian GHG inventory under the UN-FCCC and Kyoto Protocol.

3) Updated data on ‘drain’:

Austria already indicated in the course of the technical assessment of its FMRL, that a certain “inconsistency” arises from the fact, that the projections used to calculate the FMRL only cover emissions resulting from the harvest of “useable” trees, whereas the NFI and subsequently the reporting under the UNFCCC covers all biomass drain, including biomass losses due to mortality, which were around 10 % of the total biomass drain in the forests in yield according to the latest NFI.

The ERT concluded that the FMRL should in principle take account of the most recent data available at the time of estimation and suggested that Austria should assess whether including the NFI 2007–2009 data would make a significant difference to the FMRL. The losses due to mortality represent an increase in emissions of around 2 200 Gg CO₂, which requires a technical correction to ensure methodological consistency between the FMRL and the national reporting of the Austrian GHG inventory under the UN-FCCC and Kyoto Protocol.

4) Updated dead wood pool

The gains in the dead wood pool have been recalculated on the basis of the new NFI results. The annual removals in this pool changed from approx. 600 to 800 Gg CO₂. The changes in the dead wood pool represent an increase in removals of around 200 Gg CO₂, which requires a technical correction to ensure methodological consistency between the FMRL and the national reporting of the Austrian GHG inventory under the UN-FCCC and Kyoto Protocol.

5) Corrections in the calculations of the ‘increment’

As indicated in the “Report of the technical assessment of the forest management reference level submission of Austria submitted in 2011” Austria assumed a constant stemwood increment of 29.8 Mio. m³ o.b. per year, based on the weighted average of the last NFIs available at the time of compiling the FMRL submission. An error occurred in this estimate, which requires a correction. In addition results of the new NFI 2007/09 were taken up in the calculation of the weighted average. This correction results in a change of the projected annual stemwood increment from 29.9 to 30.1 Mio m³ o.b. This change represents an increase in removals of around 200 Gg CO₂ which requires a technical correction to ensure methodological consistency in the calculations of the FMRL and the national forest inventory.

The sum of all the technical corrections result in a ‘calculatory’ difference between the FMRLs adopted for Austria pursuant to Decision 2/CMP.7 of the Conference of the Parties serving as the meeting of the Parties to the Kyoto Protocol (as listed in FCCC/KP/CMP/2011/10/Add.1 to Decision 2/CMP.7 (UN-FCCC 2012)) and the national reporting of the Austrian GHG inventory under the UN-FCCC and Kyoto Protocol of 6 760 Gg CO₂ p.a.

If these technical corrections would be applied to the FMRLs referred to above, the FMRLs would need to be revised from -2 121 to 4 638 Gg CO₂ (with harvested wood products on basis of instantaneous oxidation) and from -6 516 to 244 Gg CO₂ (with harvested wood products on the basis of delayed emissions).

These technical corrections are furthermore in line with the provisions of Paragraph 14 of the Annex to decision 2/CMP.7 which requires parties to demonstrate methodological consistency between the FMRL and reporting for forest management.

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.): Measured data of biomass increment and loss at ARD areas will be available after finalisation of the recently running NFI survey 2011-13 at ARD areas.

The annual increment of stemwood over bark (o.b.) on LUC areas to forests was estimated with 3 m³ 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 m³ 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 m³ 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:

$$\Delta C_{\text{BM increment}} = 3 \cdot 0.8 \cdot 0.49 = 1.176 \text{ t C ha}^{-1} \text{ a}^{-1}$$

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:

$$\Delta C_{\text{BM harvest}} = 60 \cdot 0.72 \cdot 0.49 = 21.168 \text{ t C ha}^{-1} \text{ a}^{-1}$$

This value is then multiplied with the related annual LUC area from forest to another land use in the year of LUC.

An overview of the emissions/removals from land use changes from and to forests is given in Table 210.

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 Litter and soil

In the submission 2012 more stratified estimates of soil and litter C stock changes were calculated for all land use change sub-categories to and from forests. The soil C stock changes were stratified according to the specific soil C pools of different land use changes (as in previous submissions) and, additionally, according to five forest growth regions in Austria (Bohemian Massif, Inner Alps, Calcareous Alps, Foothills and Alpine ridge). The calculations for the regionalised land use specific agricultural soil C stocks are based on the Austrian soil inventories (same sources as for the national averages used in previous submissions). The calculations for the stratified forest soil and litter C stocks are based on the results of the EU-wide Biosoil project (BFW, 2009), which was carried out on 140 sites of the former forest soil survey (BFW, 1992). For the other land use categories than forest, cropland and grassland national estimates

were applied. Table 219 gives an overview of the estimates of C stocks in mineral soils (0-50 cm) and litter according to different land uses and forest growth regions.

Table 219: Specific C-stocks ($t\ C\ ha^{-1}$) for litter and soil (0-50 cm) stratified according to five forest growth regions in Austria.

IPCC LU categories	National LU categories	Forest growth regions					Source
		Bohemian Massif	Inner alps	Calcareous alps	Foot-hills	Alpine Ridge	
		t C ha ⁻¹ (0-50 cm)					
Forest - litter	Forest	40	24	24	19	26	BFW, in prep.
Forest - mineral soil	Forest	88	91	109	77	117	BFW, in prep.
Cropland	Cropland	56	90	80	65	90	Umweltbundesamt, in prep.
	Vineyards	58	58	58	58	58	Gerzabek et al. 2005
	Orchards/garden land	78	78	78	78	78	Gerzabek et al. 2005
Grassland	grassland intensive use	75	95	100	79	94	Umweltbundesamt, in prep.
	grassland extensive use	132	130	120	139	139	Umweltbundesamt, in prep.
Wetlands	Bogs*	500	500	500	500	500	expert judgement
	Surface waters and reed beds:	0	0	0	0	0	expert judgement
Settlements	Settlements and traffic area	60	60	60	60	60	expert judgement
	Industrial and mining areas, dumps	0	0	0	0	0	expert judgement
Other land	Alpine shrub lands	119	119	119	119	119	Körner et al. 1993
	Rocks and stone slopes:	0	0	0	0	0	expert judgement
	Other land uses	30	30	30	30	30	expert judgement

The values for forests, cropland and grassland represent regional averages which are based on Austrian soil inventories for forests (BFW 2009) 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 LANDESREGIERUNG 1994, AMT DER BURGENLÄNDISCHEN LANDESREGIERUNG 1996, AMT DER KÄRNTNER LANDESREGIERUNG 1999, compiled in the Austrian Soil Information System BORIS). The data have been stratified according to the Austrian forest growth regions (BFW, Umweltbundesamt).

The estimate of C stocks in bogs (0–50 cm) has been revised from $150\ t\ C\ ha^{-1}$ (0-50 cm) to $500\ t\ C\ ha^{-1}$ due to extensive literature studies and soil data of the Austrian Soil Information System BORIS. However, in Austria only minor LUC between bogs and forests were observed during the last two NFIs (annual changes between 9 and 50 ha). These land use changes always occur along forest boundaries. For these LUC areas no evidence is given, that the soil carbon stocks

change significantly over a time period of 20 years. Therefore no emissions or removals from these LUC are reported.

The estimate and expert judgment of the soil C stocks in areas of settlements and traffic areas is based on the same approach as described in chapter 7.6.4.1.2 (1/3 of these areas are assumed to be sealed and 2/3 unsealed; unsealed areas have the same soil C stock as grassland), but the higher value for the LUCs with forests takes the higher soil depth of 0–50 cm into account which is used for these estimates. For the “other land uses” of “other land” (those which are not alpine shrub lands, rocks and stone slopes) we assume some C stock in soils, but due to the shallow depth of these soils only 30 t C ha⁻¹.

The NFIs 2000/02 and 2007/09 specify the LUC from and to forests in a broader range of LUC categories than the existing six major IPCC land use categories (see Table 219). Consequently, for each IPCC GPG land use change category from and to forest an area weighted mean value of C-stocks for each subcategory and growth region was calculated for each NFI period (NFI 1992/96 to 2000/02 and NFI 2000/02 to 2007/09). The area weighted mean values of C-stocks used to estimate emissions and removals from soil and litter at LUC areas from and to forest are shown in Table 220 and Table 221.

Table 220: Area weighted mean values for carbon stocks in mineral soils (0–50 cm) of land use change areas from and to forest land between the NFI periods 1992/96 and 2000/02 and previous NFIs

Land use categories (IPCC – GPG)	C-stocks (t ha ⁻¹) in soils (0–50 cm) ¹									
	LUC to forest (forest growth regions)					LUC from forest (forest growth regions)				
	Bohemian Massif	Inner alps	Calc. alps	Foot-hills	Alpine Ridge	Bohemian Massif	Inner alps	Calc. alps	Foot-hills	Alpine Ridge
Forest	88	91	109	77	117	88	91	109	77	117
Cropland	56	90	78	65	89	56	-	-	66	83
Grassland	81	127	112	92	118	75	123	112	79	125
Wetlands	0	0	0	0	0	-	0	0	0	0
Settlements	60	60	46	41	28	60	-	41	35	40
Other land	-	13	35	30	43	-	27	33	13	70

Table 221: Area weighted mean values for carbon stocks in mineral soils (0–50 cm) of land use change areas from and to forest land between the NFI periods 2000/02 and 2007/09.

Land use categories (IPCC – GPG)	C-stocks (t ha ⁻¹) in soils (0–50 cm) ¹									
	LUC to forest (forest growth regions)					LUC from forest (forest growth regions)				
	Bohemian Massif	Inner alps	Calc. alps	Foot-hills	Alpine Ridge	Bohemian Massif	Inner alps	Calc. alps	Foot-hills	Alpine Ridge
Forest	88	91	109	77	117	88	91	109	77	117
Cropland	57	90	80	65	90	58	-	80	66	71
Grassland	75	124	111	86	128	75	128	108	90	130
Wetlands	0	0	0	0	0	-	0	0	-	0
Settlements	60	56	60	59	60	2	60	60	12	60

Other land	30	63	14	30	45	-	57	0	30	39
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- no LUC from/to forest could be observed in these regions

The estimates of the soil C stock changes of land use change areas from and to forests were split into litter (humus layer, see Table 219) and mineral soil (see Table 220 and Table 221) and follow the equations below. The changes are estimated annually on a regional basis (forest growth region) and summed up for each LUC subcategory in the CFR tables. For these estimates, the LUC areas to and from forests consistent with the NFI results were also stratified according to the forest growth regions and the different previous or subsequent land-uses (see chapter 7.2.2.2).

Annual carbon stock changes in soils at LUC areas from and to forest land

$$\Delta \text{SOC} = A * (\text{SOC}_O - \text{SOC}_{O-T}) / 20$$

ΔSOC = average annual carbon stock change in soils (t C a^{-1}) over the LUC transition period of 20 years

A = conversion area from or to forest land for a transition period of 20 years

SOC_O = carbon stock in soils after conversion, respectively (e.g. mineral forest soils in the Calcareous Alps $\rightarrow 109 \text{ t C ha}^{-1}$, see Table 221)

SOC_{O-T} = carbon stock in soils before conversion, respectively (e.g. area weighted mean value of soil C stocks from grassland converted to forest land: 111 t C ha^{-1} , see Table 221).

Annual carbon stock changes in litter at LUC areas from and to forest land:

$$\Delta \text{C}_{LT} = A * (\text{C}_{LT0} - \text{C}_{LT0-t}) / T$$

ΔC_{LT} = average annual carbon stock change in litter (t C a^{-1})

A = annual area of land converted from forests, respectively the annual area of land converted to forests following a transition period of 20 years.

C_{LT0} = carbon stock in litter after conversion, (e.g. 24 t C ha^{-1} for Calcareous alps, see Table 221)

C_{LT0-t} = carbon stock in litter before conversion, respectively

T = transition period for the litter carbon stock changes (1 year for LUC areas from forest, 20 years for LUC areas to forest)

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).

7.2.5 Uncertainty Assessment

The Austrian Federal Research and Training Centre for Forests, Natural Hazards and Landscape carried out a re-assessment of the uncertainty of the C stock changes of the biomass of the Austrian Forests (BFW 2010, internal report – a scientific paper is in preparation). The in-depth approach uses three different methods to construct lower and upper bounds of the estimated C increment and drain of the biomass of the Austrian forests: 1) A geometrical approach where instead of the stem volume functions different geometrical objects are used to derive stem volumes, 2) a statistical approach based on the root mean square error of the regression functions and t -values corresponding to various probabilities and 3) a classical approach based on the theory of error propagation and using specified numerical values for uncertainty of assessed input variables. The upper and lower bounds of branches'/needles' biomass and root biomass was estimated with the approaches 2) and 3), respectively, in connection with the used

input data and functions. The results for the upper and lower bounds of the individual tree compartments and approaches were combined to derive overall lower and upper bounds for increment and drain of the biomass C stocks. In a final step, a combination of these bounds led to the uncertainty for the net change of the biomass C stock. The uncertainty estimate accounts for all sources of uncertainty from the measurement errors, uncertainties of the volume and biomass functions up to the conversion factors in the estimate. The three different approaches for the estimates should secure an uncertainty accounting for the eventual bias of single approaches. This in-depth analysis leads to an almost complete picture for the uncertainty of the biomass changes in the Austrian forests. It was estimated to be $\pm 40\%$ for the average annual net change⁶⁹ of the C biomass stock in the NFI period 2000/02.

It is important to note that due to the design of the NFI these changes in biomass stock also include the biomass changes due to LUC to and from forests. So, this $\pm 40\%$ uncertainty is valid for the total biomass changes at “forest land rem. forest land” plus lands of the sub-categories with LUC to and from forests. As a consequence, the estimates of the overall uncertainty of sector 5 were carried out with the total net biomass changes at all forest lands and lands with LUC to and from forests and with the related uncertainty of this total net change.

The stock of dead wood is assessed within the NFI and with the same methods as living biomass. Therefore, we assume that the figures of the dead wood stock change have the same uncertainty as those of living tree biomass ($\pm 40\%$).

The forest litter/soil simulations for the single plots show a standard deviation $\pm 0.7 \text{ t C ha}^{-1} \text{ a}^{-1}$. The average emission out of the forest soils is $0.2 \text{ t C ha}^{-1} \text{ a}^{-1}$. So, just the standard deviation is more than 3 times the simulated C stock change, but the double standard deviation is the uncertainty to be considered according to IPCC GPG. The uncertainty of the forest area in yield was estimated with $\pm 2\%$. In addition, the uncertainties of the estimates of the litter/soil C stock changes due to forest road construction (about 10 % of the total emissions of the litter/soil pool of 5.A.1) have the following uncertainties of input data: Annual area of forest road construction: $\pm 100\%$ until 1994, $\pm 60\%$ after 1994; soil C stock of the forest road: triangle distribution with 10, 30 and 60 t C ha^{-1} .

According to these accuracy values for the input parameters, the uncertainty of the C stock changes in the litter/soil pool of 5.A.1 is very high. The Monte-Carlo-simulations show that these two pools of 5.A.1 have by far the highest contributions (75 % and 70 %, respectively) to the total uncertainties of the emissions/removals of the total forest land subcategory and total LULUCF sector. For the LUC lands to and from forests the following uncertainties of the input parameters were used. Table 222 shows the uncertainties for the areas of the subcategories with LUC to and from forests:

Table 222: *Uncertainties of LUC areas to and from forests*

	before NFI 1985/90	since NFI 1985/90
Annual LUC area CL to FL or FL to CL	$\pm 200\% ^1$	$\pm 80\%$

⁶⁹ It should be noted that the estimated and reported biomass C stock changes for single years have higher uncertainties than the annual average for the NFI period due to the additional methodological approaches and input data to adjust the annual average out of the NFI to specific values for single years. However, these single year values are estimated in a way that its average for a NFI period gives exactly the annual average based on the NFI results (see chapter 7.2.4.1.1). Therefore, we consider this problem to be of minor relevance.

Annual LUC area GL to FL or FL to GL	$\pm 200\%$ ¹	$\pm 10\%$
Annual LUC area WL to FL or FL to WL	$\pm 200\%$ ¹	$\pm 120\%$ ¹
Annual LUC area SL to FL or FL to SL	$\pm 200\%$ ¹	$\pm 80\%$
Annual LUC area OL to FL or FL to OL	$\pm 200\%$ ¹	$\pm 80\%$
Annual LUC area to or from FL	$\pm 200\%$ ¹	$\pm 10\%$

¹ Distribution was truncated at 0, because negative areas are not possible

These uncertainties were derived on an expert judgement on basis of a consultation of several experts of the Austrian NFI (Federal Office and Research Centre for Forests) with the help of a questionnaire. The different uncertainties between the time series reflect the fact that since NFI 1981/85 a fixed grid system has been installed which allows a separate assessment of both, the gains and losses of forest land. The NFIs before could only detect the net changes of the forest area between the NFI periods. The differences of the uncertainties of single subcategories reflect the different size of the LUC areas of these subcategories and, as a consequence, the different accuracy with which they can be detected by the NFI system (larger LUC areas with a higher accuracy than smaller areas). It should be noted that a re-assessment of these uncertainties of LUC areas is planned when the results of the recently running ARD NFI 2011/13 will be available.

For the litter/soil C stocks of all LUC areas the uncertainties according to Table 223 were used for the estimate of the uncertainties of soil C stock changes. These uncertainties are based on the results of the Austrian soil inventories (forest, cropland, grassland), on the information of the related literature according to Table 219 (other land) or on expert judgement based on information from related studies. For instance, for LUC to wetlands (surface waters and reed beds) we assumed in the estimates 0 t C ha^{-1} as final C stocks after the LUC according to the lack of information/methods in the IPCC GPG and in literature (see chapter 7.5.4). However, a study of lakes in Finland found stocks of 190 t C ha^{-1} in the lake sediments (KORTELAINE et al. 2004). Most of the wetland increase in Austria is standing surface water. Due to the lack of further information we used for the uncertainty analysis a uniform distribution of $0 - 190 \text{ t C ha}^{-1}$ for the final sediment C stocks after LUC to wetlands.

Table 223: Uncertainties of the litter/soil C stocks in the forest growth regions according to Table 219 (all distributions were truncated at the assessed minimum and maximum)

IPCC LU categories	National LU categories	Forest growth regions					Austria
		Bohemian Massif	Inner alps	Calcareous alps	Foot-hills	Alpine Ridge	
		%					
Forest - litter	Forest	±118	±140	±196	±144	±147	±162
Forest - mineral soil	Forest	±110	±78	±93	±102	±85	±95
Cropland	Annual cropland, fallows	±62	±100	±89	±71	±100	±79

IPCC LU categories	National LU categories	Forest growth regions					Austria
		Bohemian Massif	Inner alps	Calcareous alps	Foot-hills	Alpine Ridge	
		%					
	Vineyards, Orchards/garden land	±49	±127	±100	±65	±127	±79
Grassland	grassland intensive use	±66	±90	±76	±59	±70	±87
	grassland extensive use	±103	±105	±81	±98	±88	
Wetlands	Surface waters and reed beds	Uniform distribution 0 – 190 t C ha ⁻¹					
Settlements	Settlements and traffic area	Triangle distribution 10 – 60 – 75 t C ha ⁻¹					
	Industrial and mining areas, dumps	Uniform distribution 0 – 20 t C ha ⁻¹					
Other land	Alpine shrub lands	Triangle distribution 15 – 119 – 567 t C ha ⁻¹					
	Rocks and stone slopes:	Uniform distribution 0 – 13 t C ha ⁻¹					
	Other land uses	Uniform distribution 0 – 70 t C ha ⁻¹					

The Monte-Carlo-simulation with all these single uncertainties gave the following uncertainty of the total emissions/removals of the complete forest land category: ±9 356 Gg CO₂. This represents on average ±135 % in the years 1990 to 2002 with significant annual net sinks in category 5.A and between 216 and 1 866 % after 2002 when the net removals/emissions were very low (with highest relative uncertainties in the years of lowest net removals/emissions). If the significant uncertainty of litter/soil C stock changes of sub-category 5.A.1 (see above) is neglected during the simulations, the total uncertainty of category 5.A is on average ±4 764 Gg CO₂ with higher absolute uncertainty values in the 90ies and lower uncertainty values in the recent years due to more accurate input data in recent years. On average the relative uncertainties are ±43 % in the years 1990 to 2002 with significant annual net sinks and in the range of 44 to 161 % after 2002 with much lower annual net emissions/removals than in the years before.

As expected from the high share of the forest land category in the total Austrian area and in the total LULUCF removals, the uncertainty of the total emissions/removals of this category has the highest impact on the total uncertainty of the LULUCF sector removals.

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 HAUKE & SCHADAUER (2009) and SCHIELER & HAUKE (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 7.1.4).

7.2.7 Recalculations

For the submission 2012, the results of the NFI 2007/09 were for the first time available. On basis of these results, biomass increment and drain, changes in dead wood stocks of subcategory 5.A.1, the total forest area and all LUC areas to and from forests for the years from 2002 onwards were revised. The NFI 2007/09 showed a significant increase in harvest in these years. In previous submissions the average results of the NFI 2000/02 were reported for these years. So, the use of the new NFI results causes significant lower biomass net sinks for category 5.A.1 in the years since 2002 than in previous submissions.

The intermediate interpolation steps for forest biomass increment and drain between the NFI observation periods were deleted. The NFI increment and drain results are taken as a basis for the full NFI observation period and the single year values are estimated then from these average annual NFI results for the single NFI observation periods with the help of related annual indices.

The whole time series of the biomass increment and harvest of subcategory 5.A.1 was recalculated on basis of partly new biomass functions. We used slightly improved functions for the branch biomass and a different function for the root biomass. It was realized that the previously used function for the root biomass from Wirth et al. (2004) with DBH only as input parameter leads to unrealistic high root biomasses for dimensions with higher DBH due to an extreme rise of the shape of the curve at larger DBHs. This had a significant impact on the results for increment biomass, but also on the results for drain biomass. So, a different root function from Wirth et al. (2004) was selected which includes besides DBH also the tree age as explaining parameter and leads to more realistic estimates for the root biomass. The use of the new functions leads to approximately 12 % lower net biomass removals of category 5.A.1 for the whole time series compared to the estimates of previous submissions.

For submission 2012 litter and soil C stock changes of category 5.A.1 were estimated and reported for the first time. This was done with the Yasso model and with data for litter input as estimated on basis of the results of the Austrian NFIs 1986/90, 1992/96, 2000/02 and 2007/09 and on basis of the results of the Austrian forest soil surveys. In addition, estimates of soil C pool losses due to forest road construction were carried out. According to all these estimates the litter plus soil of category 5.A.1 was an emission source in the whole time series since 1990 with an annual average C stock loss of 0.2 t C per ha and year and with total annual emissions of approx. 0.7 Mt C per year.

Soil and litter C stock changes for all land-use-change subcategories to and from forests were estimated more stratified according to land use categories and forest growth regions. Thus the total time series was recalculated: The sink of the mineral soil C pool of subcategory 5.A.2 is 40 % lower, those of the litter pool 60 % higher compared to previous submissions. On the other hand, the total emissions from mineral soil from all subcategories with LUC from forest to other land uses are in submission 2012 25 % lower, those of the litter pool 5 % higher than in previous submissions (also due to the changed estimate assuming an oxidation of the whole litter layer in the year of LUC instead of 20-years decay time as in previous submissions).

7.2.8 Planned improvements

See Chapter 7.1.8

7.3 Cropland (5.B)

7.3.1 Category description

In Category 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 2010. 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 224.

Table 224: 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 biomass of “perennial cropland remaining perennial cropland” and carbon stock changes in biomass due to LUC between annual and perennial cropland
- soil carbon stock changes due to management changes “annual cropland remaining annual cropland” and due to LUC between annual and perennial cropland
- 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
- carbon stock change in biomass due to LUC from forest land to cropland
- carbon stock change in DOM due to LUC from forest land to cropland
- carbon stock change in SOM due to LUC from forest land to cropland
- N ₂ O emissions from soils due to LUC from forest land to cropland
5 B 2 2 Grassland converted to cropland
- carbon stock change in biomass due to LUC from grassland to cropland
- carbon stock change in SOM due to LUC from grassland to cropland
- N ₂ O emissions from soils due to LUC from grassland to cropland

In 2010 1.43 Mio ha of Austria were arable land including annual and permanent crops (STATISTIK AUSTRIA 2011).

For consistency and transparency reasons also the biomass C stock changes at LUC areas to perennial cropland are reported in these LUC categories for a transition period of 20 years (see chapter 7.3.4.1.2).

In 2010 the land use change area to cropland was 101 461 ha. The annual emissions from 1990-2010 range from 244 Gg CO₂ equivalents to 568 Gg CO₂ equivalents. The source is mainly caused by soil C stock changes of land use change areas, particularly by grassland converted to cropland.

Table 225: Activity data of cropland (1990–2010) in ha –transition period of 20 years for LUC lands.

	5.B Total cropland	5.B.1 Cropland remaining cropland-total	a. annual remaining annual & perennial remaining perennial	b. annual cropland converted to perennial cropland	c. Perennial cropland converted to annual cropland	5.B. 2. Land converted to cropland	2.1 Forest Land converted to cropland	2.2 Grassland Land converted to cropland - total	a. Grassland converted to annual cropland	b. 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	1507533	1424651	1394507	16722	13423	82882	9652	73229	71681	1548	NO	NO	NO
1991	1526723	1444204	1414062	16644	13498	82519	9926	72592	71058	1535	NO	NO	NO
1992	1518074	1435911	1405770	16576	13565	82163	10200	71963	70442	1521	NO	NO	NO
1993	1500454	1418644	1388519	16503	13622	81810	10474	71336	69828	1508	NO	NO	NO
1994	1501453	1420822	1390686	16465	13671	80631	9980	70651	69157	1494	NO	NO	NO
1995	1492280	1412950	1382814	16427	13708	79330	9364	69966	68487	1479	NO	NO	NO
1996	1491907	1413938	1383811	16393	13734	77969	8747	69222	67758	1464	NO	NO	NO
1997	1481910	1405106	1375024	16354	13728	76804	8131	68673	67221	1452	NO	NO	NO
1998	1470763	1395097	1365091	16307	13699	75666	7514	68152	66711	1441	NO	NO	NO
1999	1470396	1395503	1365603	16243	13656	74893	7263	67630	66201	1430	NO	NO	NO
2000	1462108	1387889	1358097	16193	13599	74219	7012	67207	65786	1421	NO	NO	NO
2001	1460067	1386547	1356877	16133	13538	73520	6761	66759	65348	1411	NO	NO	NO
2002	1459095	1385870	1356327	16076	13468	73225	6914	66311	64909	1402	NO	NO	NO
2003	1459991	1386972	1357551	15903	13518	73019	7066	65952	64558	1394	NO	NO	NO
2004	1454572	1382422	1353415	15703	13304	72150	7275	64875	63503	1372	NO	NO	NO
2005	1455984	1382894	1354342	15430	13123	73090	7485	65605	64218	1387	NO	NO	NO
2006	1453893	1375519	1347107	15404	13008	78374	7694	70680	69186	1494	NO	NO	NO
2007	1451900	1364934	1336218	15740	12976	86966	7903	79063	77391	1672	NO	NO	NO
2008	1443738	1347091	1318664	15744	12683	96647	8112	88534	86662	1872	NO	NO	NO
2009	1437190	1337869	1309530	15709	12631	99320	8394	90927	89004	1922	NO	NO	NO
2010	1434409	1332948	1304241	15817	12890	101461	8675	92786	90824	1962	NO	NO	NO

Table 226: Emissions from cropland management (1990–2010) in Gg CO₂; other land use changes are not occurring.

	5 B Total Cropland	5 B 1 Cropland remaining Cropland - total	a. Annual remaining annual and perennial remaining perennial	b. Annual cropland converted to perennial cropland	c. Perennial cropland converted to annual cropland	Liming	5 B 2 Land converted to cropland	2.1 Forest land converted to cropland	2.2 Grassland converted to cropland - total	2.2.a Grassland converted to annual cropland	2.2.b Grassland converted to perennial cropland	N ₂ O (in CO ₂ equiv)
1990	244.58	-242.38	-271.41	-130.18	159.22	90.30	396.66	111.47	244.25	250.99	-6.74	40.94
1991	243.80	-243.10	-276.90	-129.96	163.76	91.06	395.84	112.77	242.33	249.04	-6.71	40.73
1992	265.25	-220.22	-253.40	-129.08	162.26	90.72	394.76	114.08	240.15	246.78	-6.64	40.53
1993	281.93	-202.44	-234.66	-128.54	160.76	90.69	393.68	115.38	237.96	244.53	-6.57	40.33
1994	283.72	-195.44	-226.25	-128.43	159.24	90.73	388.43	113.03	235.62	242.12	-6.50	39.78
1995	293.80	-157.73	-189.46	-128.08	159.81	91.97	359.57	87.16	233.24	239.66	-6.42	39.17
1996	305.36	-140.20	-172.81	-127.75	160.37	91.95	353.60	84.22	230.83	237.20	-6.36	38.54
1997	318.24	-122.06	-151.64	-127.41	156.99	92.08	348.22	81.29	228.93	235.23	-6.30	38.00
1998	324.19	-110.32	-136.84	-127.06	153.58	91.64	342.87	78.36	227.03	233.26	-6.23	37.48
1999	324.79	-106.34	-131.75	-126.64	152.05	91.63	339.49	77.16	225.22	231.39	-6.17	37.12
2000	330.71	-96.15	-120.47	-126.19	150.51	90.35	336.51	75.97	223.75	229.87	-6.12	36.80
2001	336.26	-87.51	-110.77	-125.71	148.96	90.27	333.50	74.77	222.26	228.35	-6.08	36.47
2002	412.29	-78.89	-100.38	-125.23	146.71	90.23	400.95	144.00	220.71	226.74	-6.03	36.25

2003	422.25	-67.38	-112.15	-126.40	171.17	90.27	399.37	144.11	219.18	225.14	-5.95	36.08
2004	443.52	-45.27	-35.00	-126.19	115.92	90.22	398.57	144.48	218.52	224.80	-6.28	35.56
2005	439.65	-46.98	-41.06	-125.43	119.51	90.28	396.35	144.86	215.52	221.09	-5.56	35.96
2006	452.21	-41.55	-52.72	-119.11	130.28	90.09	403.67	145.24	219.88	224.09	-4.21	38.55
2007	487.76	-29.56	-60.52	-113.46	144.42	90.01	427.31	145.62	238.88	242.57	-3.69	42.81
2008	514.13	-36.20	-7.17	-121.58	92.55	88.24	462.09	146.00	268.48	272.75	-4.28	47.61
2009	565.77	-16.40	-39.35	-121.97	144.92	88.12	494.05	146.72	298.46	306.13	-7.67	48.88
2010	568.08	-23.81	-116.42	-119.40	212.00	88.02	503.87	147.44	306.55	314.67	-8.12	49.88

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 1990–2011). 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 (e.g. experts of the chambers of agriculture estimate the area of these crops). For the years 1995 and 1999 there was a full survey available, in between there are random sample surveys. The last full survey was in 2010 (VO (EG) Nr. 1166/2008). The results will be available for the next submission.

Areas for land use change between and within grassland and cropland were also estimated on basis of 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 land uses of the agricultural parcels of land per farm. IACS provides information of land uses and land use changes of cropland (annual, perennial) and grassland between 2002 and 2010. 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.

Based on expert judgement there was a bias in the estimated land use change areas between grassland and cropland in submissions before 2011: The share of LUC area from grassland to cropland (across a 20 years transition period) was estimated to be in the order of 1/3 of the total cropland area. This was assumed to be by far too much since ecological and site conditions of agricultural land use and agricultural management in Austria as well as legal obligations would not allow such a high LUC rate. For instance, 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. This 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 particularly observed in the last years.

The previous over estimate of LUC between cropland and grassland was caused by a repeated accounting of single areas as LUC areas within the IACS period (areas that changed several times between cropland and grassland) and, in addition, by extrapolating then this repeatedly

accounted area to a transition period of 20 years. To avoid this bias, the method for assessing the LUC area between cropland and grassland on basis of the IACS was changed for the estimates for submission 2011 and the subsequent submissions. A sub-sample of plots of land was selected which fulfilled the following criteria: continuity and constant area across the whole IACS time series and homogenous land use (the whole plot is either cropland or grassland) at the start of the time series. This resulted in a sub-sample that contains about 1/3 of all IACS plots (the IACS covers nearly the whole agricultural area of Austria). In a next step, only those areas were accounted as LUC between cropland and grassland that remained after LUC in the new land use category for the whole IACS time series. These land use change areas between cropland and grassland of the sub-sample were extrapolated then to the total cropland and grassland area of Austria, respectively (except for alpine meadows, which are not part of the IACS subsample because they were in 2007 for the first time covered by IACS and alpine meadows are not suited for any land use as cropland). The years before 2001 are not sufficiently reflected in the IACS database to derive LUC between cropland and grassland. In order to receive reliable activity data before 2001 the LUC areas between cropland and grassland for these years were estimated on basis of an average “land use change share” of the total cropland and grassland area derived from the LUC areas between 2001 and 2004. The LUC activity data of these years are rather stable and it is assumed that LUC before 2001 followed the same trend. Taking this time period into account we avoided a bias in the estimates of the years before 2001. 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.

The new method results in much more realistic estimates for the LUC area from grassland to cropland which is in the order of 5% of the total cropland area (across a LUC transition period of 20 years) and on average 0,3% of the total cropland area each year.

It is evident that these significant changes in the areas of land use change from grassland to cropland (lower LUC areas) led also to different (clearly higher) figures for the areas of “cropland remaining cropland” because the total cropland area was not influenced by this methodological improvement. Both changes in the activity data result in clearly different outcomes for the emissions/removals of the cropland sub-category since submission 2011 compared to previous ones.

The LUC areas from forest land to cropland are based on the NFI data (see chapter 7.2.2). The revision of the activity data of LUC from forest land to cropland since 2002 (due to the availability of new NFI data) lead also to the change of the cropland remaining cropland area consequently. Therefore activity data and emissions/removals in 5.B.1 and 5.B.2.1 are different compared to previous submissions. 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 cropland use.

7.3.3 Land-use definitions and the classification systems used and their correspondence to the LULUCF categories

The STATISTIK AUSTRIA (2001) classification was used for land use definitions:

- Annual Cropland (arable land planted with annual crops such as e. g. cereals, corn, rape, field vegetables, strawberries, potatoes, soya beans)
- Perennial cropland (viticulture, horticulture, christmas tree, perennial energy crops)
- House garden (area of gardening nearby settlements mostly used for non-profit household demand. This category includes annual as well as perennial crops)

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 and comprises:

5. B. 1 cropland remaining cropland total

- a annual remaining annual and perennial remaining perennial cropland
- b annual cropland converted to perennial cropland
- c perennial cropland converted to annual 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 carbon stock changes of living biomass in the subcategory “annual cropland remaining annual cropland” are estimated to be zero. For annual crops in the subcategory “annual cropland remaining annual cropland” increase in biomass stocks in a single year is assumed to be equal to biomass losses from harvest and mortality in the same year – thus there are no net emissions/removals from biomass in the subcategory “annual cropland remaining annual cropland” (IPCC GPG 2003, chapter 3.3.1.1.1).

The emissions/removals were estimated for the changes in woody perennial biomass stocks of the sub-category “perennial cropland remaining perennial cropland” (see chapter 7.3.4.1.1). In addition, according to GPG (IPCC 2003) the emissions/removals from stock changes in living biomass at land use change areas have to be considered. So, these emissions/removals were estimated for areas of LUC from annual cropland to perennial cropland and vice versa. For that purpose, the carbon stocks of annual crops and perennial crops were estimated and applied in the LUC calculation subsequently (see chapters 7.3.4.1.2 and 7.3.4.1.3).

The biomass stocks of Christmas tree cultures, energy crops and annual crops 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.

All soil carbon stocks and soil carbon stock changes were also estimated on basis of country specific values.

The total annual removals of 5.B.1 range between 243.1 Gg CO₂ and 16.4 Gg CO₂.

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 “annual cropland remaining annual cropland” and “perennial cropland remaining perennial cropland” (5.B.1.a)

In accordance with the IPCC GPG (2003) the carbon stock changes of living biomass in the subcategory “annual cropland remaining annual cropland” are estimated to be zero.

For the subcategory “perennial cropland remaining perennial cropland” the C stock changes in biomass are estimated. It includes orchards, vineyards, Christmas tree cultures, perennial 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 during the 30 years of rotation period was assumed. 3.33% of these cultures are removed and replanted annually and cause emissions.

The observation period started in 1960 based entirely on the activity data from Statistik Austria (Statistik 1960–2010). 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.

A vineyard survey was undertaken in 2009. It led to a figure of 45 533 ha (STATISTIK AUSTRIA 2010) for 2009 and the following years.

Table 227: Estimated total area of perennial crops from 1990–2010 in ha (including areas of LUC to perennial cropland).

	Viticulture	Horticulture	Garden	Energy crops	Christmas trees	Total area
1990	58 203	19 693	13 809	1 027	1 167	93 899
1991	57 462	19 248	12 943	1 210	1 306	92 169
1992	56 720	18 804	12 077	1 394	1 444	90 439
1993	55 979	18 359	11 211	1 577	1 583	88 709
1994	55 803	18 704	10 345	1 571	1 707	88 130
1995	55 627	19 049	9 479	1 565	1 830	87 550
1996	54 061	18 673	9 129	1 615	1 878	85 355
1997	52 494	18 297	8 778	1 665	1 925	83 159
1998	52 067	17 995	8 050	1 542	1 973	81 627
1999	51 641	17 694	7 321	1 420	2 020	80 096
2000	51 214	17 392	6 593	1 297	2 068	78 564
2001	50 304	17 120	6 609	1 403	1 962	77 398
2002	49 393	16 849	6 625	1 510	1 856	76 232
2003	48 483	16 577	6 641	1 616	1 750	75 066
2004	47 572	16 305	6 657	1 722	1 644	73 900
2005	48 846	15 851	5 924	1 711	1 846	74 177
2006	50 119	15 396	5 191	1 700	2 048	74 454
2007	49 981	14 952	4 818	1 700	2 449	73 113
2008	49 842	14 507	4 444	2 141	2 849	72 977
2009	45 533	14 507	4 444	2 785	2 849	70 118
2010	45 533	14 507	4 444	2 657	2 849	69 990

Figure 29 indicates the decrease of the total perennial cropland area from 1960 to 2010. 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 and replanted 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 1994. Christmas trees and energy crops have only a small share of the perennial cropland area, and the calculation is based on country specific values (Tier 2). 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.

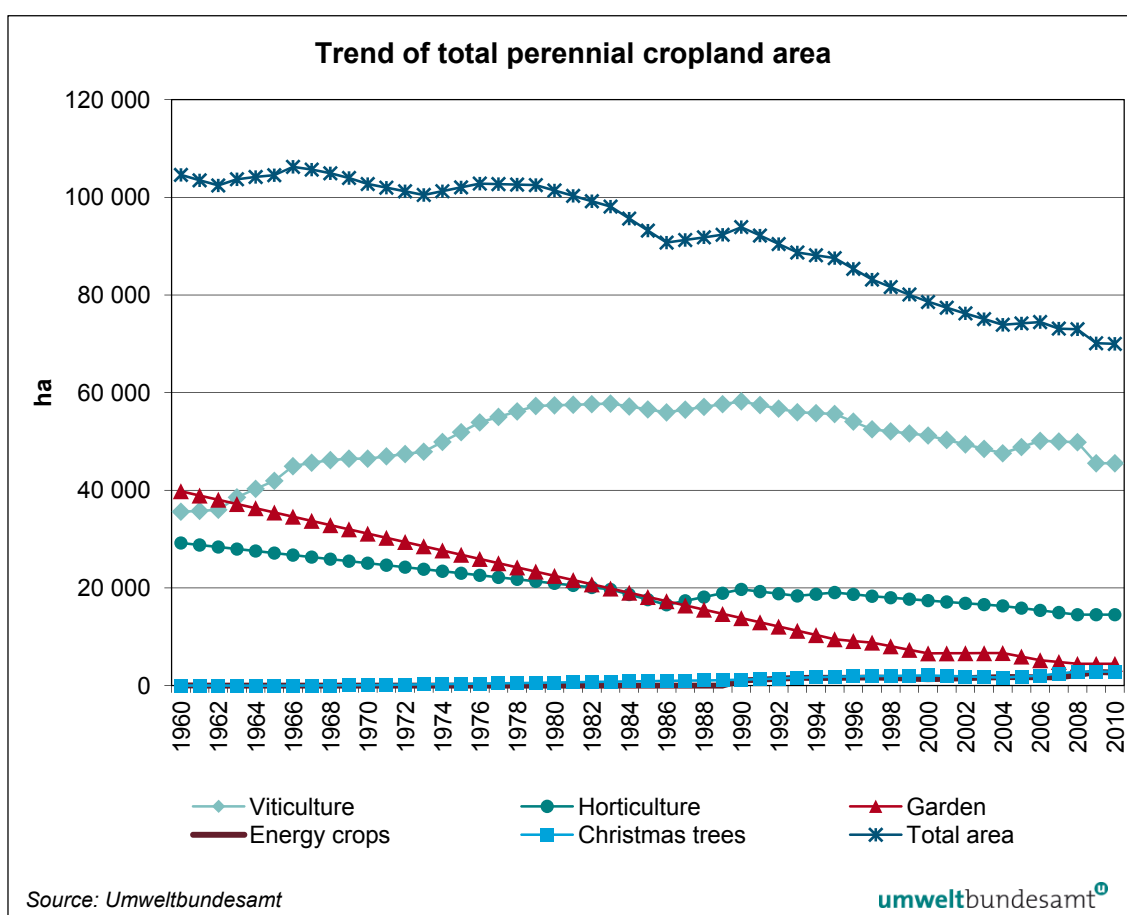


Figure 29: Trend of total perennial cropland area (ha) from 1960–2010 (including LUC areas to perennial cropland).

The reason for the interannual changes of emissions/removals within this category lies mainly within the area decrease (changes) of the subcategory “perennial cropland remaining perennial cropland”: The area of vineyards increased until the 90ies but decreased thereafter, the areas of orchard and house garden continuously decreased since 1960. The related losses of older perennial biomass at the end of rotation periods is not compensated by the growth of the replanted areas of “perennial cropland remaining perennial cropland” due to these land use changes and a related unbalanced age/area distribution in “perennial cropland remaining perennial cropland”.

This 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 from the IPCC GPG (2003) was applied:

$$\text{Annual change in biomass} = (\text{area of perennial cropland remaining perennial cropland}^a * \text{Carbon accumulation rate}) - (\text{area of perennial cropland before 30 years}^{a,b} * 0.033 * \text{biomass carbon stock at harvest})$$

^aexcluding areas of Christmas tree cultures and energy crops (which are estimated according to the approaches below)

^bexcluding perennial cropland areas lost by LUCs

For the annual "carbon accumulation rate" in perennial cropland^a the IPCC GPG (2003) default value of 2.1 t C ha⁻¹a⁻¹ was used.

For the above ground "biomass carbon stock at harvest" the IPCC GPG (2003) 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.

For some perennial cropland types (Christmas trees, energy plants) country specific carbon biomass stocks, growth rates and rotation periods were applied:

For calculating the carbon stock change of living biomass from Christmas trees the following equation was applied using country specific data:

$$\text{Annual change in biomass} = (\text{area of Christmas tree cultures remaining Christmas tree cultures} * \text{Carbon accumulation rate}) - (\text{area of Christmas trees before 10 years} * 0.1 * \text{biomass carbon stock at harvest})$$

According to BMLFUW (2000a) and expert judgement a country specific average value of 36 t C ha⁻¹ for the carbon stock of Christmas trees at harvest was used. The rotation period for Christmas trees is 10 years, This leads to an accumulation rate of 3.6 t C ha⁻¹a⁻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 this literature the rotation period for energy crops is six years. This leads to a carbon accumulation rate of 5 t C ha⁻¹a⁻¹ for energy crops.

For calculating the carbon stock change of living biomass on energy crops the following equation was applied:

$$\text{Annual change in biomass of energy crops} = (\text{area of energy crops remaining energy crops} * \text{Carbon accumulation rate}) - (\text{area of energy crops before 6 years} * 0.166 * \text{biomass carbon stock at harvest})$$

Figures for the area of energy crops are available since 1990 (STATISTIK AUSTRIA 1991).

Table 228: Annual carbon accumulation rate of the 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 IPCC 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 annual cropland converted to perennial cropland (5.B.1.b)

The annual land use change area from annual cropland converted to perennial cropland was 928 ha in 2010.

The applied method follows entirely the IPCC GPG (2003) approaches for LUCs (e.g. IPCC GPG (2003), chapter 3.3.2 “Land converted to cropland”). It is important to note that the IPCC GPG do not foresee any method for LUCs within the cropland category. However, annual cropland and perennial cropland have completely different C stocks and C accumulation rates in both, biomass and soil. Therefore our approach to account for the C stock changes due to LUC between annual cropland and perennial cropland gives a more accurate picture on the emissions/removals of the sub-category “cropland remaining cropland”. In accordance with the method described in chapter 3.3.2, equation 3.3.8 (and in other LUC chapters) of the IPCC GPG (2003) the biomass gains or losses of annual crops due to LUC to/from annual cropland have to be accounted once, namely in the year of LUC (even though annual crops represent a biomass C pool only during the growing season and not during the whole year). This approach does not represent any double accounting to the estimates in the soil C pool (the estimates in chapters 7.3.4.1.4, 7.3.4.1.5 and 7.3.4.1.6), because the estimates of the soil C stock changes in these sub-categories only account for the change in “land management factors” of “annual cropland remaining annual cropland” and for the change between the equilibrium soil C stocks of annual cropland and perennial cropland (or vice versa) when LUC between these two cropland sub-categories occur. The used activity data for estimating these emissions/removals do also strictly represent the areas of these “cropland remaining cropland” subcategories. So, there is no double accounting in these “cropland remaining cropland” subcategories.

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 ($2.1 \text{ t C ha}^{-1} \text{ a}^{-1}$) was assumed for each year of the whole LUC transition period of 20 years.

*Annual change in biomass = conversion area for a transition period of 20 years * ΔC_{growth} + annual area of currently converted land * $L_{\text{conversion}}$*

$L_{\text{conversion}} = C_{\text{after}} - C_{\text{before}}$

C_{after} = carbon stock immediately after conversion is 0

ΔC_{growth} = IPCC default value for perennial crops carbon accumulation rate is $2.1 \text{ t C ha}^{-1} \text{ a}^{-1}$ (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 $6.67 \text{ t C ha}^{-1} \text{ a}^{-1}$ (biomass loss accounted only for the year of LUC)

For the annual cropland biomass losses in the year of LUC from annual to perennial cropland the country specific average biomass stock in annual cropland 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 average carbon stock of living biomass in annual cropland was recalculated by using country specific data from Statistik Austria (STATISTIK AUSTRIA 2007). For all annual crops mentioned in the Statistical Report the harvested yield biomass has been taken and the related biomass of straw, leaves or other aboveground plant parts not covered by the “yield biomass” has been estimated. 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 (IPCC GPG default values for root/shoot ratios of crops are not available). These factors represent the average root/shoot values from 1990-2005

for different types of annual crops (WEST 2008). The estimated Austrian aboveground biomass in annual cropland was multiplied with the root/shoot ratio to provide an estimate of the below-ground biomass. The means 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 related area of these crops in Austria to get the average annual cropland biomass.

This led to a figure of 6.67 t C ha^{-1} for the biomass in annual cropland that is used for the estimates of LUCs to and from annual cropland. This country specific value is 40% higher than the IPCC-GPG (2003) default value.

7.3.4.1.3 Changes of carbon stocks in biomass of perennial cropland converted to annual cropland (5.B.1.c)

The annual land use change area from perennial cropland converted to annual cropland was 946 ha in 2010.

The rationale for these estimates and the used methods are described in chapter 7.3.4.1.2. For the calculation of the annual change in carbon stocks of living biomass of perennial cropland converted to annual cropland the IPCC GPG equation 3.3.8 was applied (IPCC 2003).

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 (see also chapter 7.3.4.1.2 for the considerations in behind):

$$\text{Annual change in biomass} = \text{annual area of currently converted land} * (L_{\text{conversion}} + \Delta C_{\text{growth}})$$

$$L_{\text{conversion}} = C_{\text{after}} - C_{\text{before}}$$

$$C_{\text{after}} = \text{carbon stock immediately after conversion is 0}$$

$$\Delta C_{\text{growth}} = \text{country specific value for annual crops carbon accumulation rate is } 6.67 \text{ t C ha}^{-1} \text{ a}^{-1} \text{ (see chapter 7.3.4.1.2 ; accounted only for the year of LUC)}$$

$$C_{\text{before}} = \text{IPCC default value for carbon stock of perennial cropland biomass before conversion is } 63 \text{ t C ha}^{-1} \text{ (accounted only for the year of LUC)}$$

7.3.4.1.4 Changes of carbon stocks in mineral soils of “annual cropland remaining annual cropland” and “perennial cropland remaining perennial cropland” (5.B.1.a)

According to the soil inventories in Austria organic soils are not occurring in arable land in Austria.

Emissions/removals of the soil C stock changes in “annual cropland remaining annual cropland” were calculated using a country specific methodology (Tier 2). 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 assumed for 1990 which is based on the results of the Austrian soil inventory (GERZABEK et al. 2003, STREBL et al. 2003). 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 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 further 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). In a recently published study (UMWELTBUNDESAMT 2010) the IPCC GPG default factors have been assessed against results from national long-term field experiments. Consistency be-

tween default and national factors for arable land was found for management induced soil carbon stock changes (reduced tillage, no-till), removal of crop residues and green manuring (input factor: low-medium residue return). A weaker correlation was found for the application of organic fertilisers (e.g. manure) and land use. Table 229 shows the national factors used since the submission 2011 compared to the previously used IPCC default values.

Table 229: Management factors for arable land according to IPCC (Default values, IPCC GPG 2003) and national studies (Umweltbundesamt, 2010)

Factor value type	Level	IPCC default	Applied national factors
Land use (F_{LU})	Long-term cultivated	0.82	0.93
	Full	1.0	1.0
Tillage (F_{MG})	Reduced	1.03	1.03
	No-Till	1.10	1.10
Input (F_i)	Low	0.92	0.92
	Medium	1.0	1.0
	High – without manure	1.07	1.07
	High – with manure	1.34	1.11

These management factors were applied at areas of arable land in 1990 and 2007 resulting in an average annual increase of soil organic carbon of 43 kg ha^{-1} . This increase is mainly caused by 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) since 1985.

For the default inventory time of 20 years an increase from 50 t C ha^{-1} to $50.86 \text{ t C ha}^{-1}$ was estimated.

The equation used for calculating the soil carbon stock changes in the sub category “annual cropland remaining annual cropland” was:

$$SOC_{1990+20} = SOC_{1990} + (SOC_{1990} \times ((Flu \times Fmg \times Fi)_{2007} / (Flu \times Fmg \times Fi)_{1990}))$$

$$\Delta SOC_{20} = (SOC_{1990+20} - SOC_{1990}) / 20 = 0.043 \text{ t C ha}^{-1} \text{ a}^{-1}$$

Annual change in carbon stock of mineral soils in annual cropland remaining annual cropland
 $\text{land} = \Delta SOC_{20} \times \text{area of annual cropland remaining annual cropland}$

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 (calculated value $50.86 \text{ t C ha}^{-1}$)

ΔSOC_{20} average annual carbon stock change in Austrian cropland soils ($\text{t C ha}^{-1} \text{ a}^{-1}$) over a period of 20 years

$(Flu \times Fmg \times Fi)_{1990}$ - Management factor 1990

$(Flu \times Fmg \times Fi)_{2007}$ - Management factor 2007

For the sub-category “perennial cropland remaining perennial cropland” the same soil C stock changes as for “annual cropland remaining annual cropland” are assumed.

The LUC areas from forest land to cropland are based on the NFI data (see chapter 7.2.2). The revision of the activity data of LUC from forest land to cropland since 2002 (due to the availability of new NFI data) led also to a change of the cropland remaining cropland area consequently. Therefore, activity data and emissions/removals in 5.B.1 are different compared to previous submissions.

7.3.4.1.5 Changes of carbon stock in soils of annual cropland converted to perennial cropland (5.B.1.b)

The LUC area from annual cropland to perennial cropland (in conversion status for a time period of 20 years) changed from 16 722 ha to 15 817 ha from 1990 to 2010.

The rationale for estimating the soil C stock changes of this LUC has been given in chapter 7.3.4.1.2.

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 SOC₀, 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 SOC₀ 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.

Annual change in carbon stock of mineral soils in annual cropland converted to perennial cropland =

*Δ SOC₂₀ * conversion area for a transition period of 20 years*

$$\Delta \text{SOC} = (\text{SOC}_0 - \text{SOC}_{0-T}) / 20 = 0.35 \text{ t C ha}^{-1} \text{ a}^{-1}$$

Δ SOC₂₀...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

SOC₀..... carbon stock in soils 20 years after conversion from annual to perennial cropland (i.e. average C stock in 0 – 30 cm of perennial cropland soils in Austria) → 57 t C ha⁻¹

SOC_{0-T}..... carbon stock in Austrian annual cropland soils before conversion (i.e. average C stock in 0 – 30 cm of annual cropland soils in Austria; see chapter 7.3.4.1.4) → 50 t C ha⁻¹

7.3.4.1.6 Changes of carbon stocks in soils of perennial cropland converted to annual cropland (5.B.1.c)

The area in conversion status from perennial cropland to annual cropland for a time period of 20 years is rather stable and ranges from 13 423 ha to 12 890 ha for the period 1990 to 2010.

The rationale for estimating the soil C stock changes of this LUC has been given in chapter 7.3.4.1.2.

Emissions/removals were calculated by country specific values for carbon stocks in mineral soils of perennial cropland and annual cropland, respectively. Calculation steps and input data are the same as in chapter 7.3.4.1.5:

$$\Delta SOC_{20} = (SOC_0 - SOC_{0-7}) / 20 = -0.35 \text{ t C ha}^{-1} \text{ a}^{-1}$$

Annual change in carbon stock of mineral soils in perennial cropland converted to annual cropland =

*ΔSOC * conversion area for a transition period of 20 years*

ΔSOC_{20} ...average annual carbon stock change in soils of perennial cropland converted to annual cropland ($\text{t C ha}^{-1} \text{ a}^{-1}$) over a LUC transition period of 20 years

7.3.4.1.7 Liming

The application of lime to agricultural soils is a source of CO₂ 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, CaCO₃) information is incomplete. For the estimation of CO₂ 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. There are no recommendations of the advisory committee for good agricultural practices to lime perennial cropland (BMLFUW, 2006; Term of reference for the appropriate fertilization, made by the consulting committee for soil fertility at the Federal Ministry of Agriculture, Forestry, Environment and Water).

Table 230: Area with potential lime application in ha.

Landuse (ha)	1990	2010
Cropland	1 406 394	1 362 467
Grassland	884 124	870 112
Total	2 290 518	2 232 579

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 $0.7 \text{ t ha}^{-1} \text{ a}^{-1}$.
- a pilot study on waste management in agriculture (UMWELTBUNDESAMT 2004c) showed that only 32% of this recommended amount is actually applied ($0.224 \text{ t ha}^{-1} \text{ a}^{-1}$)
- 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

The area with actual lime application (considering that only 40% of cropland and grassland need liming) is shown in the following table, as recommended by the ERT.

Table 231: Area with actual lime application in ha.

Landuse (ha)	1990	2010
Cropland	562 558	544 987
Grassland	353 650	348 045
Total	916 207	893 032

The GPG (IPCC 2003) procedure for calculating the CO₂ 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. The revision of the activity data of LUC from forest land to cropland since 2002 (due to the availability of new NFI data) led to a change of activity data and emissions/removals compared to previous submissions. The area in conversion status from forest land to cropland (for a time period of 20 years) changes from 10 474 ha to 6 761 ha between 1990 and 2010 causing annual emission rates due to the loss of biomass and C stock changes in soil and litter from 74.8 Gg CO₂ to 147.4 Gg CO₂.

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. The changes of the soil carbon stocks were, for the first time, stratified according to five forest growth regions. The stratified LUC areas and soil C stocks according to these growth regions were used for the estimates. These improvements led to changes in the removals/emissions of subcategory 5.B.2.1 compared to previous submissions. The whole time series of such LUC was revised due to the changed estimate assuming an oxidation of the whole litter layer in the year of LUC instead of 20-years decay time as in previous submissions. The method is described in chapter 7.2.4.2.

N₂O emissions from soils of forest land converted to cropland

The area of land use conversions (forest land to cropland) was taken from Table 225. The annual release of N₂O was calculated with IPCC default values (TIER 1) using equations 3.3.14 and 3.3.15 (IPCC 2003). On basis of the results of the Austrian forest soil survey the C/N ratio in soil organic matter was assumed to be 19 for forest soils (BFW, 1992). The revision of the activity data of LUC from forest land to cropland since 2002 (due to the availability of new NFI data) led to a change of N₂O emissions accordingly.

7.3.4.2.2 Grassland converted to Cropland (5.B.2.2)

This section provides information about emissions/removals for grassland converted to cropland and comprises:

5.B.2.2 grassland converted to cropland total

a grassland converted to annual cropland

b grassland converted to perennial cropland

The average annual land use change area from grassland to annual cropland from 1990–2010 is 4 483ha. The area in conversion status for a time period of 20 years ranges from 64 875 ha to 92 786 ha for the period 1990 to 2010. Considering the area of the 20 year time period this leads to emissions between 215.6 and 306.6 Gg CO₂.

The average annual land use change area from grassland to perennial cropland from 1990–2010 is 97 ha. Data for land use change from grassland to cropland were estimated from IACS as described in chapter 7.3.2.

Activity data of grassland converted to cropland in the 20 year conversion status see Table 225. 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

Country specific data for grassland biomass from the Agricultural Research and Education Centre Raumberg-Gumpenstein (Höhere Bundeslehr- und Forschungsanstalt Raumberg-Gumpenstein) were used. 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):

$$\text{Annual change in biomass} = \text{annual area of currently converted land} * (L_{\text{conversion}} + \Delta C_{\text{growth}})$$

$$L_{\text{conversion}} = C_{\text{after}} - C_{\text{before}}$$

ΔC_{growth} = country specific value for annual carbon accumulation rate in annual crops is 6.67 t C ha⁻¹a⁻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 (see chapter 7.4.4.2.2; biomass loss accounted only in the year of LUC)

Changes of carbon stock in biomass of grassland converted to perennial cropland

The annual land use change area from grassland to perennial cropland in 2010 is 111 ha.

For perennial cropland an annual growth according to the IPCC GPG (2.1 t C ha⁻¹a⁻¹) was used for the whole LUC transition period of 20 years:

$$\text{Annual change in biomass} = \text{conversion area for a transition period of 20 years} * \Delta C_{\text{growth}} + \text{annual area of currently converted land} * L_{\text{conversion}}$$

$$L_{\text{conversion}} = C_{\text{after}} - C_{\text{before}}$$

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⁻¹a⁻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).

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.

$$\Delta \text{SOC} = (\text{SOC}_0 - \text{SOC}_{0-T}) / 20 = -1.0 \text{ t C ha}^{-1} \text{ a}^{-1}$$

annual change in carbon stock of mineral soils converted from grassland to cropland = $\Delta \text{SOC} \times \text{conversion area for a transition period of 20 years}$

ΔSOC = average annual carbon stock change in soils of grassland converted to annual cropland ($\text{t C ha}^{-1} \text{ a}^{-1}$) over a LUC transition period of 20 years

SOC_0 = carbon stock in cropland soils 20 years after conversion from grassland to annual cropland $\rightarrow 50 \text{ t C ha}^{-1}$

SOC_{0-T} = carbon stock in Austrian grassland soils before conversion $\rightarrow 70 \text{ t C ha}^{-1}$

Changes of carbon stock in mineral soils of grassland converted to perennial cropland

The annual land use change area from grassland to perennial cropland ranges from 1 372 ha to 1 962 ha for the period 1990–2010 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.

For consistency and transparency reasons the biomass C stock changes at these LUC areas to perennial cropland are reported in these LUC categories for a transition period of 20 years.

$$\Delta \text{SOC} = (\text{SOC}_0 - \text{SOC}_{0-T}) / 20 = -0.65 \text{ t C ha}^{-1} \text{ a}^{-1}$$

annual change in carbon stock of mineral soils converted from grassland to perennial cropland = $\Delta \text{SOC} \times \text{conversion area for a transition period of 20 years}$

ΔSOC = average annual carbon stock change in soils of grassland converted to perennial cropland ($\text{t C ha}^{-1} \text{ a}^{-1}$) over a LUC transition period of 20 years

SOC_0 = carbon stock in perennial cropland soils 20 years after conversion from grassland $\rightarrow 57 \text{ t C ha}^{-1}$

SOC_{0-T} = carbon stock in grassland soils before conversion $\rightarrow 70 \text{ t C ha}^{-1}$

The data in the CRF table represent grassland converted to annual cropland and grassland converted to perennial cropland, separately, as recommended by the ERT.

N₂O emissions from soils of grassland converted to cropland

The N₂O emissions due to the conversion of grassland to cropland were calculated with IPCC default values (TIER 1) using equations 3.3.14 and 3.3.15 (IPCC 2003). The area of land use conversions (grassland to annual and perennial cropland) was taken from Table 225.

The C/N ratio in soil organic matter was assumed to be 12 for grassland soils (based on Austrian soil inventory data, BORIS).

7.3.5 Uncertainty assessment

For the Monte-Carlo-simulations the following uncertainties of the input parameters were used:

Table 232: Uncertainties of areas in the CL category

	Before 2001	Since 2001
Total cropland	±4 %	±4 %
Perennial cropland	±20 %	±20 %
Annual LUC area CL to FL or FL to CL	see chapter 7.2.5, Table 222	see chapter 7.2.5, Table 222
Annual LUC area pCL to aCL, aCL to pCL, GL to pCL	±300 % ¹	±260 %
Annual LUC area GL to aCL	±200 % ¹	±150 % ¹

¹ Distribution was truncated at 0, because negative areas are not possible

Table 233: Uncertainties of the input data for the emission factors in the CL category (distributions were truncated at the minima and maxima)

	stock	growth rate or emission factor
Annual CL biomass	±15 %	±15 %
Perennial CL biomass (except perennial crops below)	±75 %	±75 %
Perennial energy plants	Triangle Distribution with 21-30-45 t C ha ⁻¹	Triangle Distribution with 3.5-5.0-7.5 t C ha ⁻¹
Christmas trees	±40 %	±40 %
Grassland biomass	±45 %	±45 %
Soil C stock change in CL rem Cl		±40 %
Soil C stocks for LUC to CL	see chapter 7.2.5, Table 223	
N ₂ O emission factor for soil at LUC to CL		±150 %
C/N ratio grassland soils	±55 %	
C/N ratio forest soils	±58 %	
Liming		±50 %

On basis of these input uncertainties the Monte Carlo simulations led to the following range of uncertainties of the total emissions/removals of the cropland category in the single years of the time series: $\pm 1\,044$ to $\pm 1\,659$ Gg CO₂ with higher uncertainties in the 90ies. This reflects the fact that the activity data of previous years have a higher uncertainty (see Table 222). The relative uncertainties in the single years are in the range from ± 198 to ± 459 %. Again, the higher relative uncertainties were assessed for the 90ies. Here, the fact that the net emissions in these years were clearly lower than in the 2000s plays an additional and significant role for this result.

It should be noted that the net emission/removals of the GL category are the result of subtractions between emissions and removals of several subcategories and pools. Only in single cases they are correlated. In line with error propagation laws the uncertainty of such net values based on subtractions of uncorrelated parameters are additive and therefore rather high.

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 7.1.4).

7.3.7 Recalculations

LUC areas forest land to cropland were revised according to the new NFI data for the years since 2002 (NFI 2007/09). This resulted in related changes of the areas of the subcategory CL remaining CL.

In addition, the more stratified estimates of the soil C stock changes of LUC areas forest land to cropland according to forest growth regions led to a revision of the related emissions/removals for the whole time series.

As recommended by the ERT, in 2011 the method to estimate C-stock changes from the litter pool at LUC areas from forest land to other land uses was changed to an annual discounting.

As a consequence the emissions/removals of this category differ to those of previous submissions.

7.3.8 Planned improvements

See Chapter 7.1.8.

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 2010, 1.79 Mio ha of Austria were grassland (STATISTIK AUSTRIA 2011). Total grassland includes one cut meadows, two and more cut meadows, cultivated pastures, litter meadows, rough pastures, alpine meadows and pastures and grassland where grassland management was stopped.

Due to the availability of new NFI data, the activity data of LUC from forest land to grassland and as an indirect consequence also the area of grassland remaining grassland were revised for the years since 2002 (see chapter 7.3.2). Therefore, activity data and emissions/removals (also those of grassland remaining grassland) are different compared to previous submissions.

The annual emission of grassland in Austria amounted to 257 Gg CO₂ in 1990 and 281 Gg CO₂ in 2010. The main driver of the emissions is the LUC from forest land to grassland.

The general trend states a reduction of the grassland area from 1990 to 2010 (-196 597 ha). Since 2007 an increase of LUC from cropland to grassland areas can be observed.

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 occur in Austria only in the grassland remaining grassland category and dead wood and litter is assumed not to occur at grassland.

Table 234: Sources (or sinks) considered for grassland management.

Category/source or sink
5.C Grassland – total
5.C.1 Grassland remaining grassland
- carbon stock changes in soil due to changes in grassland management
5.C.2 Land converted to grassland
5.C.2.1 Forest land converted to grassland
- carbon stock change in biomass due to LUC from forest land to grassland
- carbon stock change in DOM due to LUC from forest land to grassland
- carbon stock change in SOM due to LUC from forest land to grassland
5.C.2.2 Cropland converted to grassland
- carbon stock change in biomass due to LUC from cropland to grassland
- carbon stock change in SOM due to LUC from cropland to grassland

Table 235: Activity data of grassland 1990–2010 in ha; transition period of 20 years for LUC lands.

	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 - total	a. Annual cropland converted to grassland	b. Perennial cropland converted to grassland	2.3 Wetlands converted to grassland	2.4 Settlements converted to grassland	2.5 Other land converted to grassland
1990	1 992 765	1 878 598	114 167	99 259	14 908	14 780	128	NO	NO	NO
1991	1 989 050	1 872 138	116 912	102 076	14 836	14 709	127	NO	NO	NO
1992	1 985 335	1 865 669	119 666	104 893	14 773	14 646	127	NO	NO	NO
1993	1 981 620	1 859 205	122 415	107 710	14 705	14 579	126	NO	NO	NO
1994	1 979 096	1 861 801	117 294	102 630	14 665	14 539	126	NO	NO	NO
1995	1 976 571	1 865 657	110 914	96 290	14 624	14 499	126	NO	NO	NO
1996	1 978 490	1 873 953	104 536	89 950	14 587	14 461	125	NO	NO	NO
1997	1 980 408	1 882 259	98 149	83 609	14 539	14 414	125	NO	NO	NO
1998	1 972 662	1 880 903	91 758	77 269	14 489	14 364	124	NO	NO	NO
1999	1 964 915	1 875 803	89 112	74 688	14 425	14 301	124	NO	NO	NO

	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 - total	a. Annual cropland converted to grassland	b. Perennial cropland converted to grassland	2.3 Wetlands converted to grassland	2.4 Settlements converted to grassland	2.5 Other land converted to grassland
2000	1 957 169	1 870 692	86 477	72 106	14 371	14 248	123	NO	NO	NO
2001	1 929 902	1 846 069	83 833	69 524	14 309	14 186	123	NO	NO	NO
2002	1 902 636	1 820 347	82 288	68 040	14 249	14 126	122	NO	NO	NO
2003	1 875 369	1 794 801	80 568	66 555	14 013	13 892	120	NO	NO	NO
2004	1 848 102	1 768 618	79 484	65 652	13 832	13 713	119	NO	NO	NO
2005	1 843 105	1 764 222	78 883	64 748	14 134	14 013	121	NO	NO	NO
2006	1 838 107	1 759 842	78 265	63 845	14 420	14 296	124	NO	NO	NO
2007	1 817 138	1 737 999	79 138	62 942	16 197	16 058	139	NO	NO	NO
2008	1 796 168	1 713 210	82 958	62 038	20 920	20 740	180	NO	NO	NO
2009	1 796 168	1 711 955	84 213	61 875	22 337	22 146	192	NO	NO	NO
2010	1 796 168	1 710 925	85 243	61 712	23 530	23 328	202	NO	NO	NO

Table 236: Emissions from grassland management in Gg CO₂ (1990-2010); 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-total	2.2.a Annual cropland converted to grassland	2.2.b Perennial cropland converted to grassland
1990	257.02	-95.87	352.88	403.51	-50.63	-51.63	1.00
1991	251.90	-95.49	347.39	397.83	-50.43	-51.41	0.98
1992	246.87	-95.12	341.99	392.14	-50.15	-51.15	1.00
1993	241.78	-94.75	336.52	386.45	-49.93	-50.92	0.99
1994	251.98	-94.90	346.88	396.71	-49.83	-50.80	0.97
1995	53.33	-95.12	148.45	198.13	-49.68	-50.65	0.98
1996	65.79	-95.60	161.39	210.93	-49.53	-50.51	0.98
1997	78.29	-96.08	174.37	223.73	-49.36	-50.34	0.98
1998	91.33	-96.00	187.33	236.53	-49.20	-50.17	0.97
1999	97.04	-95.71	192.74	241.74	-49.00	-49.96	0.96
2000	102.74	-95.41	198.15	246.95	-48.80	-49.77	0.97
2001	109.59	-93.99	203.58	252.16	-48.59	-49.55	0.96
2002	303.18	-92.50	395.68	444.06	-48.37	-49.34	0.96
2003	305.83	-91.03	396.85	445.29	-48.43	-49.09	0.65
2004	308.13	-89.52	397.64	445.34	-47.70	-48.38	0.68
2005	309.94	-89.26	399.20	445.40	-46.20	-47.76	1.55
2006	309.12	-89.01	398.13	445.46	-47.33	-48.85	1.52
2007	311.88	-87.75	399.62	445.52	-45.89	-50.05	4.16
2008	311.87	-86.32	398.19	445.57	-47.39	-56.77	9.38

	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-total	2.2.a Annual cropland converted to grassland	2.2.b Perennial cropland converted to grassland
2009	287.69	-86.24	373.93	444.14	-70.20	-73.61	3.41
2010	280.75	-86.18	366.93	442.70	-75.77	-78.74	2.98

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 – 2011). 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, 2007 and 2010. For the years between the surveys the data have been interpolated. The data of 2010 will be available for the next submission.

Data for land use changes between cropland and grassland were estimated on basis of IACS (for a detailed description see chapter 7.3.2).

Based on expert judgement there was a bias in the estimated land use change areas between grassland and cropland in previous submissions before submission 2011: The share of LUC area from cropland to grassland (across a 20 years transition period) was estimated to be in the order of 1/4 of the total Austrian grassland area. This was assumed to be by far too much since ecological and site conditions for agricultural land use and agricultural management in Austria as well as legal obligations would not allow such a high LUC rate. The reasons for the previous over estimate of LUC between cropland and grassland as well as the new methodological approach to solve the problem are described in chapter 7.3.2.

The new method results in much more realistic estimates for the LUC area from cropland to grassland which is in the order of 1% of the total grassland area (across a LUC transition period of 20 years) and on average 0.06% of the total cropland area each year.

The LUC areas from forest land to grassland are based on the NFI data (see chapter 7.2.2). Due to the availability of new NFI data, the activity data of LUC from forest land to grassland and as an indirect consequence also the area of grassland remaining grassland since 2002 were revised. Therefore, activity data and emissions/removals are different compared to previous submissions

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,
- Grassland where grassland management was stopped.

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 2010 was 1.71 Mio ha.

The annual removals from grassland remaining grassland between 1990 and 2010 range from 96.1 Gg CO₂ to 86.2 Gg CO₂.

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 (Tier 2). 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 and it was assumed that it represents the soil carbon stock in 1990. This assumption is supported by the fact that the 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 grassland management for the period before 1990 and that grassland management was rather stable in that period.

The further methodology follows closely the equation presented by the IPCC guidelines which includes a management factor (F_{MG}), a land use factor (F_{LU}) and an input factor (F_I) (table 3.4.5 of the IPCC GPG, 2003).

These default factors were applied to the Austrian situation of grassland management in the years 1990 and 2003 on basis of national statistics for the grassland management (STATISTIK AUSTRIA 1985–2003; BMLFUW 1985–2003). Management improvements (e.g. increase of biological agriculture) were considered since 1985. On basis of these grassland management data and changes and on the IPCC GPG default management factors an annual increase of soil organic carbon of 0.0157 t C ha⁻¹ across a period of 20 years is calculated.

The carbon stock changes of grassland soil (70 t C ha^{-1}) from 1990–2010 were calculated then on basis of this annual soil C stock increase.

The IPCC default values (table 3.4.5, IPCC 2003) were applied. For the default inventory time of 20 years increases from 70 t C ha^{-1} to $70.315 \text{ t C ha}^{-1}$ 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 = ΔSOC_{20} * area of grassland remaining grassland*

$$\Delta \text{SOC}_{20} = (\text{SOC}_{1990+20} - \text{SOC}_{1990}) / 20 = 0.0157 \text{ t C ha}^{-1} \text{ a}^{-1}$$

The LUC areas from forest land to grassland are based on the NFI data (see chapter 7.2.2). The revision of the activity data of LUC from forest land to grassland since 2002 (due to the availability of new NFI data) led also to a change of the grassland remaining grassland area consequently. Therefore, activity data and emissions/removals in 5.C.1 are different compared to previous submissions.

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.at>). 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 to the whole Austrian grassland area.

The estimation resulted in a total area of 12 954 ha organic grassland soils.

The emissions from organic soils were estimated according to the IPCC GPG with the EF for cold, temperate region ($\text{EF}_{\text{cold temperate}} = 0.25 \text{ t C/ha}$)

The calculated emission from organic grassland soils was 11.87 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)

Due to the availability of new NFI data, the activity data of LUC from forest land to grassland were revised (see chapter 7.3.2). Therefore, activity data and emissions/removals are different compared to previous submissions.

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 changes from 114 167 ha to 85 243 ha between the years 1990 and 2010. 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 between 198.1 Gg CO_2 and 445.6 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. The changes of soil carbon stocks were, for the first time, stratified according to five forest growth regions. The stratified LUC areas and soil C stocks according to these growth regions were used for the estimates. These improvements led to changes in the removals/emissions of subcategory 5.C.2.1 compared to previous submissions. The whole time series of such LUC was revised due to the changed estimate assuming an oxidation of the whole litter layer in the year of LUC instead of 20-years decay time as in previous submissions. The method is described in 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 annual cropland to grassland from 1990–2010 is 1 145 ha. The average annual land use change area (1990-2010) from perennial cropland to grassland is 10 ha. The total area in conversion status for a time period of 20 years amounts to 14 908 ha in 1990 and 23 530 ha in 2010. Considering the area of the 20 years time period this leads to annual removals from 50.6 Gg CO₂ in 1990 and 75.8 Gg CO₂ in 2010.

Changes of carbon stock in biomass of annual cropland converted to grassland

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 6.67 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 from 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 total area of these 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.

To calculate the weighted mean a “weighting factor” is used. This factor is estimated on basis of the area share of a specific grassland type (e.g. two and more cut meadows have a share of 78% of the total grassland area in the 10 years average (1996-2005), thus the weight factor is 0.78). These weighting factors are multiplied then by the related yields and summed up to get the weighted grassland yields.

As recommended by the ERT and in order to make the estimation process more transparent the weighting factors are presented in the table below.

Table 237: Area weighted mean values of grassland biomass.

	area in ha (avg 10 year)	weighting factor	yield in t (avg 10 year)	contribution to weighted mean (t dm ha ⁻¹)
one cut meadows	54 827	0.05	3.2	0.2
two and more cut	844 126	0.78	6.8	5.3
litter meadows	17 126	0.02	3.5	0.1
culture pastures	74 839	0.07	6.7	0.5
rough pastures	90 264	0.08	2.4	0.2
weighted grassland yield (t dm ha ⁻¹)				6.2

weighted grassland yield (t C ha ⁻¹)	3.1
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The country specific root to shoot ratio from the Agricultural Research and Education Centre Raumberg-Gumpenstein (Höhere Bundeslehr- und Forschungsanstalt Raumberg-Gumpenstein -HBLFA) were used. 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).

The total grassland biomass of 5.7 t C ha⁻¹ comprises the above ground biomass (3.1 t C ha⁻¹) plus the root biomass (2.1 t C ha⁻¹) and the stubble biomass (0.5 t C ha⁻¹). This value is 16% lower than the GPG IPPC default value for cold temperate wet regions (Table 3.4.9 in IPCC GPG 2003).

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).

$$\text{Annual change in biomass} = \text{annual area of currently converted land} * (L_{\text{conversion}} + \Delta C_{\text{growth}})$$

$$L_{\text{conversion}} = C_{\text{after}} - C_{\text{before}}$$

$$C_{\text{after}} = \text{carbon stock immediately after conversion is 0}$$

$$\Delta C_{\text{growth}} = \text{country specific value for grassland biomass } 5.70 \text{ t C ha}^{-1} \text{a}^{-1} \text{ (accounted only for the year of LUC)}$$

$$C_{\text{before}} = \text{country specific value of carbon stock of annual crops before conversion is } 6.67 \text{ t C ha}^{-1} \text{a}^{-1} \text{ (see chapter 7.3.4.1.2; accounted only for the year of LUC)}$$

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 2010 is 16 ha. The used equation and methodological approach is described before (see in chapter “Changes of carbon stock in biomass of annual cropland converted to grassland”). For the grassland biomass after LUC the same value as described in chapter “Changes of carbon stock in biomass of annual cropland converted to grassland” before is used (5.7 t C ha⁻¹). The lost perennial cropland biomass due to this LUC represents the IPCC GPG default value for perennial cropland:

$$C_{\text{before}} = \text{IPCC default value of biomass carbon stock of perennial crops before conversion is } 63 \text{ t C ha}^{-1}$$

The results in the CRF table are split into the biomass carbon stock changes of annual cropland converted to grassland and perennial cropland converted to grassland and the sum of these sub-categories.

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 14 780 ha and 23 328 ha in the years 1990 and 2010, respectively.

The IPCC method with a four step approach was applied. The calculation steps for determining SOC₀, SOC_(0-T) and net soil change per ha of area are as follows:

- Step 1: Selecting Austrian specific values for annual cropland before conversion → SOC_{0-T}
- Step 2: Selecting Austrian specific values for grassland 20 years after conversion → SOC₀
- 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.

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).

$$\text{Average annual carbon stock change (t C ha}^{-1} \text{ a}^{-1}) = (SOC_0 - SOC_{0-T}) / 20 = 1.0$$

SOC₀..... 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 128 ha and 202 ha in the years 1990 and 2010:

For the estimates 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 cropland were used (GERZABEK et al. 2003, STREBL et al. 2003).

$$\Delta SOC = (SOC_0 - SOC_{0-T}) / 20 = 0.65 \text{ t C ha}^{-1} \text{ a}^{-1}$$

*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*

SOC₀..... carbon stock in soils 20 years after conversion from perennial cropland to grassland → 70 t C ha⁻¹

SOC_{0-T}..... carbon stock in Austrian perennial cropland soils before conversion → 57 t C ha⁻¹

The results in the CRF table are split into the soil carbon stock changes of annual cropland converted to grassland and perennial cropland converted to grassland and the sum of these sub-categories.

7.4.5 Uncertainty assessment

Table 238: Uncertainties of areas in the GL category

	Before 2001	Since 2001
Total grassland	±8 %	±8 %
Area of organic grassland soils	Triangle distribution 9 800 – 12 954 – 40 000 ha	
Annual LUC area CL to FL or FL to CL	see chapter 7.2.5, Table 222	see chapter 7.2.5, Table 222
Annual LUC area pCL to GL	±300 % ¹	±260 % ¹
Annual LUC area aCL to GL	±200 % ¹	±150 % ¹

¹ Distribution was truncated at 0, because negative areas are not possible

The uncertainties of the (input variables for or) emission factors were given in the chapters 7.2.5 and 7.3.5. The only uncertainty values that were not presented so far are those of the soil C stock changes in grassland remaining grassland with ±40 % and those for the emission factor of organic soils which are ±90 % according to IPCC GPG.

The Monte Carlo simulations resulted in the following range of uncertainties for the total emissions/removals of the grassland category in the single years of the time series: ±538 to ±831 Gg CO₂ with higher uncertainties in the 90ies. Like in the cropland subcategory, this difference is caused by the activity data of previous years which have a higher uncertainty (see Table 238).

The relative uncertainties in the single years are in the range from ± 548 to ± 108 %. Extremely high relative uncertainties occur in the first years of the 90ies, but also in the most recent years when the net emissions/removals were clearly lower than in the intermediate years.

It should be noted that the net emission/removals of the GL category are the result of subtractions between emissions and removals of several sub-categories and pools. Only in single cases they are correlated. In line with error propagation laws the uncertainty of such net values based on subtractions of uncorrelated parameters are additive and therefore rather high.

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 7.1.4).

7.4.7 Recalculations

LUC areas forest land to grassland were revised according to the new NFI data for the years since 2002 (NFI 2007/09). This results in related changes of the areas of the subcategory grassland remaining grassland.

In addition, the more stratified estimates of the soil C stock changes of LUC lands forest lands to grasslands according to forest growth regions led to a revision of the related emissions/removals for the whole time series.

As recommended by the ERT in 2011 the method to estimate C-stock changes from the litter pool at LUC areas from forest land to other land uses was changed to an annual discounting.

As a consequence the emissions/removals of this category differ to those of previous submissions.

7.4.8 Planned improvements

See chapter 7.1.8.

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 146 123 ha in the years 1990–2010.

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.

The wetlands category was also affected by the new NFI results because the LUC areas from forest land to wetlands since 2002 and the related emissions/removals were revised on basis of the new NFI results. In addition, the more stratified estimates of the soil C stock changes of such LUC lands for the whole time series led to a revision of the related emissions/removals

(see chapter 7.2.4.2). The whole time series of such LUC was revised due to the changed estimate assuming an oxidation of the whole litter layer in the year of LUC instead of 20-years decay time as in previous submissions.

Furthermore, for area consistency reasons also the LUC areas from other categories to wetlands and, as a consequence, the related emissions/removals had to be revised due to the new NFI results. Table 239 and Table 240 show the land use change and removals/emissions from LUC to wetland from 1990-2010.

Table 239: Activity data of wetland 1990–2010 in ha.

	5 D Total wetland	1. Wetland remaining wetland	2. Land converted to wetland	2.1 Forest land converted to wetland	2.2 Cropland converted to wetland	2.3 Grassland converted to wetland	2.4 Settlements converted to wetland	2.5 Other Land converted to wetland
1990	133 068	124 114	8 953	5 055	NO	3 899	NO	NO
1991	133 519	123 489	10 030	5 198	NO	4 832	NO	NO
1992	133 970	122 864	11 106	5 342	NO	5 764	NO	NO
1993	134 422	122 239	12 183	5 485	NO	6 697	NO	NO
1994	134 873	122 016	12 857	5 227	NO	7 630	NO	NO
1995	135 587	122 015	13 572	4 904	NO	8 668	NO	NO
1996	136 302	122 015	14 287	4 581	NO	9 706	NO	NO
1997	137 016	122 014	15 002	4 258	NO	10 744	NO	NO
1998	137 731	122 014	15 717	3 935	NO	11 782	NO	NO
1999	138 445	121 822	16 624	3 804	NO	12 820	NO	NO
2000	139 160	121 629	17 530	3 672	NO	13 858	NO	NO
2001	139 874	121 437	18 437	3 541	NO	14 896	NO	NO
2002	140 589	121 285	19 304	3 489	NO	15 815	NO	NO
2003	141 303	121 133	20 171	3 437	NO	16 734	NO	NO
2004	142 018	120 951	21 067	3 415	NO	17 653	NO	NO
2005	142 245	120 769	21 477	3 392	NO	18 085	NO	NO
2006	142 575	121 012	21 562	3 370	NO	18 193	NO	NO
2007	143 477	121 634	21 843	3 348	NO	18 496	NO	NO
2008	144 265	122 255	22 009	3 325	NO	18 684	NO	NO
2009	145 084	122 968	22 115	3 341	NO	18 774	NO	NO
2010	146 123	123 682	22 442	3 356	NO	19 085	NO	NO

Table 240: Emissions of wetland 1990–2010 in Gg CO₂.

	5 D Total wetland	1. Wetland remaining wetland	2. Land converted to wetland	2.1 Forest land converted to wetland	2.2 Cropland converted to Wetland	2.3 Grassland converted to wetland	2.4 Settlements converted to wetland	2.5 Other land converted to wetland
1990	191.08	NE	191.08	121.56	NO	69.51	NO	NO
1991	205.66	NE	205.66	124.17	NO	81.49	NO	NO
1992	220.24	NE	220.24	126.78	NO	93.46	NO	NO
1993	234.82	NE	234.82	129.38	NO	105.43	NO	NO
1994	242.09	NE	242.09	124.68	NO	117.41	NO	NO
1995	241.34	NE	241.34	108.42	NO	132.92	NO	NO
1996	248.79	NE	248.79	102.55	NO	146.24	NO	NO
1997	256.24	NE	256.24	96.68	NO	159.56	NO	NO
1998	263.70	NE	263.70	90.82	NO	172.88	NO	NO
1999	274.63	NE	274.63	88.43	NO	186.20	NO	NO
2000	285.56	NE	285.56	86.04	NO	199.52	NO	NO
2001	296.49	NE	296.49	83.65	NO	212.84	NO	NO
2002	313.96	NE	313.96	91.82	NO	222.14	NO	NO
2003	324.24	NE	324.24	90.31	NO	233.94	NO	NO
2004	335.06	NE	335.06	89.34	NO	245.73	NO	NO
2005	329.47	NE	329.47	88.36	NO	241.11	NO	NO
2006	332.01	NE	332.01	87.39	NO	244.62	NO	NO
2007	346.88	NE	346.88	86.42	NO	260.47	NO	NO
2008	345.94	NE	345.94	85.44	NO	260.49	NO	NO
2009	347.46	NE	347.46	85.16	NO	262.31	NO	NO
2010	355.78	NE	355.78	84.87	NO	270.91	NO	NO

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 2011). 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 Austria, 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. This

expert judgment is based on the consideration that these activities occur (besides on forest areas) primarily on grassland sites and do not affect cropland, settlements or other land. Furthermore national statistics show a steady increase of settlement area and other land, thus LUC from these categories to wetlands is considered not to occur in Austria.

The area in conversion status of land converted to wetland for a time period of 20 years ranges from 8 953 ha to 22 442 ha for the period 1990 to 2010.

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 sub-categories 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)

Due to the availability of new NFI data, the activity data of LUC from forest land to wetland were revised (see chapter 7.3.2). Therefore, activity data and emissions/removals are different compared to previous submissions

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 3 325 ha to 5 485 ha between the years 1990 and 2010 causing annual emission rates due to the loss of biomass and C stock changes in soil and litter from 83.7 Gg CO₂ to 129.4 Gg CO₂.

For the calculation of the annual change of carbon stocks IPCC Tier 2 approach is used. Emissions/removals were calculated by country specific values. Changes in soil carbon stocks were, for the first time, stratified according to five forest growth regions. The stratified LUC areas and C stocks according to these growth regions were used for the estimates. These improvements led to changes in the removals/emissions of subcategory 5.D.2.1 compared to previous submissions. The whole time series of such LUC was revised due to the changed estimate assuming an oxidation of the whole litter layer in the year of LUC instead of 20-years decay time as in previous submissions. The method is described in 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.

7.5.4.1.3 Grassland converted to Wetland (5.D.2.3)

For area consistency reasons also the LUC areas from other categories to wetlands and, as a consequence, the related emissions/removals had to be revised due to the new NFI results for LUC areas forest land to wetlands.

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):

$$\Delta C_{LW\ flood} = (\text{Sum } A_i * (B_{after} - B_{before}))$$

A_i = annual area of land currently 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 (see chapter 7.4.4.2.2)

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 continuous increase until 2010 and ranges from 3 899 ha to 19 085 ha between 1990 and 2010.

Calculation:

$$\Delta C_{LW\ flood} = (\text{Sum } A_i * (B_{after} - B_{before})) / 20$$

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 (see chapter 7.4.4.1.2)

B_{after} = carbon stock in soils 20 years after conversion to wetland (default = 0 t C ha.a⁻¹)

7.5.5 Uncertainty assessment

The following uncertainties of the activity data were used: Annual LUC area FL to WL - see chapter 7.2.5, Table 222; annual LUC area GL to WL: ±20 %.

The uncertainties of the emission factors are given in chapter 7.2.5, Table 223 and chapter 7.3.5, Table 233. Since only the sub-categories FL to WL and GL to WL exist, no further emission factors and uncertainties were necessary.

The uncertainties of the total wetland emissions/removals are in the range between 176 and 627 Gg CO₂ with a steady increase across the time series, or between 100 and 190 % of the total emissions in the single years. The low absolute uncertainty despite the high uncertainties of the input data reflects the low LUC activity in this subcategory. The relatively low percentage uncertainties despite the low accuracy of the input variables of this subcategory is based on the fact that the total net emissions are estimated only out of emissions in the single pools and sub-categories of wetland (no removals occur). Without subtractions in the estimates, the total relative uncertainty of the estimates tends to be lower which is in line with error propagation laws.

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 7.1.4).

7.5.7 Recalculations

LUC areas forest land to wetlands were revised according to the new NFI data for the years since 2002 (NFI 2007/09). Furthermore, for area consistency reasons also the LUC areas from other categories to wetlands had to be changed.

In addition, the more stratified estimates of the soil C stock changes of LUC lands forest land to wetlands according to forest growth regions led to a revision of the related emissions/removals for the whole time series.

As recommended by the ERT in 2011 the method to estimate C-stock changes from the litter pool at LUC areas from forest land to other land uses was changed to an annual discounting.

As a consequence the emissions/removals of this category differ to those of previous submissions.

7.5.8 Planned improvements

See chapter 7.1.8.

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 wood and litter is assumed to occur not at settlement areas. About 0.53 Mio ha of Austria's surface can be allocated to the IPCC land use category "Settlement" (BEV 2011). The area in conversion status from "Land converted to Settlement" for a time period of 20 years ranges from 169 652 ha to 197 680 ha between the years 1990 and 2010 causing annual emission rates due to C stock changes of biomass and soils from 91 Gg CO₂ to 302 Gg CO₂.

Annual LUCs to settlement occur from the sub-categories "Forest Land", "Cropland" and "Grassland". The portions of these categories vary between the years and cause variations of CO₂ 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 LUC areas with current LUC (in the year of LUC) in the categories.

For the submission 2012 all LUC areas in the settlement subcategory were revised on basis of the new NFI data (see chapter 7.3.2). As a consequence the year-to-year changes of forest land to and from other land use categories resulted in different areas that were "available" (due to

reasons of area consistency in these categories) to account for the observed increases in the total areas of wetland, settlement and other land. On basis of these consistency estimates the LUC areas to settlements were revised. In addition, the more stratified estimates of the soil C stock changes of LUC lands forest land to settlements for the whole time series led to a revision of the related emissions/removals. The whole time series of such LUC was revised due to the changed estimate assuming an oxidation of the whole litter layer in the year of LUC instead of 20-years decay time as in previous submissions. This leads to revised estimates for the emissions/removals of the settlement sub-category.

Table 241 and Table 242 show the land use changes and removals/emissions from LUC to settlements for the period 1990 to 2010.

Table 241: Derived land use changes for the subcategory 5 E for the period 1990 to 2010 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	193 218	190 847	29 872	156 883	4 093	NO	NO
1991	391 101	198 102	193 000	30 719	157 739	4 541	NO	NO
1992	398 137	202 986	195 152	31 567	158 596	4 989	NO	NO
1993	405 173	207 869	197 304	32 415	159 453	5 436	NO	NO
1994	412 209	215 130	197 080	30 886	160 310	5 884	NO	NO
1995	419 245	222 272	196 973	28 978	161 664	6 332	NO	NO
1996	426 281	229 414	196 867	27 070	163 018	6 779	NO	NO
1997	433 317	236 556	196 761	25 162	164 372	7 227	NO	NO
1998	440 353	243 698	196 655	23 254	165 726	7 675	NO	NO
1999	447 389	249 709	197 680	22 477	167 080	8 122	NO	NO
2000	454 425	261 837	192 588	21 700	162 214	8 675	NO	NO
2001	461 461	273 964	187 497	20 923	157 347	9 227	NO	NO
2002	468 497	285 709	182 789	20 529	152 481	9 779	NO	NO
2003	475 395	297 315	178 080	20 135	147 614	10 331	NO	NO
2004	482 293	308 746	173 547	19 916	142 747	10 883	NO	NO
2005	489 190	316 467	172 723	19 697	141 591	11 435	NO	NO
2006	494 950	323 051	171 900	19 478	140 434	11 987	NO	NO
2007	502 903	331 827	171 076	19 259	139 277	12 539	NO	NO
2008	513 017	342 764	170 253	19 040	138 121	13 092	NO	NO
2009	521 598	351 946	169 652	19 044	136 964	13 644	NO	NO
2010	529 188	358 112	171 076	19 048	138 385	13 644	NO	NO

Table 242: Emissions/removals from land use changes to settlement for the period 1990 to 2010 in Gg CO₂.

	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 Grass-land converted to settlement	5.E.2.4 Wetland converted to settlement	5.E.2.5 Other Land converted to settlement
1990	281	468	-204	17	NO	NO
1991	288	476	-205	17	NO	NO
1992	295	484	-207	18	NO	NO
1993	302	492	-209	19	NO	NO
1994	286	478	-211	19	NO	NO
1995	211	395	-204	20	NO	NO
1996	190	377	-207	21	NO	NO
1997	170	359	-210	22	NO	NO
1998	150	341	-213	22	NO	NO
1999	140	333	-216	23	NO	NO
2000	91	326	-258	24	NO	NO
2001	95	319	-248	25	NO	NO
2002	164	376	-237	25	NO	NO
2003	171	371	-227	26	NO	NO
2004	179	368	-217	27	NO	NO
2005	249	365	-144	28	NO	NO
2006	250	362	-141	29	NO	NO
2007	250	359	-139	30	NO	NO
2008	250	356	-137	31	NO	NO
2009	252	355	-134	31	NO	NO
2010	248	354	-137	31	NO	NO

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 2011). 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 since 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 from cropland and grassland with changing shares according to “availability” out of area consistency in these two categories.

In compliance with this method the land use changes to settlement area as shown in Table 241 were derived for the period 1990 to 2010.

For the submission 2012 all LUC areas forest land to settlements since 2002 were revised on basis of the new NFI data (see chapter 7.3.2). Furthermore, for area consistency reasons also the LUC areas from other categories to wetlands had to be changed. This leads to revised estimates for the emissions/removals of the settlement sub-category.

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 sub-categories 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 category 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 ($\text{t C ha}^{-1} \text{a}^{-1}$) of biomass were calculated:

t C ha^{-1}				$\text{t C ha}^{-1} \text{a}^{-1}$			
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 $0.58 \text{ t C ha}^{-1}\text{a}^{-1}$. 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 current LUC to settlement (in the year of LUC).

7.6.4.1.2 Litter and soil

For the calculation of the annual changes of carbon stocks in litter and mineral 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 litter and mineral soils due to land use changes from forests to settlements are based on regionally stratified carbon stocks in litter and soils of forest land and carbon stocks in mineral soils of settlement land (see chapter 7.2.4.2). These C stocks refer to a mineral soil depth of 0 to 50 cm.

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} ($= 2/3 * 70 \text{ t ha}^{-1}$) on average (0–30 cm soil depth). 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}

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 19 040 ha to 32 415 ha between the years 1990 and 2010 causing annual emission rates due to the loss of biomass and C stock changes in soil and litter from 319 Gg CO_2 to 492 Gg CO_2 . For the submission 2012 all LUC areas forest land to settlements since 2002 were revised on basis of the new NFI data (see chapter 7.3.2).

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 44 Gg CO_2 in the years 1990 to 2010.

Changes in carbon stocks in litter and mineral soils of forest land converted to settlement

For the calculation of the annual change of carbon stocks in forest litter and mineral soils converted to soils of settlements the IPCC Tier 2 approach is used. Emissions/removals were calculated by country specific values for carbon stocks, for the first time stratified according to five forest growth regions. The stratified LUC areas and C stocks according to these growth regions were used for the estimates. These improvements led to changes in the removals/emissions of subcategory 5.E.2.1 compared to previous submissions. The whole time series of such LUC

was revised due to the changed estimate assuming an oxidation of the whole litter layer in the year of LUC instead of 20-years decay time as in previous submissions. The method is described in chapter 7.2.4.2

The annual emission rates due to C stock changes in litter range from 66 to 101 Gg CO₂ in the years 1990 to 2010.

The annual emission rates due to C stock changes in soil range from 212 to 376 Gg CO₂ in the years 1990–2010.

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 136 964 to 167 080 ha in the years 1990–2010. For area consistency reasons also the LUC areas from other categories to settlements and, as a consequence, the related emissions/removals had to be revised due to the new NFI results for LUC areas forest land to settlements.

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 cropland and 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.

In the years 1990 to 2010 the annual removal rates range from 134 to 258 Gg CO₂ due to increase of biomass on settlement areas.

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 4 093 to 13 644 ha in the years 1990–2010 resulting in annual emission rates due to C stock changes of biomass and soils from 17 Gg CO₂ to 31 Gg CO₂. For area consistency reasons also the LUC areas from other categories to settlements and, as a consequence, the related emissions/removals had to be revised due to the new NFI results for LUC areas forest land to settlements.

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 is the same as described in the chapters 7.3.4.2.2 and 7.4.4.2.2 with country specific biomass data for grasslands and set-

tlements (see 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.

In the years 1990–2010 the annual emission or removal rates (net change) range from 1.8 to -18.7 Gg CO₂.

Changes in carbon stocks in soils 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 is the same as described in chapters 7.3.4.2.2 and 7.4.4.2.2 with country specific soil C stocks for grassland and settlement areas (see chapter 7.6.4.1.2).

The annual emission rate due to loss of soil carbon in soils ranges from 15 to 50 Gg CO₂ in the years 1990–2010.

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 1990–2010.

7.6.4.1.7 Other land converted to Settlement (5.E.2.5)

It is assumed by expert judgement that in Austria no conversion from other land to settlement occurred in the years 1990–2010.

7.6.5 Uncertainty assessment

The following uncertainties of the input data were used:

For the annual LUC area FL to SL see chapter 7.2.5, Table 222. For the area of LUC from CL to SL and GL to SL, triangle distributions were defined. The minima and maxima of the triangle distributions around the most likely areas (i.e. the areas that were used for the emission estimates) of these LUCs were derived by assessing the minimum and maximum potential of available areas that could contribute to such LUCs on basis of the area consistency with other related land use change sub-categories and their uncertainties. These estimates for the whole time series resulted in different minima and maxima for different periods of years. The minimum/maximum range around the most likely area varied from ±388 ha to ±3 510 ha for annual LUC areas CL to SL. For the annual LUC areas GL to SL, the minimum/maximum area ranges were from 68 - 1 806 ha to 13 - 2 942 ha in the single periods of years. The better the area consistency the lower was the minimum/maximum range for both types of LUCs.

The uncertainties of the emission factors were given in the chapter 7.2.5, Table 223 and chapter 7.3.5, Table 233. For the settlement biomass growth rates ±75 % were used.

The uncertainty of the totals of the emissions/removals of the settlement category across the time series ranges from 1 817 Gg CO₂ to 2 108 Gg CO₂. Higher values were found for the 90ies were the input data had a lower accuracy. With these values, the settlement category contributes (after the forest land category) the second highest share to the uncertainty of the total emissions/removals of the total LULUCF sector. This result is not unexpected since the activity is significant and the input parameters are rather uncertain. Expressed in % of the total emis-

sions of the settlement category, the uncertainty lies between 720 and 2 468 % depending on the amount of net emissions in the single years.

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 7.1.4).

7.6.7 Recalculations

LUC areas forest land to settlement were revised according to the new NFI data for the years since 2002 (NFI 2007/09). Furthermore, for area consistency reasons also the LUC areas from other categories to settlements had to be changed.

In addition, the more stratified estimates of the soil C stock changes of LUC lands forest land to settlement according to forest growth regions led to a revision of the related emissions/removals for the whole time series.

As recommended by the ERT in 2011 the method to estimate C-stock changes from the litter pool at LUC areas from forest land to other land uses was changed to an annual discounting.

As a consequence the emissions/removals of this category differ to those of previous submissions.

7.6.8 Planned improvements

See Chapter 7.1.8.

7.7 Other Land 5.F

7.7.1 Category description

The other land category was also affected by the new NFI results because the LUC areas from forest land to other lands since 2002 and the related emissions/removals were revised on basis of the new NFI results. Furthermore, for area consistency reasons also the LUC areas from grassland to other land had to be changed. In addition, the more stratified estimates of the soil C stock changes of such LUC lands for the whole time series led to a revision of the related emissions/removals (see chapter 7.2.4.2). The whole time series of such LUC was revised due to the changed estimate assuming an oxidation of the whole litter layer in the year of LUC instead of 20-years decay time as in previous submissions. As a consequence, the related emissions/removals had to be revised.

Table 243: Derived land use changes for the subcategory 5 F for the period 1990 to 2010 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	389 027	89 209	49 170	NO	40 039	NO	NO
1991	446 607	356 079	90 528	50 565	NO	39 963	NO	NO
1992	442 817	350 969	91 847	51 961	NO	39 887	NO	NO
1993	447 998	354 831	93 167	53 356	NO	39 811	NO	NO
1994	433 369	342 795	90 574	50 840	NO	39 735	NO	NO
1995	432 459	345 101	87 358	47 699	NO	39 659	NO	NO
1996	418 306	334 165	84 141	44 558	NO	39 583	NO	NO
1997	413 777	332 853	80 924	41 418	NO	39 507	NO	NO
1998	420 063	342 355	77 708	38 277	NO	39 431	NO	NO
1999	415 568	339 216	76 353	36 998	NO	39 355	NO	NO
2000	418 995	345 609	73 386	35 719	NO	37 667	NO	NO
2001	435 695	365 275	70 420	34 440	NO	35 980	NO	NO
2002	451 755	384 876	66 879	32 587	NO	34 292	NO	NO
2003	466 085	402 747	63 338	30 733	NO	32 605	NO	NO
2004	486 730	426 645	60 085	29 168	NO	30 917	NO	NO
2005	478 762	421 930	56 832	27 602	NO	29 230	NO	NO
2006	475 332	421 753	53 579	26 036	NO	27 542	NO	NO
2007	485 011	434 685	50 326	24 471	NO	25 855	NO	NO
2008	498 812	451 740	47 073	22 905	NO	24 167	NO	NO
2009	491 533	447 346	44 186	21 706	NO	22 480	NO	NO
2010	481 255	438 267	42 988	20 508	NO	22 480	NO	NO

Table 244: Emissions/removals from land use changes to Other Land for the period 1990 to 2010 in Gg CO₂.

	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 Grass-land converted to Other land	5.F.2.4 Wet-land converted to Other land	5.F.2.5 Set-lement converted to Other land
1990	866	878	NO	-12.3	NO	NO
1991	882	894	NO	-12.2	NO	NO
1992	899	911	NO	-12.1	NO	NO
1993	916	928	NO	-12.1	NO	NO
1994	886	898	NO	-12.0	NO	NO
1995	747	759	NO	-11.9	NO	NO
1996	709	721	NO	-11.9	NO	NO
1997	672	684	NO	-11.8	NO	NO
1998	634	646	NO	-11.7	NO	NO
1999	619	631	NO	-11.7	NO	NO
2000	606	616	NO	-10.2	NO	NO
2001	592	600	NO	-8.7	NO	NO
2002	479	486	NO	-7.2	NO	NO
2003	458	464	NO	-5.6	NO	NO
2004	442	446	NO	-4.1	NO	NO
2005	425	427	NO	-2.6	NO	NO
2006	408	409	NO	-1.1	NO	NO
2007	391	390	NO	0.4	NO	NO
2008	374	372	NO	1.9	NO	NO
2009	361	358	NO	3.4	NO	NO
2010	347	344	NO	3.4	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 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 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.

The LUC areas from forest land to other land are based on the NFIs. The remaining LUC area to cover the increase in the total area of other land is assumed to come from grassland. All other LUCs to other land are assumed as not occurring. These assumptions make 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. Cropland occurs only in ecologically favorable conditions).

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, Table 245). It gives an overview of the constitution (mixture) of “other land” area in Austria. 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 245: 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 grassland¹⁾	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 and the related C stocks per ha in biomass (see Table 245) a weighted mean for living biomass stock in other land was calculated (10.89 t C per ha). On basis of this stock, an annual biomass growth rate of 0.18 t C per ha and year of perennial plants in other land was derived and used for the estimates.

7.7.4.1.2 Soil

For the calculation of the annual changes of carbon stocks in litter and mineral soils converted to other land 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 litter and mineral soils due to land use changes from forests to other land are based on regionally stratified carbon stocks in litter and soils of forest land and carbon stocks in mineral soils of other land (see chapter 7.2.4.2). These C stocks refer to a mineral soil depth of 0 to 50 cm.

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. Estimates for the soil carbon stock in other land areas were also based on the results of the study by KÖRNER et al. (1993, Table 245 in chapter 7.7.4.1.1). According to the share of the different areas (glacier and bolder, types of unproductive areas) in the category other land and the related C stocks per ha in soil (see Table 245) a weighted mean for the soil carbon stock of 71.24 t C per ha (0–30 cm soil depth) was calculated and used for the other land use change categories to other land.

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 20 508 ha to 53 356 ha in the years 1990 to 2010 causing annual emission rates due to the loss of biomass and C stock changes in soil and litter from 344 Gg CO₂ to 928 Gg CO₂. The LUC areas from forest land to other lands since 2002 and the related emissions/removals were revised on basis of the new NFI results.

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 45 to 138 Gg CO₂ in the years 1990–2010.

Changes in carbon stocks in litter and mineral soils of forest land converted to other land

For the calculation of the annual change of carbon stocks in forest litter and mineral 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, for the first time stratified according to five forest growth regions. The stratified LUC areas and C stocks according to these growth regions were used for the estimates. These improvements led to changes in the removals/emissions of subcategory 5.F.2.1 compared to previous submissions. The whole time series of such LUC was revised due to the changed estimate assuming an oxidation of the whole litter layer in the year of LUC instead of 20-years decay time as in previous submissions. The method is described in chapter 7.2.4.2.

The annual emission rates due to C stock changes in litter range from 52 to 153 Gg CO₂ in the years 1990–2010.

The annual emission rates due to C stock changes in mineral soils range from 247 to 636 Gg CO₂ in the years 1990–2010.

7.7.4.1.4 Grassland converted to Other Land (5.F.2.3)

The area in conversion status from grassland to other land for a time period of 20 years ranges from 22 480 ha to 40 039 ha in the years 1990 to 2010 causing annual emission/removal rates from 3.4 Gg CO₂ to -12.3 Gg CO₂. For area consistency reasons also the LUC areas from other categories to other land and, as a consequence, the related emissions/removals had to be revised due to the new NFI results for LUC areas forest land to other lands.

Changes in carbon stocks in biomass of grassland 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 method is the same as described in the chapters 7.3.4.2.2 and 7.4.4.2.2 with country specific biomass data for grassland and other land (see chapter 7.7.4.1.1).

The annual emission/removal rates due to the loss/increase of biomass on areas of land use change from grassland land to other land range from 8.5 to -3.2 Gg CO₂ in the years 1990–2010.

Changes in carbon stocks soil of grassland land converted to other land

For the calculation of the annual change of carbon stocks in grassland soils converted to soils of other land the IPCC Tier 2 approach is used. The method is the same as described in chapters 7.3.4.2.2 and 7.4.4.2.2. Removals were calculated by country specific values for carbon stocks in grassland (70 t C ha⁻¹, see chapter 7.4.4.1.2) and other land (71 t C ha⁻¹, see chapter 7.6.4.1.2) and range from 5.1 Gg CO₂ to 9.1 Gg CO₂ in the years 1990–2010.

7.7.5 Uncertainty assessment

The following uncertainties of the input data were used:

For the annual LUC area FL to OL see chapter 7.2.5, Table 222. For the area of LUC from GL to OL triangle distributions were defined. The minima and maxima of the triangle distributions around the most likely areas (i.e. the areas that were used for the emission estimates) of these LUCs were derived by assessing the minimum and maximum potential of available areas that could contribute to such LUCs on basis of the area consistency with other related land use change sub-categories and their uncertainties. These estimates for the whole time series resulted in different minima and maxima for different periods of years. For the annual LUC areas GL to OL the minimum/maximum area ranges ranged from 0 - 1 434 ha to 0 - 2 942 ha in the single periods of years. The better the area consistency the lower was the minimum/maximum range for these LUC areas.

The uncertainties of the emission factors were given in the chapter 7.2.5, Table 223 and chapter 7.3.5, Table 233. For the other land biomass growth rates, a triangle distribution of 0.05-0.18-1.2 t C ha⁻¹ a⁻¹ was derived and used for the uncertainty analysis.

The uncertainty of the totals of the emissions/removals of the other land category across the time series ranges from 1 044 Gg CO₂ to 1 659 Gg CO₂. Higher values were found for the 90ies were the input data had a lower accuracy. Expressed in % of the total emissions of the other land category, the uncertainty lies between 213 and 346 %. The amount of net emissions was in the most recent years lower, as a consequence, the relative uncertainty of the estimates was higher in these years.

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 7.1.4).

7.7.7 Recalculations

LUC areas forest land to other land were revised according to the new NFI data for the years since 2002 (NFI 2007/09). Furthermore, for area consistency reasons also the LUC areas from other categories to other land had to be changed.

In addition, the more stratified estimates of the soil C stock changes of LUC lands forest land to other land according to forest growth regions led to a revision of the related emissions/removals for the whole time series.

As recommended by the ERT in 2011 the method to estimate C-stock changes from the litter pool at LUC areas from forest land to other land uses was changed to an annual discounting.

As a consequence the emissions/removals of this category differ to those of previous submissions.

7.7.8 Planned improvements

See chapter 7.1.8.

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 (CH₄), carbon dioxide (CO₂) and nitrous oxide (N₂O) emissions.

8.1.1 Emission trend

Overall greenhouse gas emissions from waste management and treatment activities during the year 2010 amounted to 1 806 Gg CO₂ equivalent (1990: 3 587 Gg CO₂ equivalent). These are about 2.1% of total greenhouse gas emissions in Austria in 2010 and 4.6% in the base year. In 2010, greenhouse gas emissions from the waste sector were 49.7% below the level of the base year.

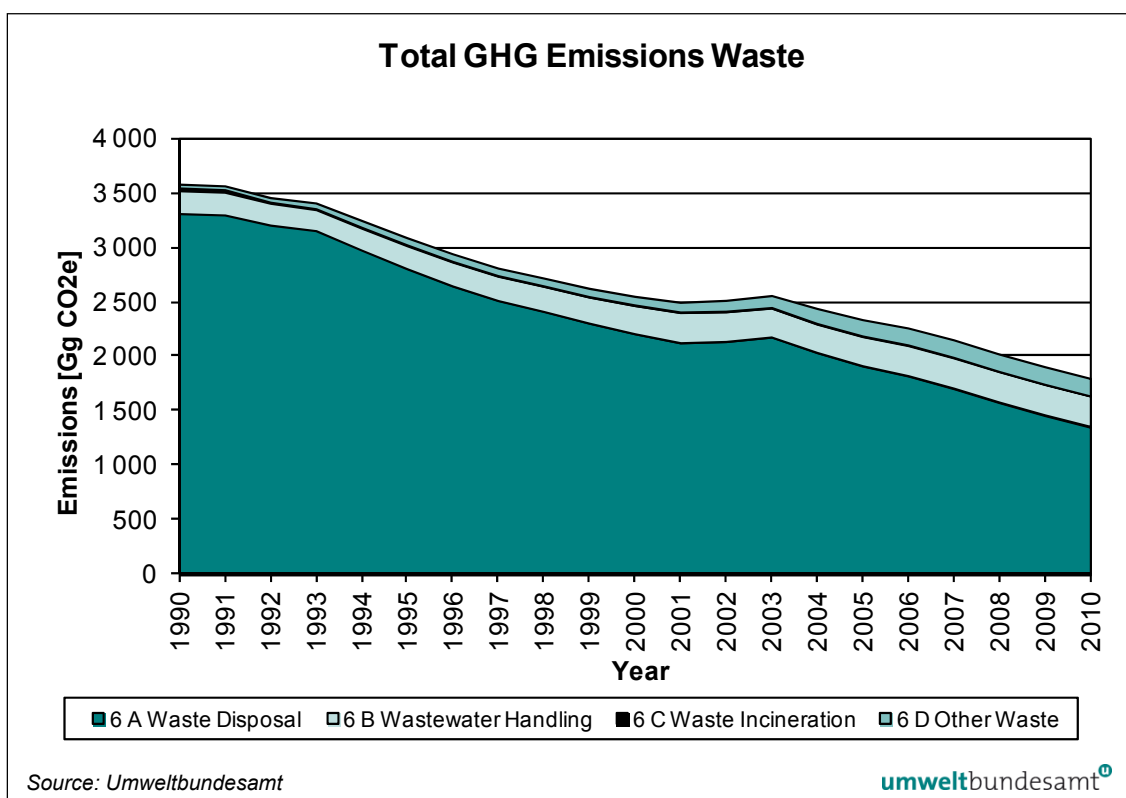


Figure 30: GHG emissions from waste 1990–2010.

Table 246 presents the emission trend by GHG. The major greenhouse gas emissions from this sector are CH₄ emissions, which represent 79.2% of all emissions from this sector in 2010, followed by N₂O (20.7%) and CO₂ (0.1%).

CH₄ emissions

CH₄ emissions originate from all subcategories within the sector, but the largest source is *Solid Waste Disposal on Land (6A)*. 94.4% of total CH₄ emissions from this sector are attributable to this subcategory.

CH₄ emissions from the Waste sector amounted to 1 431 Gg CO₂ equivalent in 2010; this was 58.3% below the level of the base year.

The decrease of CH₄ emissions is a result of waste management policies. The amount of land filled waste decreased significantly, the organic fraction within these waste decreased as well and methane recovery systems have increasingly been implemented during the period, reducing further the amount of methane emitted.

N₂O emissions

N₂O emissions from the waste sector increased remarkably over the considered period. In 2010, N₂O emissions from the Waste sector amounted to 373 Gg CO₂ equivalent. This was 180.0% above the level of the base year.

About 71.0% of N₂O emissions from the waste sector originated from waste water handling and about 29.0% from 'other waste' (mainly compost production). In both categories emissions are increasing; waste incineration (municipal solid waste and waste oil) is a minor source of N₂O emissions.

CO₂ emissions

CO₂ emissions from waste decreased. In 2010, CO₂ emissions from this sector amounted to 2.03 Gg CO₂ equivalent, this was 92.4% below the level of the base year.

CO₂ 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 CO₂ emissions from 1991–1992. The decrease in emissions 2005–2010 is due to the waste incineration regulation specifying more stringent emission limits for all facilities to be complied to by 2005 and thus reducing the number of facilities and thus waste incinerated.

Table 246: Emissions of greenhouse gases from waste and trend from 1990–2010.

	CO ₂ [Gg]	CH ₄ [Gg CO ₂ e]	N ₂ O [Gg CO ₂ e]	Total [Gg CO ₂ e]
1990	26.89	3427.11	133.28	3587.28
1991	23.40	3415.04	133.49	3571.93
1992	10.86	3320.77	132.30	3463.94
1993	10.60	3270.24	134.11	3414.94
1994	10.65	3090.54	153.05	3254.24
1995	10.97	2916.05	169.44	3096.47
1996	11.30	2749.73	187.64	2948.66
1997	11.62	2608.26	196.80	2816.67
1998	11.94	2502.30	211.80	2726.05
1999	12.26	2389.52	229.69	2631.47
2000	12.26	2288.40	257.51	2558.17

	CO ₂ [Gg]	CH ₄ [Gg CO ₂ e]	N ₂ O [Gg CO ₂ e]	Total [Gg CO ₂ e]
2001	12.26	2203.43	288.42	2504.11
2002	12.26	2213.41	296.03	2521.70
2003	12.26	2253.34	300.42	2566.02
2004	12.26	2116.72	318.21	2447.19
2005	12.26	1994.51	337.92	2344.70
2006	10.15	1901.61	357.05	2268.81
2007	8.12	1786.63	364.55	2159.30
2008	6.09	1656.09	367.72	2029.90
2009	4.06	1538.58	370.67	1913.30
2010	2.03	1430.81	373.21	1806.05
<i>Trend 1990–2010</i>	<i>-92.45%</i>	<i>-58.25%</i>	<i>180.02%</i>	<i>-49.65%</i>

Emission trends by sub categories

Table 247 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 2010, this category contributed 74.8% to total greenhouse gas emissions of the waste sector.

Table 247: Total greenhouse gas emissions of waste by subcategories and trend from 1990–2010.

CO ₂ equivalent [Gg]	6 A	6 B	6 C	6 D	Total
1990	3 314.27	211.35	27.09	34.57	3 587.28
1991	3 301.91	210.19	23.58	36.24	3 571.93
1992	3 208.21	201.88	10.91	42.94	3 463.94
1993	3 157.33	193.76	10.64	53.21	3 414.94
1994	2 977.86	202.57	10.69	63.12	3 254.24
1995	2 805.89	212.91	11.01	66.66	3 096.47
1996	2 645.54	221.85	11.33	69.93	2 948.66
1997	2 511.51	224.71	11.66	68.79	2 816.67
1998	2 411.87	230.93	11.98	71.27	2 726.05
1999	2 303.20	241.01	12.30	74.96	2 631.47
2000	2 206.05	261.01	12.30	78.81	2 558.17
2001	2 122.75	279.70	12.30	89.35	2 504.11
2002	2 134.46	275.12	12.30	99.81	2 521.70
2003	2 175.94	268.04	12.30	109.74	2 566.02
2004	2 033.64	263.49	12.30	137.75	2 447.19
2005	1 911.05	272.04	12.30	149.30	2 344.70
2006	1 819.15	283.05	10.18	156.43	2 268.81
2007	1 704.43	285.14	8.15	161.59	2 159.30
2008	1 576.15	287.35	6.11	160.28	2 029.90
2009	1 458.06	289.80	4.07	161.37	1 913.30
2010	1 350.08	292.20	2.04	161.73	1 806.05
<i>Trend 1990-2010</i>	<i>-59.26%</i>	<i>38.26%</i>	<i>-92.48%</i>	<i>367.76%</i>	<i>-49.65%</i>

8.1.2 Key Categories

Methodology and results of the key category analysis is presented in Chapter 1.5. Table 248 summarizes the key categories in the waste sector.

Table 248: Key sources of Category 6 Waste (KCA including LULUCF).

IPCC Category	Source Categories	Key Sources	
		GHG	KS-Assessment
6.A	Managed Waste Disposal on Land	CH ₄	LA; TA
6.B	Wastewater Handling	N ₂ O	LA 2010; TA

LA 1990 = Level Assessment 1990

LA 2010 = Level Assessment 2010

TA = Trend Assessment BY-2010

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 QA/QC checks, especially with regard to plausibility of activity data, are performed:

To ensure, that newly available data/parameters (e.g. landfill gas recovery, denitrification rate, connection rate to wastewater treatment plants) are accounted for in the inventory as early as possible, waste experts of the Umweltbundesamt are regularly 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) – is checked for plausibility and 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. Recalculations are validated in detail by comparing several parameters and partial results over the whole time series. Explanations for recalculations are clearly documented. Finally, after the calculation is finished, waste experts of the Umweltbundesamt not directly involved in the emissions calculation of that year are asked to check the applied parameters, the calculation as well as the trend description in the NIR.

In the course of the continuous QAQC-program, the calculation sheets – especially the FOD model applied for the various waste fractions – have been validated to ensure there are no transcription errors and have finally been protected against accidental modification.

Solid Waste Disposal

Beginning from the year 1998 until the end of the year 2007, 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). After a first check the reports were forwarded to the Umweltbundesamt, who in turn incorporated the reports into a landfill database. Landfill operators in default were prosecuted. 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 plausibility. To clarify any discrepancies landfill operators were contacted. Lists of

landfill owners were sent to competent authorities of each province (responsible for licensing and controlling) in order to check if number and type of landfill facilities were correct. Last but not least, plausibility was gained by comparison of the data with previous reports.

Since the year 2008 landfill operators are obliged⁷⁰ to report their data directly and electronically at the portal of <http://edm.gv.at> (EDM: **E**lectronic **D**ata **M**anagement in environmental and waste management). Every person or installation collecting and treating waste is obliged to register in EDM and submit annually reports of each waste input and output (yearly balance of type, quantity, origin and destination of waste). In various meetings and training courses especially landfill operators were educated in using this new reporting tool. Responsible institution for administration of the EDM is the Austrian Federal Ministry of Agriculture, Forestry, Environment and Water Management. The former landfill database is not maintained any more, but its data were used for checking accurately whether all landfill operators have registered in EDM. Analysis and quality control of the data is carried out on an on-going basis. Although the comparison with previous reports is an important tool, the advantage of having the landfill data embedded in the general input-output reports is obvious (counterchecking with the reports of partners).

In addition, supervisors appointed by the competent authority for each landfill are obliged to monitor regularly not only the landfill site itself but also each registration in EDM and the reporting of data.

As there is a special tax on wastes being landfilled, another independent mechanism of control on landfills is realised by the ministry of finance (via former customs executives).

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 subchapters).

8.1.6 Recalculations

Recalculations have been required for wastewater handling and 'other waste' (compost), but not for solid waste disposal. For further information please refer to the respective subchapters.

8.1.7 Completeness

Table 249 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.

⁷⁰ According to §41 (1) Landfill Ordinance

Table 249: Overview of subcategories of Category Waste: transformation into SNAP Codes and status of estimation.

IPCC Category	SNAP	CO ₂	CH ₄	N ₂ O
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

Emissions: CH₄

Key Source: Yes

In Austria all waste disposal sites are managed sites (landfills).

In the year 2008 about 650 landfill sites received waste (Federal Waste Management Plan 2011), whereas only the landfills for mass waste are sources of CH₄ emissions. Landfills for residual waste do not contain the fraction 'residual waste' as defined in the inventory and do not cover relevant organic material as they have to comply with stronger limits with regard to organic material (TOC). Excavated soil and construction waste are not relevant for GHG emissions too.

Table 250: Number and type of landfill sites

Landfill type	2002	2003	2004	2005	2006	2007	2008
Mass waste landfill	61	62	58	50	54	53	46
Residual waste landfill ^{*)}	18	23	30	27	29	31	40
Construction and demolition waste landfill	64	63	124	74	84	87	90
Excavated soil material landfill	108	211	454	340	376	377	475 ^{**)}

^{*)} Residual waste has to be disposed of on mass waste landfills

^{**)} In this number inert waste landfills are included

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 Law⁷¹ (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 generally only pre-treated waste was allowed to be deposited. This is due to the implementation of the Landfill Ordinance⁷², 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.

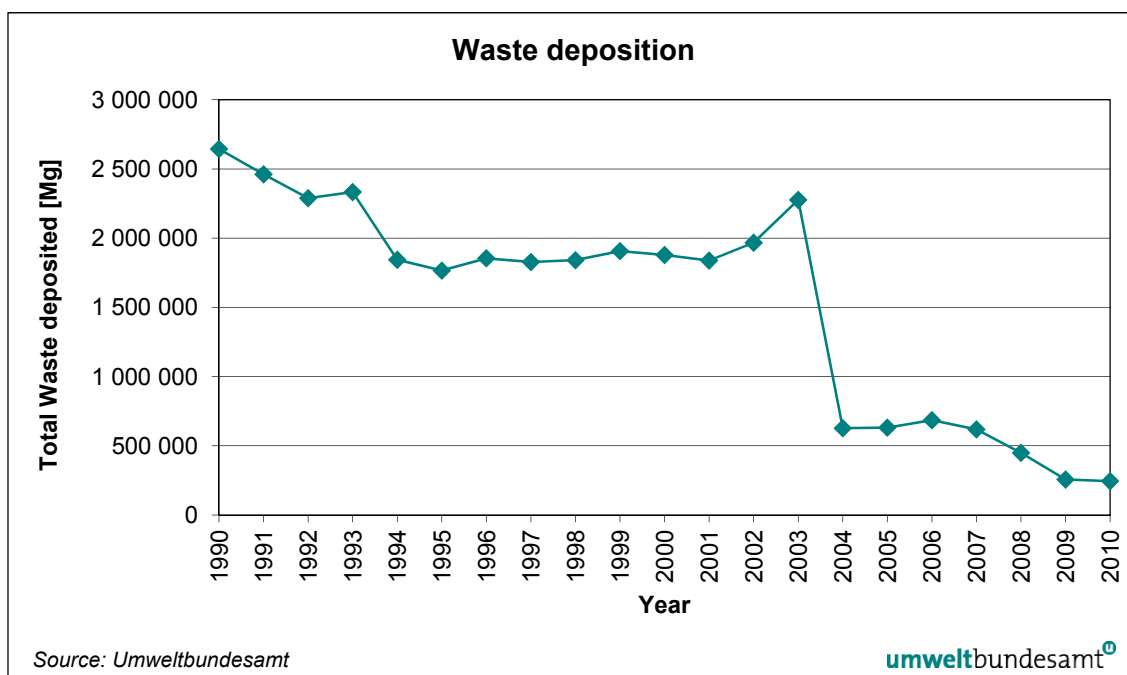


Figure 31: Waste ('residual waste' and 'non-residual waste') with a relevant share of degradable organic carbon (deposited on mass waste landfills), period 1990–2010.

However, under certain circumstances there were some exceptions to this pre-treatment-obligation granted to some Austrian provinces.⁷³ In four of the nine Austrian provinces it was still allowed to deposit waste directly without any pre-treatment until the end of 2008.

⁷¹ Abfallwirtschaftsgesetz 2002, BGBl. I Nr. 102/2002

⁷² 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)

⁷³ Regulated in § 76 Abs. 7 AWG 2002

Table 251 presents CH₄ emissions from managed waste disposal on land as well as activity data of 'residual waste' and 'non residual waste' for the period 1990–2010.

Table 251: Activity data for 'residual waste' and 'non residual waste', greenhouse gas emissions and implied emission factors 1990–2010.

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	157 234	63.9
1992	674 909	1 614 157	2 289 067	152 772	66.7
1993	688 407	1 644 718	2 333 126	150 349	64.4
1994	702 175	1 142 067	1 844 242	141 803	76.9
1995	716 219	1 049 709	1 765 928	133 614	75.7
1996	730 543	1 124 169	1 854 713	125 978	67.9
1997	745 154	1 082 634	1 827 788	119 596	65.4
1998	760 057	1 081 114	1 841 171	114 851	62.4
1999	822 179	1 084 625	1 906 804	109 676	57.5
2000	826 874	1 052 061	1 878 935	105 050	55.9
2001	772 786	1 065 592	1 838 378	101 083	55.0
2002	792 753	1 174 543	1 967 296	101 641	51.7
2003	890 640	1 385 944	2 276 584	103 616	45.5
2004	344 747	282 656	627 403	96 840	154.4
2005	389 660	241 733	631 393	91 002	144.1
2006	425 091	260 068	685 159	86 626	126.4
2007	464 109	154 517	618 626	81 163	131.2
2008	319 927	129 324	449 251	75 055	167.1
2009	256 340	0	256 340	69 431	270.9
2010	244 786	0	244 786	64 290	262.6

CH₄ emissions are affected by waste volumes deposited since 1950 (IPCC FOD Method). Significant changes in the amount of deposited waste – as happened between 1993 and 1994 or 2003 and 2004 – resulted in declining emissions too. However, CH₄ emissions (in a particular year) do not fall to the same extent than waste volumes decline (in a particular year) as the IPCC Tier 2 model is applied for the calculation and emissions are affected by historical depositions too. This is in general the reason for the significant changes of the IEF from 2003 to 2004 and from 2008 to 2009 as the IEF for CH₄ is calculated by dividing the emissions of CH₄ by the total amount of waste deposited.

The fall in total waste deposited, respectively the increase of IEF 2003–2004 and 2006–2009 is attributable to the implementation of the Landfill Ordinance.

8.2.2 Methodological Issues

For the emissions calculation the 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. Residual waste is directly landfilled waste without having passed any pre-treatment.

In 2009 only 0.4% of total waste from households and similar sources was directly deposited. The main part of waste is incinerated, recycled or treated mechanical-biologically.

Table 252: Recycling and treatment of waste from households and similar establishments.

Treatment	1989 ¹⁾	1999 ³⁾	2004 ³⁾	2006 ⁴⁾	2008 ⁵⁾	2009 ⁶⁾
Bio-technical treatment (mechanical-biological treatment)	16.7% ²⁾	6.3%	11.2%	17.9%	8.8%	10.4%
thermal treatment (incineration)	5.9%	14.7%	28.3%	23.7%	34.7%	36.4%
treatment in plants for hazardous waste	0.4%	0.8%	1.2%	1.8%	2.3%	2.4%
recycling	12.9%	34.3%	35.6%	34.8%	32.3%	31.7%
recycling (biogenous waste)	1.0%	15.4%	16.0%	17.9%	18.2%	18.7%
direct deposition at landfills ("residual waste")	63.1%	28.5%	7.7%	3.8%	3.7%	0.4% ^{*)}

¹⁾ Federal Waste Management Plan (BUNDESABFALLWIRTSCHAFTSPLAN 2001)

²⁾ This value also includes plants used in the past to reduce odour emissions.

³⁾ Federal Waste Management Plan (BUNDESABFALLWIRTSCHAFTSPLAN 2006)

⁴⁾ Annual update (2008) of the Federal Waste Management Plan (BUNDESABFALLWIRTSCHAFTSPLAN 2006)

⁵⁾ Annual update (2009) of the Federal Waste Management Plan (BUNDESABFALLWIRTSCHAFTSPLAN 2006)

⁶⁾ Federal Waste Management Plan (BUNDESABFALLWIRTSCHAFTSPLAN 2011)

^{*)} solely sorting residues from potentially recyclable material collected separately.

The quantities of 'residual waste' have been taken from the following sources:

- Data for 2008 and the following years have been taken from the EDM⁷⁴, an electronic database administered by the BMLFUW. Since the beginning of 2009 landfill operators are obliged to register their data directly and electronically (per upload) at the portal of <http://edm.gv.at>⁷⁶.

⁷⁴ Electronic Data Management

⁷⁵ According to §41 (1) Landfill Ordinance, Federal Gazette BGBl. Nr 39/2008

- Data for 1998 to 2007 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.
- Data for 1950 to 1997 on 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 years⁷⁷ (1998 and 1999) were examined and the difference – which represents the residual waste from administrative facilities of industries and businesses – was calculated. This difference, relative to the change of residual waste from households, was then applied to the years 1950 to 1997 accordingly.

Activity data – Non residual waste

‘Non residual waste’ is directly deposited waste other than residual waste but with biodegradable lots. Non residual waste comprises for example bulky waste, construction waste, mixed industrial waste, road sweepings, sewage sludge, rakings and residual matter from waste treatment.

The quantities of ‘non residual waste’ of the years 1998 to 2007 were taken from the database for solid waste disposal (‘Deponiedatenbank’, ‘Austrian landfill database’). For the years 2008, 2009 and 2010 the quantities have been reported via 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 253 presents a summary of all considered waste types and the corresponding identification numbers (List of waste).

⁷⁶ According to §41 (1) Landfill Ordinance, Federal Gazette BGBl. Nr 39/2008

⁷⁷ Data available from the Federal Waste Management Plan (Bundesabfallwirtschaftsplan - BAWP) as well as from the Austrian landfill database.

Table 253: Considered types of waste (list of waste⁷⁸ 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
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,

⁷⁸ 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

- green waste,
- sludge,
- sorting residues, bulky waste, landfill fraction after mechanical-biological treatment,
- textiles,
- fats.

Sorting residues remaining after mechanical, biological and mechanical-biological treatment and bulky waste are the main fraction deposited (99% in 2010). Other fractions deposited are sludges (0.8%) and construction waste (0.2%). Bio waste, paper and wood are mainly composted, recycled or reused (due to the implementing of the Waste Management Law), fats and textiles were not deposited any more.

Methodology

Where available, country specific parameters are used after they have been 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 254: Parameters for calculating CH₄ emissions of SWDS.

Waste category/ Parameters	residual waste	wood	paper	sludges	Sorting residues/ output MBT ⁷⁹ / bulky waste	Bio-waste	textiles	Construction waste	fats
Methane correction factor	1 IPCC default for managed SWDS								
Fraction of degradable organic carbon dissimilated DOC _F	0.6	0.5	0.55	0.55	0.55	0.55	0.55	0.55	0.77
	IPCC default taking into account national waste expertises.								
	See Table 256	0.45	0.3	0.11	0.16	0.16	0.5	0.09	0.2
DOC	(HACKL & MAUSCHITZ 1999) (UMWELTBUNDES- AMT 2003) (BAWP 2006)	(BAUMELER et al. 1998)							
L ₀ ¹⁾	0.106	0.165	0.121	0.444	0.065	0.064	0.202	0.034	0.113
	7	25	15	7	20	10	15	20	4
Half life period	National waste experts	(GILBERG et al. 2005)	(GILBERG et al. 2005)	Assumption: same as residual waste	IPCC default slow decay	Assumption: similar to paper	Assumption: same as paper	IPCC default slow decay	(GILBERG et al. 2005)
Number of considered years ²⁾	41	61	61	41	61	50	61	61	41
Fraction of CH ₄ in Landfill Gas	0.55 Mean value cited in the literature, also within the IPCC range.								
Methane Oxidation in the upper layer	10% IPCC default								
Landfill gas recovery	see Figure 33 (UMWELTBUNDESAMT 2004e, 2008c)								

¹⁾ L₀ is calculated for each waste category using the following equation and taking into account waste type specific parameters: $L_0 = [MCF(x) * DOC(x) * DOC_F * F * 16/12 \text{ (Gg CH}_4\text{/Gg waste)}]$

²⁾ In general historical data since 1950 are taken into account in the calculation. The number of considered years in a particular year however depends on the respective waste fraction respectively its half life period. To be in line with the base year calculation considering waste amounts for 1950-1990 the minimum number of years accounted for is 41 (to ensure time series consistency).

⁷⁹ MBT: Mechanical-biological treatment

Biodegradable organic carbon (DOC) of residual waste

For the year 1990 a DOC content of 200 g/kg residual waste was taken (UMWELTBUNDESAMT 2003)⁸⁰. In 1999 the DOC was determined to be 120 g/kg; it was calculated on the basis of information on the waste composition – i.e. the mixture of different waste fractions in residual waste deposited – and the carbon contents of the relevant fractions, based on literature on direct waste analysis (UMWELTBUNDESAMT 2003).

The DOC values for the years 2004 and 2008 were calculated in the course of the inventory preparation on basis of updated information on the composition of residual waste published in the Federal Waste Management Plan 2006 (BMLFUW 2006a) and its annual update 2009 (Status Report to the Federal Waste Management Plan 2006), taking into account the different carbon content of the fractions as published in (UMWELTBUNDESAMT 2003). The DOC for the years 2000–2003 and 2005–2007 are interpolated values.

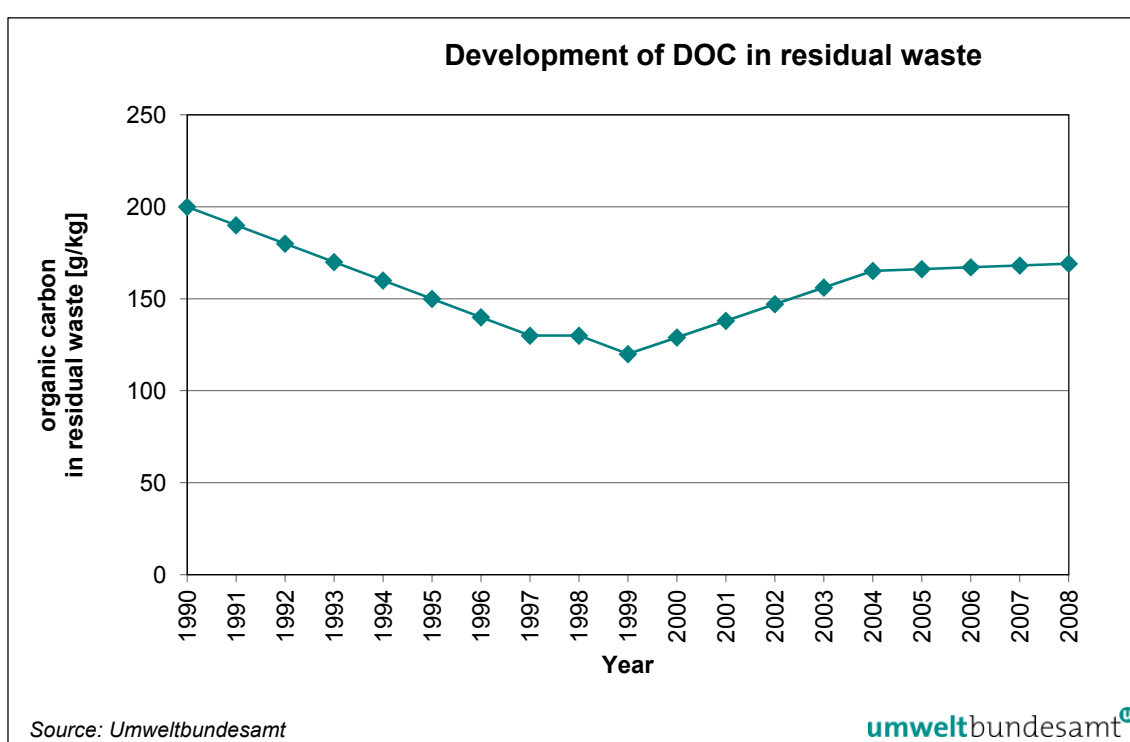


Figure 32: Development of DOC in residual waste.

The intensified separate collection of bio-organic and paper waste and the corresponding decreasing share of these materials in the residual waste fraction (deposited directly) 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 (as can be seen in Table 255).

⁸⁰ The values for the years before were taken from another national study (HACKL & MAUSCHITZ 1999).

Table 255: Composition of residual waste

Residual waste	1990 ¹⁾	1993 ¹⁾	1996 ¹⁾	1999 ¹⁾	2004 ²⁾	2008 ³⁾
	[% of moist mass]	[% 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	12
Glass	7.8	6.3	4.4	3	5	4
Metal	5.2	4.4	4.5	4.6	3	3
Plastic	9.8	9.3	10.6	15	10	10
Composite materials	11.3	11.3	13.8	–	8	10
Textiles	3.3	3.1	4.1	4.2	6	6
Hygiene materials	–	–	–	12	11	8
Biogenic components	29.8	34.4	29.7	17.8	37	40
Hazardous household waste	1.4	1.5	0.9	0.3	2	1
Mineral components	7.2	7.9	3.8	–	4	3
Wood, leather, rubber, other components	2.3	3.6	1.1	2.6	1	–
Residual fraction	–	–	13.6	26.5	2	2

¹⁾ (UMWELTBUNDESAMT 2003)²⁾ (BMLFUW 2006a)³⁾ Annual update (2009) of the Federal Waste Management Plan (BMLFUW 2006a)

For 2009 and the following years the DOC of residual waste does not need to be updated for inventory purposes as no residual waste is allowed to be deposited directly any more, but only pre-treated waste (referred to as non-residual waste).

Table 256: 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⁾	1998	130 ²⁾
1960–1969	230 ¹⁾	1999	120 ²⁾
1970–1979	220 ¹⁾	2000	129 ^{*)}
1980–1989	210 ¹⁾	2001	138 ^{*)}
1990	200 ²⁾	2002	147 ^{*)}
1991	190 ²⁾	2003	156 ^{*)}
1992	180 ²⁾	2004	165 ³⁾
1993	170 ²⁾	2005	166 ^{*)}
1994	160 ²⁾	2006	167 ^{*)}
1995	150 ²⁾	2007	168 ^{*)}
1996	140 ²⁾	2008	169 ⁴⁾
1997	130 ²⁾		

¹⁾ (HACKL & MAUSCHITZ 1999)²⁾ (UMWELTBUNDESAMT 2003)³⁾ calculated according to waste composition 2001 (BMLFUW 2006a)⁴⁾ calculated according to waste composition 2009 (Status Report to BMLFUW 2006a)^{*)} interpolated values (2000-2003) and (2005-2007)

Landfill gas recovery

In 2004, the Umweltbundesamt investigated the amount of annually collected landfill gas by questionnaires sent to landfill operators (UMWELTBUNDESAMT 2004e), showing that in 2001, the amount of collected landfill gas was more than 5 times higher than in 1990. In 1990 only 9 landfills were equipped with landfill gas wells. In 2001 at all operating mass landfills landfill gas was collected.

In 2008 a further study was conducted (UMWELTBUNDESAMT 2008c) again sending questionnaires to landfill operators to get new data on collected landfill gas as well as information on its use. Results show, that from 2002 on the amount of landfill gas generated – and landfill gas recovered accordingly – decreased as a consequence of the reduced carbon content of deposited waste (despite a consistent recovery practice).

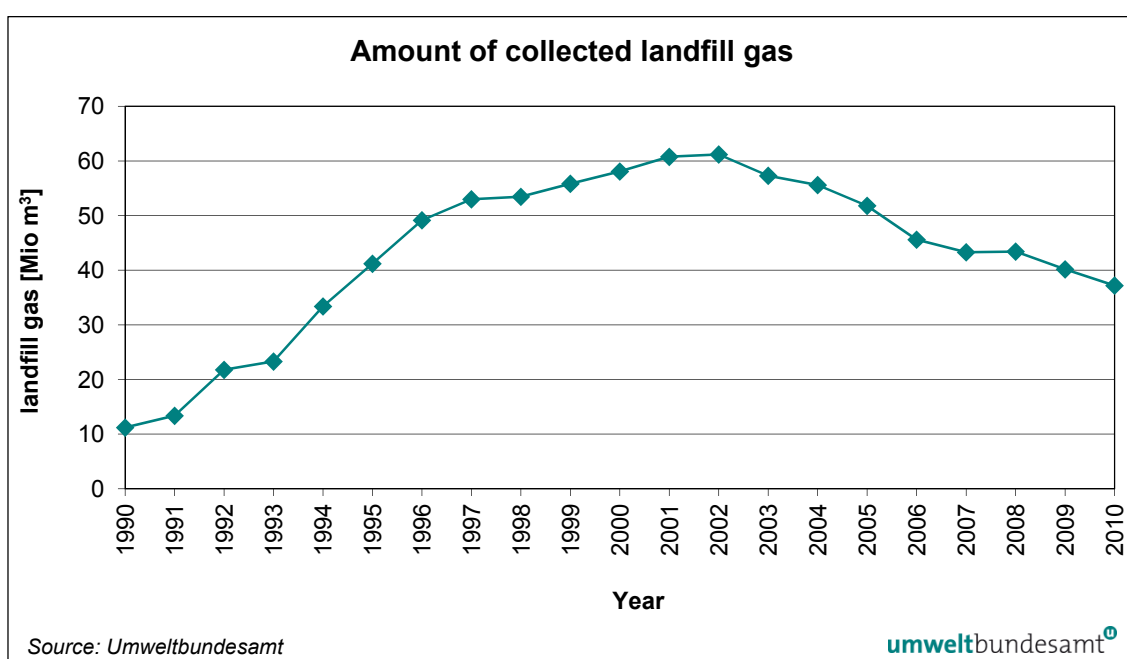


Figure 33: Amount of collected landfill gas 1990 to 2010 (UMWELTBUNDESAMT 2004e, 2008c).

The study from 2008 covers data for the years 2002-2007. As no new information on the amount of landfill gas recovered became available for the years 2008, 2009 and 2010, the mean value of the recovery rate of the years 2002 to 2007 (ranging from 12% to 14%) was taken as a proxy (13.2%) to calculate the actual amount of landfill gas recovered.

Moreover, the changing methane concentration in recovered landfill gas – decreasing from 48% (2002) to 45% (2007) (UMWELTBUNDESAMT 2008c) – has been considered in the calculation, resulting in less methane recovered and higher methane emitted accordingly. This is mainly due to the extensive capturing of landfill gas and the dilution of the landfill gas captured. For the years 2008-2010 the same methane concentration as 2007 can be assumed.

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 and the following years) 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 257: 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

No recalculations have been made since last years' submission.

8.3 Wastewater Handling (CRF Source Category 6.B)

8.3.1 Source Category Description

Emissions: CH₄, N₂O

Key Source: Yes (N₂O)

In the year 2010, greenhouse gas emissions from wastewater handling contributed 0.3% to total greenhouse gas emissions in Austria.

From 1990 to 2010 greenhouse gas emissions from this source increased by 38.3% due to increasing amounts of wastewater that is treated in treatment plants with nitrogen removal (nitrification/denitrification). Emissions from wastewater handling are estimated separately for industrial wastewater and for domestic and commercial wastewater.

Table 258: Greenhouse gas emissions from industrial as well as domestic and commercial wastewater treatment 1990–2010.

	6.B.2 Domestic and commercial wastewater		6.B.1 Industrial wastewater	Total
	CH ₄ emissions [Gg]	N ₂ O emissions [Gg]	N ₂ O emissions [Gg]	[Gg CO ₂ equivalent]
1990	4.85	0.34	0.01	211.35
1991	4.84	0.34	0.01	210.19
1992	4.70	0.32	0.01	201.88
1993	4.56	0.30	0.02	193.76
1994	4.39	0.33	0.03	202.57
1995	4.21	0.36	0.05	212.91

	6.B.2 Domestic and commercial wastewater		6.B.1 Industrial wastewater	Total
	CH ₄ emissions [Gg]	N ₂ O emissions [Gg]	N ₂ O emissions [Gg]	[Gg CO ₂ equivalent]
1996	3.87	0.39	0.06	221.85
1997	3.53	0.41	0.07	224.71
1998	3.19	0.44	0.09	230.93
1999	2.93	0.48	0.10	241.01
2000	2.68	0.54	0.12	261.01
2001	2.43	0.59	0.14	279.70
2002	2.18	0.59	0.15	275.12
2003	1.95	0.58	0.15	268.04
2004	1.79	0.58	0.15	263.49
2005	1.64	0.61	0.16	272.04
2006	1.48	0.64	0.17	283.05
2007	1.39	0.65	0.18	285.14
2008	1.30	0.66	0.18	287.35
2009	1.30	0.66	0.18	289.80
2010	1.30	0.67	0.18	292.20
<i>Trend 1990–2010</i>	-73%	97%	1 328%	38%

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 CH₄ emissions – especially between 1995 and 2003 – and the increase of N₂O emissions.

8.3.2 Methodological Issues

In the year 2008 – the latest year for which data is currently available – 92.8% of the Austrian population was connected to municipal wastewater treatment plants. The remaining wastewater is treated either in septic tanks (4.4% of the Austrian population), domestic wastewater treatment plants (2.5%), 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 N₂O emissions), whereas septic tanks are characterised by anaerobic conditions (resulting in CH₄ 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 (Gewässerschutzberichte – BMLFUW 1993, 1996, 1999, 2002) and situation reports on municipal wastewater and sludge (BMLFUW 2006, BMLFUW 2008, BMLFUW 2010). Data are available for the years 1971, 1981, 1991, 1995, 1998, 2001, 2003, 2006 and 2008. 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 CH₄ emissions – had to be extrapolated from the year 2000 onwards.

8.3.2.1 CH₄ emissions

Domestic and commercial wastewater

Wastewater treatment in Austria mainly uses aerobic procedures (in waste water treatment plants). However, 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.

CH₄ emissions from cesspools and septic tanks are calculated following to the IPCC methodology. The following parameters were used:

- Average organic load: 60 g BOD₅ per inhabitant and day [IPCC default]
- Methane producing capacity B₀: 0.6 kg CH₄/ kg BOD₅ [IPCC default]
- Methane conversion factor MCF: 0.27 (STEINLECHNER et al. 1994)

The MCF defines the share of methane producing capacity (B₀) 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 MCF value of 27%.

Activity data

CH₄ emissions reported under domestic and commercial waste water refer to emissions occurring under anaerobic conditions in septic tanks and cesspools. For calculation, the share of population disposing via septic tanks is taken into account.

Table 259: Share of population using septic tanks (1991–2008)

1991	2001	2003	2006	2008
17.8%	8.6%	6.8%	5.1%	4.4%

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.

In order to prevent uncontrolled putrefaction, the sludge is stabilized. In smaller facilities such a stabilisation is usually carried out aerobically (open pool with oxygen input), in bigger plants stabilization is carried out anaerobically (in a digestion tower). The methane gas produced in the course of the anaerobic treatment is used for energy recovery in combined heat/power generation systems (CHP). In case of technical disruptions or overloads the methane gas is flared off. In both treatment methods, no significant amounts of methane emissions are released into the environment.

Activity data and CH₄ emissions respectively from both processes are therefore reported as “not applicable”⁸¹.

Sewage sludge utilization and disposal

During the review 2010 (FCCC/ARR/2010/AUT) it was suggested to inform about the further paths of sludge utilization and disposal (after leaving the wastewater treatment plant): Most of sewage sludge is incinerated (included in 1A) or treated another way, in Austria mainly in mechanical-biological treatment plants and composting plants (included in 6D). Smaller amounts are put on agricultural soils (included in 4D). Small amounts are deposited after pre-treatment (included in 6A).

Industrial wastewater treatment

Industrial wastewater treatment and sewage sludge treatment is carried out under aerobic as well as anaerobic conditions. As CH₄ gas is usually used for energy recovery or is flared, the amount of CH₄ emissions from industrial wastewater treatment and sewage sludge treatment is negligible and therefore reported as “not applicable”. In the energy sector sewage gas is considered as an energy source.

8.3.2.2 N₂O emissions

Domestic and commercial wastewater handling

N₂O 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).

N₂O 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.

N₂O 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 (ORTHOFFER et al. 1995), in addition to the amount of wastewater treated in sewage plants, the amount of nitrogen that is denitrified is consid-

⁸¹ CH₄ emissions from domestic and commercial waste water handling reported in Table 6B solely refer to emissions from septic tanks and cesspools.

ered. 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 equivalents⁸² 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 denitrified. In 2010 this value has increased to 80% (BMLFUW 2011).

According to (ORTHOFFER et al. 1995) only 1% of the total nitrogen in the denitrification process is emitted as N₂O. The formula for estimating the N₂O emissions from wastewater treatment is:

$$N_2O \text{ Emissions} = N_2O \text{ Emissions [population connected]} + N_2O \text{ Emissions [population not connected]}$$

$$N_2O \text{ Emissions [population connected]} = (Inhabitants * P * Frac_{NPR}) * cr * DF * 0.01 * F$$

$$N_2O \text{ Emissions [population not connected]} = (Inhabitants * P * Frac_{NPR}) * (1-cr) * 0.01 * F$$

Where:

<i>CR</i>	<i>connection rate to public sewage system</i>
<i>DF</i>	<i>percentage of nitrogen that is denitrified</i>
<i>P</i>	<i>annual protein intake per capita [kg protein/ person/ a]</i>
<i>Frac_{NPR}</i>	<i>Fraction of nitrogen in protein (IPCC default value – 0.16 kg N/kg protein)</i>
<i>Inhabitants</i>	<i>total number of inhabitants in Austria</i>
<i>F</i>	<i>Factor [1.57 kg N₂O-N/ kg N]</i>

Finally the N₂O 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 N₂O emissions from municipal wastewater treatment plants (ORTHOFFER et al. 1995). This assumption has been verified by comparing several methods and different international approaches, considering different databases and reviewing literature (UMWELTBUNDESAMT 2007c). It is also in line with the IPCC Guidelines 2006 providing a factor for industrial and commercial co-discharged protein of 1.25 (AUT: 1.30) and stating that N₂O emissions from industrial sources are believed to be insignificant (page 6.27).

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 – BMLFUW 1993, 1996, 1999, 2002) as well as situation reports and questionnaires on the disposal of urban wastewater and sludge (BMLFUW 2006, BMLFUW 2008, BMLFUW 2009, BMLFUW 2010, BMLFUW 2011). Missing data in between were interpolated. The data for the daily protein intake are taken from FAO statistics⁸³, the number of inhabitants is provided by STATISTIK AUSTRIA.

⁸² Abwasseremissionsverordnung für kommunales Abwasser (BGBl. 210/1996)

⁸³ <http://www.fao.org/economic/ess/food-security-statistics/en/>

Table 260: Parameters used for the calculation of N₂O emissions for 1990–2010

	Connection rate to municipal sewage systems [%]	Denitrification rate [%]	Protein intake [g/day/capita]	Total Inhabitants
1990	59.0%	0.1	103 ^{c)}	7 677 850
1991	60.0% ^{a)}	0.1	103 ^{c)}	7 754 891
1992	63.4%	0.1	103 ^{c)}	7 840 709
1993	66.8%	0.1	104	7 905 632
1994	70.1%	0.18	105	7 936 118
1995	73.5% ^{a)}	0.27	106 ^{c)}	7 948 278
1996	76.0%	0.35 ^{a)}	106 ^{c)}	7 959 016
1997	78.4%	0.40	106 ^{c)}	7 968 041
1998	80.9% ^{a)}	0.46	108	7 976 789
1999	82.6%	0.51 ^{a)}	109	7 992 323
2000	84.3%	0.60	111 ^{c)}	8 011 566
2001	86.0% ^{b)}	0.68 ^{a)}	111 ^{c)}	8 042 293
2002	87.5%	0.68	111 ^{c)}	8 082 121
2003	88.9% ^{b)}	0.68	110	8 118 245
2004	88.9%	0.68 ^{b)}	108	8 169 441
2005	88.9%	0.73	107 ^{c)}	8 225 278
2006	91.7% ^{b)}	0.77 ^{b)}	107 ^{c)}	8 267 948
2007	92.2%	0.78	107 ^{c)}	8 300 954
2008	92.8% ^{b)}	0.79 ^{b)}	107	8 336 549
2009	92.8%	0.80	107	8 363 040
2010	92.8%	0.80 ^{b)}	107	8 387 742

^{a)} Source: Austrian reports on water pollution control (Gewässerschutzberichte – BMLFUW 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); Situation report on the disposal of urban wastewater and sludge (BMLFUW 2010); Urban Wastewater Treatment Directive (91/271/EEC) – Questionnaire 2011: Status of Implementation in Austria (BMLFUW 2011). Values in between are inter- or extrapolated

^{c)} Food and Agriculture Organisation of the UN: <http://www.fao.org/faostat/foodsecurity> (13.09.2010)

8.3.3 Recalculations

An update of the denitrification rate became available for 2010, recalculating the N₂O emissions of 2009 too due to interpolation between 2008 and 2010 (+ 0.005 Gg resp. 0.6%). No recalculations have occurred with respect to CH₄ emissions.

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 CO₂ emissions from waste are caused by waste incineration. The share in total emissions from waste is 0.8% for the year 1990 and 0.1% for the year 2010.

In Austria waste oil has been incinerated in especially designed so called “USK-facilities” (Umweltschutzkomponenten GmbH). The emissions of waste oil combustion for energy recovery (e.g. in cement industry) are reported under fuel combustion. In 2002, the Austrian waste incineration regulation⁸⁴ came into force, introducing strong limits (from 2005 on⁸⁵) for air pollution for all kind of waste incineration plants without any limit of size. The facilities which do have the allowance for incineration of waste oil other than cement plants and large waste incineration plants were only 5 in the year 2010.

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 261: Greenhouse gas emissions from Category 6.C.

	CO ₂ [Gg]	CH ₄ [Gg]	N ₂ O [Gg]	CO ₂ equiv. [Gg]
1990	26.89	0.003	0.0004	27.09
1991	23.40	0.003	0.0004	23.58
1992	10.86	0.001	0.0001	10.91
1993	10.60	0.000	0.0001	10.64
1994	10.65	0.000	0.0001	10.69
1995	10.97	0.000	0.0001	11.01
1996	11.30	0.000	0.0001	11.33
1997	11.62	0.000	0.0001	11.66
1998	11.94	0.000	0.0001	11.98
1999	12.26	0.000	0.0001	12.30
2000	12.26	0.000	0.0001	12.30
2001	12.26	0.000	0.0001	12.30
2002	12.26	0.000	0.0001	12.30
2003	12.26	0.000	0.0001	12.30

⁸⁴ Abfallverbrennungs-(Sammel-)Verordnung (AVV; BGBl. II Nr. 389/2002 i. d. g. F.): Verordnung des Bundesministers für Land- und Forstwirtschaft, Umwelt und Wasserwirtschaft und des Bundesministers für Wirtschaft und Arbeit über die Verbrennung von Abfällen.

⁸⁵ Old facilities had to conform to the new regulation 2005 at the latest.

	CO ₂ [Gg]	CH ₄ [Gg]	N ₂ O [Gg]	CO ₂ equiv. [Gg]
2004	12.26	0.000	0.0001	12.30
2005	12.26	0.000	0.0001	12.30
2006	10.15	0.000	0.0001	10.18
2007	8.12	0.000	0.0001	8.15
2008	6.09	0.000	0.0001	6.11
2009	4.06	0.000	0.0000	4.07
2010	2.03	0.000	0.0000	2.04
<i>Trend 1990–2010</i>	-92%	-98%	-96%	-92%

8.4.2 Methodological Issues

CORINAIR methodology is applied: the quantity of waste is multiplied by an emission factor for CO₂, CH₄ and N₂O.

8.4.2.1 Emission factors

National emission factors for CH₄ are derived from residual fuel oil VOC emission factors (BMW-EB 1990, BMW-EB 1996, UMWELTBUNDESAMT 2001a). N₂O emission factors are taken from a national study (ORTHOFFER et al. 1995).

For waste oil, the same CO₂ emission factor as for 1 A 1 a heavy oil (CO₂: 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 CO₂ emission factor is calculated by means of default assumptions from (IPCC-GPG 2000) as presented in Table 262.

Table 262: 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 ₂ O [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

8.4.2.2 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 2005 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.

Since 2005 the Austrian waste incineration regulation gives strong limits for air pollution for all kind of waste incineration without any limit of quantity. Since then all operators which do have an allowance for incineration of a specific type of waste needs to be registered in a federal database. The number of waste incineration plants which are not considered under sector 1.A is:

- Waste oil: 8
- Clinical waste: 1
- Municipal solid waste: None

The average yearly quantity of each waste incineration plant has been estimated as 500 t for hazardous clinical waste (plastics only). For waste oil the maximum USK facility capacity of 60.8 t per year (UMWELTBUNDESAMT 2001d) has been selected as activity data for 2010. Activity data for the years 2006 – 2009 has been interpolated.

Table 263: Activity data for IPCC Category 6 C Waste Incineration.

Year	Municipal Waste [Mg]	Clinical Waste [Mg]	Waste Oil [Mg]
1990	22 000	9 000	2 200
1991	22 000	7 525	1 500
1992	0	6 050	1 800
1993	0	4 575	2 100
1994	0	3 100	2 500
1995	0	3 100	2 600
1996	0	3 100	2 700
1997	0	3 100	2 800
1998	0	3 100	2 900
1999 – 2005	0	3 000	3 000
2006	0	2 500	2 500
2007	0	2 000	2 000
2008	0	1 500	1 500
2009	0	1 000	1 000
2010	0	500	500

The following table shows activity data of waste incineration with energy recovery.

Table 264: Activity data for waste incineration with energy recovery.

Year	1.A.1.a Public Electricity and Heat ¹⁾			1.A.2.f Cement Industry and blast furnaces ²⁾		1.A.2 Manuf. Industries ³⁾
	MSW [Mg]	hazardous waste [Mg] ⁴⁾	sewage sludge [Mg]	Industrial waste [Mg]	of which waste oil [Mg]	Ind. Waste [TJ]
1990	299 256	80 000	55 000	59 422	11 716	3 220
1991	341 001	80 000	55 000	66 552	22 069	4 556
1992	403 307	80 000	55 000	78 803	24 141	5 271
1993	421 907	72 500	64 500	78 568	21 273	4 179
1994	442 479	75 000	61 600	82 658	25 047	4 726
1995	441 502	71 337	60 672	86 998	28 675	5 270

Year	1.A.1.a Public Electricity and Heat ¹⁾			1.A.2.f Cement Industry and blast furnaces ²⁾		1.A.2 Manuf. Industries ³⁾
	MSW [Mg]	hazardous waste [Mg] ⁴⁾	sewage sludge [Mg]	Industrial waste [Mg]	of which waste oil [Mg]	Ind. Waste [TJ]
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	944 948	103 058	58 979	203 616	27 028	12 124
2006	1 180 898	113 695	60 216	261 474	21 697	12 291
2007	1 124 139	109 724	62 376	300 664	23 996	11 851
2008	1 146 547	95 548	60 082	297 133	22 206	15 280
2009	1 319 681	96 505	54 243	331 174	14 881	14 819
2010	1 368 311	109 772	57 002	293 268	21 911	19 056

¹⁾ Umweltbundesamt, Statistik Austria 2008.

²⁾ (HACKL & MAUSCHITZ 1995, 1997, 2001, 2003, 2007, MAUSCHITZ 2004, 2009, 2010), From 2005 onwards ETS data including usage for blast furnaces.

³⁾ 1.A.2.f other fuels – activity data

⁴⁾ including waste oil and clinical waste

8.4.2.3 Recalculations

Activity data for waste oil and clinical waste has been updated for the years 2006 – 2009. In the previous submission activity data 2005 was selected for 2006 – 2009.

8.5 Other waste (CRF Category 6.D)

Emission: CH₄, N₂O

Key Source: No

In this category biological treatment of solid waste is considered. This category includes CH₄ and N₂O emissions from mechanical-biological treatment of residual waste and composted waste. Emission data is presented in Table 265 for the period from 1990 to 2010.

Both CH₄ and N₂O emissions increased over the observed time period as a result of the increasing amount of composted as well as mechanical-biologically treated waste.

Table 265: Greenhouse gas emissions from 'other waste' 1990–2010

	CH ₄ emissions [Gg]	N ₂ O 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

	CH ₄ emissions [Gg]	N ₂ O emissions [Gg]	Total [Gg CO ₂ eq.]
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	2.51	0.35	160.28
2009	2.53	0.35	161.37
2010	2.54	0.35	161.73
<i>Trend 1990-2010</i>	<i>388%</i>	<i>358%</i>	<i>368%</i>

8.5.1 Methodological Issues

Emissions were estimated using a simple country specific methodology. Emissions were calculated by multiplying the quantity of waste by the corresponding emission factor.

Two different fractions were considered:

- residual waste treated in mechanical-biological treatment (MBT) plants
- composted waste: bio-waste collected separately, loppings, home composting

8.5.1.1 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 266: 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	UMWELT-BUNDES-AMT 2001e	378 796		244 587		732 273	
2000	1 703	253 660	inter-polated	374 271	303 239	771 773			
2001	1 928	241 648		399 090	361 890	944 412			
2002	2 150	229 636		422 126	420 542	1 117 051			
2003	2 362	217 625		433 911	479 194	1 289 691			
2004	2 979	487 623	UMWELT-BUNDES-AMT 2008d	491 670	BAWP (BMLFUW 2006)	537 845	1 462 330	Calculated on basis of Status Report* 2008**	
2005	3 236	623 393		543 420	inter-polated	596 497	1 472 325		
2006	3 391	660 231		595 170	Status Report* 2007	655 148	1 479 963		
2007	3 503	684 322		618 570	Status Report* 2008	713 800	Status Report* 2008		1 485 871
2008	3 470	619 495	inter-polated	650 700	Status Report* 2009	699 400	Status Report* 2009	1 500 579	Calculated on basis of Status Report* 2008**
2009	3 489	554 668	BAWP (BMLFUW 2011)	752 100	BAWP (BMLFUW 2011)	677 400	BAWP (BMLFUW 2011)	1 505 000	BAWP (BMLFUW 2011)
2010	3 497	554 668	Same as 2009	754 897	Calculated on basis of BAWP (BMLFUW 2011)	677 400	Same as 2009	1 509 794	Calculated on basis of BAWP (BMLFUW 2011)**

^{j)} Annual updates (2007, 2008, 2009) of the Federal Waste Management Plan 2006 (BUNDESBFALLWIRTSCHAFTSPLAN - BMLFUW 2006a)

^{**)} In Status Report 2008 and BAWP 2011 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, 2008 and 2010 too

8.5.1.2 Emission factors

Due to different emission factors in different national references an average value was used for both fractions of biologically treated waste.

Table 267: Emission factors for 'other waste'

	CH ₄ [kg/t FS]	N ₂ O [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

Recalculations of the years 2008 (- 2.8 Gg CO₂ eq.) and 2009 (- 5.8 Gg CO₂ eq.) are mainly due to updated data on waste amounts treated in mechanical-biological treatment plants 2009 (2008: interpolated value), delivered by a survey among operators of MBT plants carried out 2011 (published in BAWP 2011).

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 2009. The implications of the recalculations for emission levels by category for CO₂, CH₄, N₂O 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 sub-chapters 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)

9.1.1.1.1 Combustion Activities (1 A)

Stationary sources

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

Revisions affect the years from 1999 onwards with the following significant changes:

Hard coal

Revision of final consumption 2009 (-0.5 PJ) which affects category *1.A.4 Other Sectors*.

Coking coke

Revision of final consumption 2009 (-0.6 PJ) which affects category *1.A.4 Other Sectors*. Revision of non energy use 2009 (-2.6 PJ) which affects category *1.A.2.a Iron and Steel*.

Residual fuel oil

Revision of final consumption 2009 (-2.7 PJ) which affects categories *1.A.2 Manufacturing industries and construction* and *1.A.4 Other Sectors*.

Kerosene

Harmonization of international bunkers fuel consumption with the output of the inventory bottom up model for air transport.

Motor Gasoline

Revision of final consumption 2009 (-3.0 PJ) which affects category *1.A.3.b Road Transportation*.

Natural Gas

Revision of gross inland consumption 2002 – 2005 (between -3.8 PJ to +10 PJ) and 2009 (+1.5 PJ). For the year 2009 final energy consumption (1.A.4 and 1.A.2) has been revised by -12.3 PJ, the transformation sector (1.A.1.a) has been revised by +0.9 PJ, energy industries (1.A.1.b and 1.A.1.c) has been revised by +9.0 PJ and non energy use has been revised by +4.0 PJ.

For 2005 to 2009 the non energy use of natural gas which could not be allocated to process emissions under *2.B.1 Ammonia Production* is now considered under *1.A.2.f Other Manufacturing Industries*.

Biomass

Revision of log wood final consumption 2001 – 2009 (-3.3 PJ) which affects category *1.A.4 Other Sectors*. Revision of other solid biomass gross consumption 2005 (-4.0 PJ) and 2009 (+3.7 PJ). This affects the transformation sector (1.A.1.a) as well as final consumption allocated to *1.A.2 Manufacturing Industries and Construction* and *1.A.4 Other Sectors*.

Mobile sources

Update/Improvement of activity data

In 2010, the following updates have been implemented in the transport emission calculation models GLOBEMI and GEORG which result in revised emission data for the whole time series:

1.A.3.b Road Transport

- An update of the quantity structure of road transport (result of new traffic census) resulted in an increase of the transport volume (+ 2%) and consequently of fuel consumption (+0.9 %) in 2009 compared to previous submission. These data has been generated from automatic vehicle counting checkpoints on highways.
- An adaption of out-dated age pattern and failure rates of the Austrian vehicle fleet to actual fleet structure data from national statistics has lead to an adjustment of the Austrian inland fleet towards newer vehicles.
- Update of statistical energy data, particularly the biodiesel/alternative fuel consumption.

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

Activity data of mobile machinery (especially in industry) has been updated for the whole time series and adjusted downwards according to the revised national energy balance.

Update of methodology and emission factor

1.A.3.b Road Transport

Adaptation of the specific CO₂ emission factors of passenger cars according to the national CO₂ monitoring data for the Austrian fleet.

1.A.3.d Navigation

An improved method was introduced for separate reporting of emissions/activity data from national and international navigation. The calculation method is based on statistical data expressed in national tkm and leads to less emissions from national navigation.

9.1.1.1.2 Fugitive Emissions (1 B)

No recalculations have occurred in this sector.

9.1.1.2 Industrial Processes (Sector 2)

2.A.4 Soda Ash Production and Use

The data on total marketed soda ash use is provided by Solvay Austria GmbH by personal communication. Data for 2009 had to be revised as in hindsight a strong decrease in soda ash production due to the economic crises had become apparent. This leads to a downward change in emissions.

2.B.1 Ammonia Production

Plant specific data on natural gas use for the production of Ammonia for the years 1990-2010 became available in 2011. This leads to a minor change in emissions for the whole time series (upwards and downwards).

2.C.1 Pig Iron and Electric Furnace Activity

Activity data for 2008 and 2009 was updated as revised data of the energy balance became available in 2011. This leads to a minor change in emissions. Activity data on electric furnace activity from 2005-2010 also became available. This leads to minor changes in IEFs.

2.F.1/2/3/4/5 ODS Substitutes (HFCs)

Updated activity data for 2009 as well as new information on lifetime on some refrigeration equipment became available. This leads to minor changes in emissions.

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 for 2009.

Activity data concerning non-solvent use and the solvent content of products has been updated by surveys conducted at companies and associations.

9.1.1.4 Agriculture (Sector 4)

Improvements of methodologies and emission factors

4.B Manure management – CH₄

In response to a question raised by the ERT during the Centralized Review 2011, the estimations now consider methane losses from anaerobic digesters. In the calculations, the methane conversion factor (MCF) of anaerobic digesters was increased from 0% to 2%, resulting in higher CH₄ emissions.

Additionally, only the number of biogas plants under contract for electricity supply has been taken as activity data to ensure a conservative estimate (Ökostrombericht 2011).

9.1.1.5 LULUCF (Sector 5)

Revision of the data series for LULUCF are due to the following changes:

5.A Forestland

The intermediate interpolation steps for increment and drain between the NFI observation periods were deleted. There is no logic for the validity of such interpolation steps since increment and drain do not change linearly across time. So, the NFI increment and drain results are taken as a basis for the full NFI observation period and the single year values are estimated then from these average annual NFI results for the single NFI observation periods with the help of related annual indices.

The whole time series was recalculated on basis of partly new biomass functions. We used slightly improved functions for the branch biomass and a modified function for the root biomass. It was realized that the previously used function for the root biomass from Wirth et al. (2004) leads to unrealistic high root biomasses for dimensions with higher DBH due to an extreme rise of the shape of the curve at larger DBHs. This had a significant impact on the results for increment biomass, but also on the results for drain biomass. So, a different root function from Wirth et al. (2004) was selected which includes besides DBH also the tree age as explaining parameter and leads to more realistic estimates for the root biomass. The use of the new functions leads to approximately 12 % lower net biomass removals of sector 5.A.1 for the whole time series compared to the estimates of previous submissions.

For submission 2012 litter and soil C stock changes of sector 5.A.1 were estimated and reported for the first time. This was done with the Yasso model and with data for litter input as estimated on basis of the results of the Austrian NFIs 1986/90, 1992/96, 2000/02 and 2007/09 and on basis of the results of the Austrian forest soil surveys. According to the model results the litter plus soil of sector 5.A.1 was an emission source in the whole time series since 1990 with an annual average C stock loss of 0.2 t C per ha and year and with total annual emissions of approximately 0.7 Mt C per year.

More stratified estimates of the soil C stock changes were estimated for all land-use-change subcategories to and from forests for submission 2012. The soil C stock changes were stratified according to the specific soil C pools of different land use forms (as in previous submissions), and an additional stratification of the soil and litter C pools according to Austrian growth regions on basis of the results of the Austrian soil surveys was carried out. For these estimates, the LUC areas to and from forests according to the NFIs were also further stratified according to growth regions on basis of the NFI results (in addition to the stratification according to different previous or post land-use forms). These further stratified estimates have also a significant impact on the soil C stock changes of the LUC-subcategories to and from forest lands compared to previous estimates. The sink of the mineral soil C pool of sub-sector 5.A.2 is 40 % lower, those of the litter pool 60 % higher compared to previous submissions. On the other hand, the total emissions from mineral soil from all subcategories with LUC from forest to other land uses are in submission 2012 25 % lower, those of the litter pool 5 % higher than in previous submissions (also due to the changed estimate assuming an oxidation of the whole litter layer in the year of LUC instead of 20-years decay time as in previous).

For the submission 2012, the results of NFI 2007/09 were for the first time available. On basis of these results, biomass increment and drain, changes in dead wood stocks and all LUC areas to and from forests for the years from 2002 on were revised. The NFI 2007/09 showed a significant increase in harvest in these years. In previous submissions the average results of the NFI 2000/02 were reported for these years. So, the use of the new NFI results causes significant lower biomass net sinks for sector 5.A.1 in the years since 2002 than in previous submissions.

In accordance with the conclusions and recommendations of the “Report of the technical assessment of the forest management reference level submission of Austria submitted in 2011”, these improvements and updating steps will have also an impact on the Austrian forest management reference level and trigger related adjustments of this reference level. The estimates for the 5.A.1 litter and soil C pool changes need to be considered in the reference level revision. Furthermore, adjustments of the reference levels due to the improved expansion ratios from stemwood to total tree biomass are needed. Then, it was also realised that the projected harvest rates do not account for the full biomass drain, but only for the harvest of “useable” trees. In addition, there exists also a biomass drain due to mortality. This drain will be added to the projected harvest rates to account for the full biomass drain in the reference level estimates and in order to achieve consistency between the reference level and the historic values.

5.B Cropland

The cropland sector was also affected by the new NFI results because the LUC areas from forest land to cropland since 2002 and the related emissions/removals were revised on basis of the new NFI results. In addition, the more stratified estimates of the soil C stock changes of such LUC lands for the whole time series lead to a revision of the related emissions/removals (see chapter Forestland). The whole time series of such LUC was revised

due to the changed estimate assuming an oxidation of the whole litter layer in the year of LUC instead of 20-years decay time as in previous submissions.

5.C Grassland

The grassland sector was also affected by the new NFI results because the LUC areas from forest land to grassland since 2002 and the related emissions/removals were revised on basis of the new NFI results. In addition, the more stratified estimates of the soil C stock changes of such LUC lands for the whole time series lead to a revision of the related emissions/removals (see chapter Forestland). The whole time series of such LUC was revised due to the changed estimate assuming an oxidation of the whole litter layer in the year of LUC instead of 20-years decay time as in previous submissions.

5.D Wetlands

The wetlands sector was also affected by the new NFI results because the LUC areas from forest land to wetlands since 2002 and the related emissions/removals were revised on basis of the new NFI results. In addition, the more stratified estimates of the soil C stock changes of such LUC lands for the whole time series lead to a revision of the related emissions/removals (see chapter Forestland). The whole time series of such LUC was revised due to the changed estimate assuming an oxidation of the whole litter layer in the year of LUC instead of 20-years decay time as in previous submissions.

Furthermore, for area consistency reasons also the LUC areas from other categories to wetlands and, as a consequence, the related emissions/removals had to be revised due to the new NFI results.

5.E Settlements

The settlements sector was also affected by the new NFI results because the LUC areas from forest land to settlements since 2002 and the related emissions/removals were revised on basis of the new NFI results. In addition, the more stratified estimates of the soil C stock changes of such LUC lands for the whole time series lead to a revision of the related emissions/removals (see chapter Forestland). The whole time series of such LUC was revised due to the changed estimate assuming an oxidation of the whole litter layer in the year of LUC instead of 20-years decay time as in previous.

Furthermore, for area consistency reasons also the LUC areas from other categories to settlements and, as a consequence, the related emissions/removals had to be revised due to the new NFI results.

5.F Other land

The other land sector was also affected by the new NFI results because the LUC areas from forest land to other land since 2002 and the related emissions/removals were revised on basis of the new NFI results. In addition, the more stratified estimates of the soil C stock changes of such LUC lands for the whole time series lead to a revision of the related emissions/removals (see chapter Forestland). The whole time series of such LUC was revised due to the changed estimate assuming an oxidation of the whole litter layer in the year of LUC instead of 20-years decay time as in previous submissions.

Furthermore, for area consistency reasons also the LUC areas from grassland to other land and, as a consequence, the related emissions/removals had to be revised due to the new NFI results.

9.1.1.6 Waste (Sector 6)

Update of activity data

6.C Waste incineration

The amount of waste oil and clinical waste incinerated in small facilities has been revised based on updated information and is now lower than in previous estimates.

6.D Other waste

Emissions for the years 2008 and 2009 have been recalculated on basis of new/updated activity data, mainly on waste amounts treated in mechanical biological treatment plants.

9.1.2 KP-LULUCF inventory

The ARD areas for the years since 2002 and the related emissions/removals were revised on basis of the new NFI results. In addition, the regionally stratified estimates of the soil and litter C stock changes of the ARD lands for the whole time series led to a revision of the related emissions/removals at ARD lands. The whole time series of D was revised due to the changed estimate assuming an oxidation of the whole litter layer in the year of D instead of 20-years decay time as in previous submissions. A mistake in the estimates of the N₂O emissions due to soil disturbance associated with D to cropland in last year's submission was corrected.

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 2009 which are submitted this year differ slightly from data reported previously.

The following table presents the recalculation difference with respect to last years' submission for each gas (positive values indicate that this year's estimate is higher).

Table 268: Recalculation difference of Austria's greenhouse gas emissions compared to the previous submission.

	1990 (Base year)	2009
	Recalculation Difference [%]	
Total	-0.01%	-0.40%
CO ₂	-0.01%	-0.46%
CH ₄	0.01%	-0.05%
N ₂ O	-0.01%	-0.14%
HFC, PFC, SF ₆	0.00%	0.07%

Emissions without LULUCF

National total emissions (excluding LULUCF) for the **base year** have slightly been revised since last years' submission (-0.01%). The value for **2009** estimated this year is 0.4% lower than those submitted last year. However, the trend 1990-2009 remains quite the same (NIR 2011: +2.4%; NIR 2012: + 2.0%).

The lower emissions of the year 2009 are mainly attributable to recalculated CO₂ emissions occurring in the sector energy, due to revisions of the energy balance. In addition a shift of natural gas consumption (12 PJ) from 1.A.4 Other sectors to 1.A.1.b Petroleum refining, 1.A.1.c Other energy industries and 1.A.2.f Other manufacturing industries has lead to revised data on sub-sector level for 2009.

Revisions of CH₄ and N₂O are of minor importance, and mainly arise in the sectors 1.A.4. Other sectors (revision energy balance) and 4 Agriculture (biogas leakage included). A description of the recalculations is given in the relevant sectoral Chapters.

Table 269 presents the recalculation differences of national total GHG emissions for all years. The implications of recalculations for emission levels by category for CO₂, CH₄, N₂O and FCs and the recalculation differences of national total emissions by gas are presented in Annex 5.

Table 269: Recalculation Difference of National Total GHG Emissions.

Year	National Total GHG emissions without LULUCF		
	Submission 2011 [Gg CO ₂ e]	Submission 2012 [Gg CO ₂ e]	Recalculation Difference [%]
1990*	78 171	78 162	-0.01%
1991	82 214	82 203	-0.01%
1992	75 514	75 442	-0.09%
1993	75 498	75 488	-0.01%
1994	76 386	76 373	-0.02%
1995	79 811	79 806	-0.01%
1996	82 895	82 888	-0.01%
1997	82 476	82 470	-0.01%
1998	81 869	81 863	-0.01%
1999	80 254	80 254	0.00%
2000	80 476	80 470	-0.01%
2001	84 343	84 344	0.00%
2002	86 159	85 992	-0.19%
2003	91 894	91 882	-0.01%
2004	90 927	91 458	0.58%
2005	92 884	92 880	0.00%
2006	90 103	90 059	-0.05%
2007	87 373	87 366	-0.01%
2008	86 961	86 956	-0.01%
2009	80 059	79 739	-0.40%

*Base year is 1990 for all gases

9.2.2 KP-LULUCF inventory

Due to the changes described in Chapter 10.3.1.4 data for 2008 and 2009 were recalculated as presented in Table 270:

Table 270: Differences between submission 2011 and 2012 in KP-LULUCF reporting (Article 3.3 activities)

Net CO ₂ emissions/removals				
Year		Submission 2011 [Gg]	Submission 2012 [Gg]	Recalculation Difference [Gg CO ₂]
Afforestation and Reforestation				
2008	CO ₂	- 2 530.67	- 2 488.47	- 42.20
2009	CO ₂	- 2 648.33	- 2 608.25	- 40.08
Deforestation				
2008	CO ₂	1 223.61	1 361.63	- 138.02
2009	CO ₂	1 263.77	1 377.60	- 113.83
2008	N ₂ O*)	0.00022	0.0000092	0.000010
2009	N ₂ O*)	0.00023	0.0000099	0.000010

*) N₂O emissions from disturbance associated with land-use conversion to cropland

In Submission 2012 net CO₂ removals of the year 2009 were 11 % lower than in last years' submission (decrease from 1 385 Gg CO₂ to 1 231 Gg CO₂).

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 269 and Figure 34, Austria's greenhouse gas emissions as reported in the UNFCCC submission 2012 are slightly different compared to the values reported last year due to recalculations. The national total excluding LULUCF for the base year is 0.01% lower than those reported last year. The national total for 2009 is 0.40% lower than those reported in last years' submission. The trend for 1990 to 2009 reported last year (+2.4%) fairly corresponds to those based on this years' figures (+2.0%).

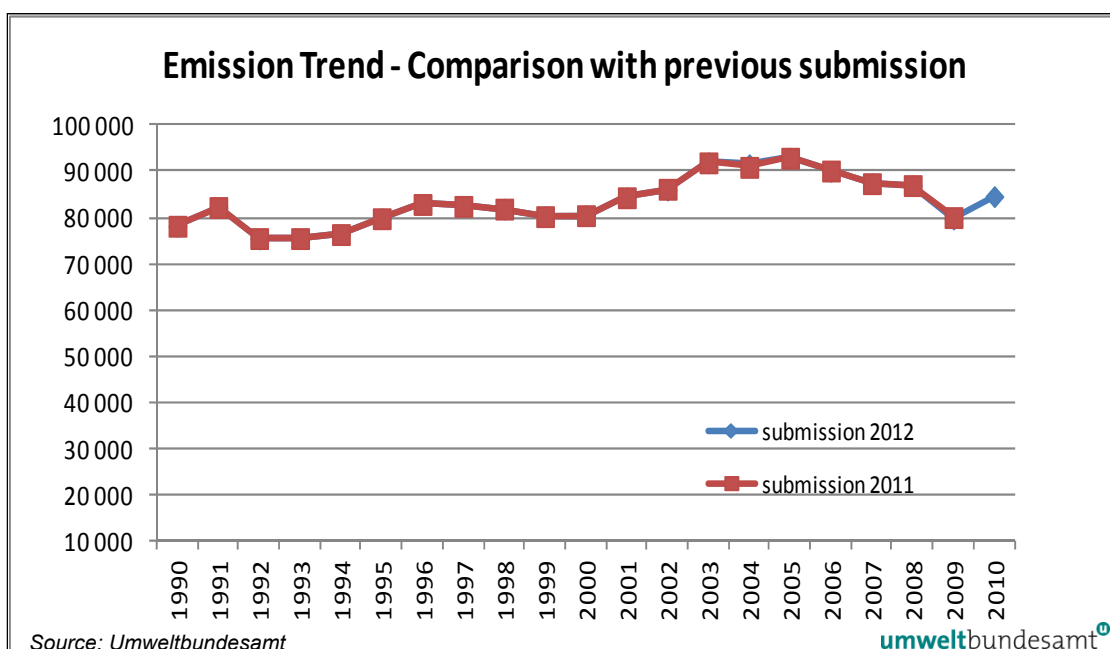


Figure 34: Emission estimates of the submission 2011 and recalculated values of the submission 2012.

9.3.2 KP-LULUCF inventory

Data on Article 3.3. activities are only reported for the years 2008, 2009 and 2010.

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 the table below.

Table 271: Improvements made in response to the UNFCCC review process.

Finding	Reference	Improvement made
General		
<u>Key Category Analysis:</u> The ERT strongly encourages Austria to conduct a tier 2 key category analysis as soon as it has a complete set of uncertainty estimates for all categories.	ARR 2010 § 20	As a complete set of uncertainty estimates for all categories is available now, a tier 2 category has been conducted for NIR 2012.
<u>Uncertainty Analysis:</u> The ERT reiterates the recommendation made in previous reviews to include the whole LULUCF sector as part of the uncertainty analysis and cover all categories of the inventory.	ARR 2010 § 22	In NIR 2012 the whole LULUCF sector is included in the uncertainty analysis.
<u>Recalculations:</u> The ERT reiterates the recommendation that Austria includes explanations for recalculations in CRF table 8(b)	ARR 2010 § 23	AUT has filled out CRF table 8(b) for 2008 in NIR 2011 and will also include explanations for 2009 in the CRF accompanying NIR 2012.
Energy – stationary		
The ERT recommends that Austria use country-specific NCVs also in the reference approach.	ARR 2009 § 42	All values used are now CS.
Energy – mobile		
Aviation: For the 2009 annual inventory submission the estimates of emissions from aviation for 2000 onwards were updated using detailed information from Statistik Austria (change to CORINAIR Tier 3a bottom up methodology).	ARR 2009 § 43 ARR 2010 § 48	Austria has already given explanations on this issue in its NIR 2010, but has further elaborated on this in NIR 2011.
The ERT recommends that Austria explains in more detail how it has ensured consistency across the time series from 1990 to provides explanations on how it has ensured consistency across the time-series when performing the recalculations.		
Waterborne navigation/international bunker fuels: The ERT recommends that Austria improve the transparency with regard to the sources of data used to differentiate between domestic and international marine fuel use.	ARR 2010 § 49 Centralised Review 2011 (Saturday paper)	The time-series of fuel consumption of domestic navigation has been reassessed and domestic navigation recalculated with a new bottom-up approach (now domestic navigation includes all navigation between harbours located in Austria expressed in x-ton kilometers)
The ERT recommends to improve the transparency used to define the split between domestic navigation and marine international bunker.		
Fugitive Emissions		
No improvements have been required in response to the UNFCCC Review process.		

Finding	Reference	Improvement made
Industrial Processes		
Between 2005 and 2008 the CO ₂ IEF for electric arc furnaces varies between 72 kg/t steel and 82 kg/t steel, thus being considerably higher than the average value used for the period 1990–2004. The ERT recommends that Austria validate the consistency of the time series and provide explanations for the high variation in the CO ₂ IEF in its next annual submission.	ARR 2010 § 59	Explanation on this is provided in NIR 2012.
Ferroalloys production: in the case that AD is not available in time for inclusion in the current submission, the ERT recommends that Austria considers the use of proxy data that correlate best for estimating emissions from this category.	ARR 2010 § 64	No proxy data, but preliminary data have been taken for the year 2010 based on personal communication with the British Geological Survey. This will also be done in future NIR when published data is not available in time.
In Austria ferromolybdenum, ferrovanadium and ferronickel are produced. As an EF is available only for ferronickel (1.36 t CO ₂ /t), this EF is also applied for the remaining ferroalloy products. In order to increase accuracy, the ERT encourages Austria to use a mass balance approach based on data collected from industry for the calculation of the estimates in its next annual submission.	ARR 2010 § 65	Explanation on this given in NIR 2012.
Solvents and Other Product Use		
No improvements have been required in response to the UNFCCC Review process.		
Agriculture		
The ERT asks whether it is possible to use the relative areas of individual crops within the total cereals area to provide a breakdown of the area burnt on a crop by crop basis.	ARR 2010 § 78	Austria considered the recommendation in NIR 2011.
An error in the calculation of N ₂ O emissions from certain crop residues has resulted in increasing the estimated emissions from crop residues for 1990 and 2007.	ARR 2010 § 74	Austria has already corrected this error in submission 2010.
During the Centralised Review 2011 Austria were asked whether there are any specific studies conducted that support the hypothesis that there are no methane emissions during or after the fermentation process particularly from leakage.	Centralised Review 2011	Estimations now consider methane losses from anaerobic digesters.
LULUCF		
The ERT reiterates the recommendation made in previous review report that Austria assess uncertainties for the whole LULUCF sector.	FCCC/ARR/2010/AUT	Uncertainties for the whole LULUCF have been assessed and reported in NIR 2012.

Finding	Reference	Improvement made
CSC in Litter pool and mineral soil pool due to LUC is calculated following the equation with 20 year transition period for both LUC “to forest” and “from forest”. According to the GPG-LULUCF Chapter 3 (ex.3.3.2.2.1. p3.89), the method of litter loss estimation due to LUC to non-forest land use is stated as “Any litter and dead wood pools should be assumed oxidized following land conversion”. Thus, the applied method for “from forest” seems to be not in line with the default methodology of litter calculation.	Centralised Review 2011	The method was changed for submission 2012 to be in line with the IPCC GPG. The litter pool at LUC areas from forests is estimated to be oxidized in the year of LUC.
Waste		
Austria informed the ERT that it is planning to elaborate on the treatment of municipal sewage sludge in its next submission. The ERT strongly recommends that Austria make efforts to obtain data on sludge to reflect these data in its inventory.	ARR 2010 § 98	NIR 2012 includes information on the treatment of sewage sludge.
No improvements (resulting in changed emissions) were made in response to the UNFCCC Review process		

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.

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 272.

Table 272: 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 Report⁸⁶ Austria has decided not to elect any of the activities under Article 3.4 of the Kyoto Protocol.

⁸⁶ http://unfccc.int/files/national_reports/initial_reports_under_the_kyoto_protocol/application/pdf/at-initial-report-200611-corr.pdf

Activity coverage relating to activities under Article 3.3 and 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 to croplands	Liming	Biomass burning ⁽⁴⁾		
							N ₂ O	N ₂ O	N ₂ O	CO ₂	CO ₂	CH ₄	N ₂ O
Article 3.3 activities	Afforestation and Reforestation	R	R	R	NO	R	NO			NO	NO	NO	NO
	Deforestation	R	R	R	IE	R			R	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

Source: CRF NIR 1 – Table

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Figure 35: Activity coverage relating to activities under Art. 3.3 and 3.4 (CRF NIR 1 – Table).

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 – (BFW 2011; GSCHWANTNER et al. 2010, SCHIELER et al. 1995; WINKLER 1997)). The NFI was carried out in the periods 1961–70, 1971–80, 1981–85, 1986–90, 1992–96, 2000–02 and 2007–09. So far, the NFI periods 1986/90, 1992/96, 2000/02 and 2007–09 are the relevant ones for the Kyoto-Protocol-reporting-period. Recently, the new figures of the NFI assessment period 2007/09 were published. On basis of these new NFI results, the ARD estimates were revised for the submission 2012.

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 (see Figure 33 in UMWELTBUNDESAMT 2010d or at BFW 2005, <http://www.bfw.ac.at/rz/bfwcms.web?dok=2384>) with four permanent sample plots of 300 m² size at each grid point (see Figure 34 in UMWELTBUNDESAMT 2010d or “Abbildung 1” in the download of HAUKE & SCHADAUER 2009). Details are described in HAUKE & SCHADAUER (2009). 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 $\pm 1.2\%$. Each grid point shown in Figure 33 in UMWELTBUNDESAMT (2010d) or at BFW (2005, <http://www.bfw.ac.at/rz/bfwcms.web?dok=2384>) is terrestrially inspected during each NFI assessment for a potential afforestation 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 ($> 30 \text{ m}^2$). 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 in UMWELTBUNDESAMT 2010d or “Abbildung 5” in the download of HAUKE & SCHADAUER 2009). This does not mean that the sample plot is further subdivided into parcels of 30 m², but the 30 m² 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.

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 (since the observation period between NFI 1992/96 and NFI 2000/02). The evaluation of 2/3 of such forest boundary points led to the land use statistic shown in Table 273 and Table 274. It is assumed, that the other third follows the same distribution. For the NFI 2007/09 the detection of LUC area was accurate to a tenth at each plot and evaluated for all NFI points. The results are also shown in Table 273 and Table 274.

The total AR area between the NFI periods 1992/96 and 2000/02 was 68 000 ha and 72 000 ha between the NFI 2000/02 and 2007/09 (total forest area). The total D area for the same periods was about 32 000 ha and 42 000 ha.

Table 273: AR areas observed for the NFI periods 2000/02 and 2007/09; based on BFW (2011).

Categories of land use changes according to the IPCC GPG 2003	NFI 2000/02		NFI 2007/09	
	Land use changes to forest land (% of total conversion to forest land)	Land use changes to forest land [1000 ha]	Land use changes to forest land (% of total conversion to forest land)	Land use changes to forest land [1000 ha]
Cropland	15.7	10.7	13.0	9.3
Grassland	58.4	39.9	59.7	42.7
Wetlands	4.6	3.1	3.9	2.8
Settlements	14.0	9.6	8.4	6.0
Others	7.3	5.0	15.0	10.7
Total	100.0	68.3	100.0	71.6

Table 274: D areas observed for the NFI periods 2000/02 and 2007/09; based on BFW (2011).

Categories of land use changes according to the IPCC GPG 2003	NFI 2000/02		NFI 2007/09	
	Land use changes from forest land (% of total conversion to forest land)	Land use changes from forest land [1000 ha]	Land use changes from forest land (% of total conversion to forest land)	Land use changes from forest land [1000 ha]
Cropland	5.0	1.6	10.6	4.4
Grassland	53.0	16.4	57.9	24.1
Wetlands	3.0	0.8	3.4	1.4
Settlements	15.0	4.9	18.3	7.6
Others	24.0	8.1	9.8	4.1
Total	100.0	31.8	100.0	41.6

As shown in Table 273 and Table 274 ARDs mainly occur from or to grassland sites (58-60% or 53-58%, respectively). The land use changes from or to other categories are far below this value.

For the years before the observation period between NFI 1992/96 and NFI 2000/02 (as represented by the results of NFI 2000/02) it was assumed that the measured land use change areas show the same relative ratio of LUC distribution as assessed by the NFI 2000/02 because only the total areas of AR-lands and D-lands are available from previous NFIs.

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. For the estimates of changes in litter and soil carbon stocks the ARD areas were further stratified according to five forest growth regions (Bohemian Massif, Inner Alps, Calcareous Alps, Foothills and Alpine ridge). The area information for these LUCs is also based on the NFI results 2000/02 and 2007/09. The results are finally summed up according to the areas of LUCs as shown in Table 273 and Table 274.

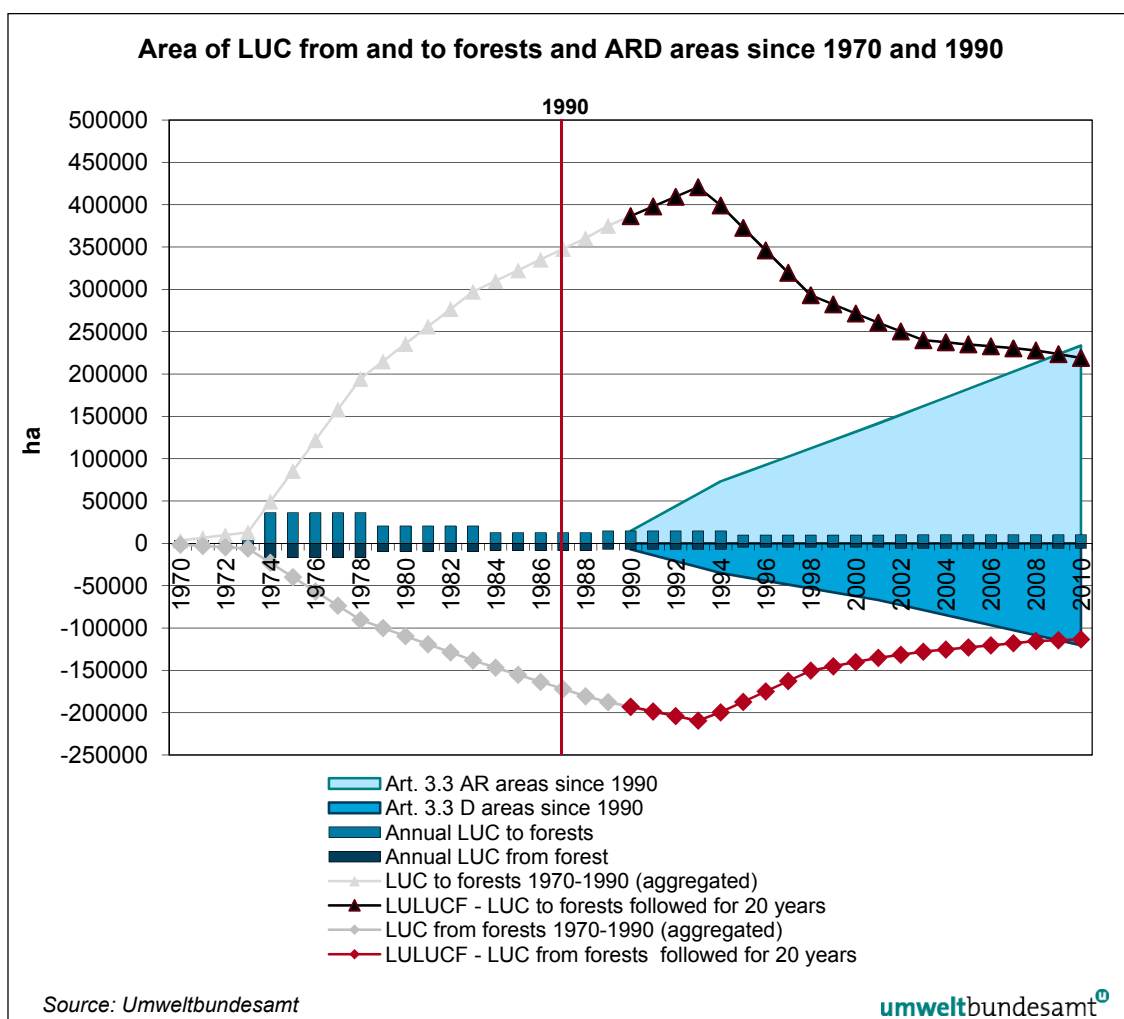


Figure 36: Areas of LUC from and to forests and ARD areas since 1970 and 1990, respectively.

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, 2000/02 and 2007/09. 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 1990-1994 the annual increase of AR area was on average 14 700 ha, between 1995 and 2001 on average 9 800 ha and between 2002 and 2008 on average 10 200 ha. In the same time periods the annual deforestation areas amounted to 7 000 ha, 4 500 ha and 5 900 ha on average.. The following Figure 37 shows the current land use transition matrix for the years 1990 to 2010.

Land transition matrix – Area change between the current and the previous year								
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)		
		(kha)						
Article 3.3 activities	Afforestation and Reforestation	223.46	NO					223.46
	Deforestation		114.36					114.36
Article 3.4 activities	Forest Management (if elected)		NA	NA				0.00
	Cropland Management ⁽¹⁾ (if elected)	NA	NA		NA	NA	NA	0.00
	Grazing Land Management ⁽²⁾ (if elected)	NA	NA		NA	NA	NA	0.00
	Revegetation ⁽⁴⁾ (if elected)	NA			NA	NA	NA	0.00
Other		10.22	5.94	NA	NA	NA	NA	8033.02
Total area		233.68	120.30	0.00	0.00	0.00	0.00	8387.00

Source: CRF NIR 2 – Table

umweltbundesamt[®]

Source: CRF NIR 2 – Table

umweltbundesamt[®]

Figure 37: Land transition matrix. Area change between the current and the previous year (CRF NIR-2 table).

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 in UMWELTBUNDESAMT (2010d) or in the download of RUSS (2004). 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.

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. com.):

The annual increment of stemwood over bark (o.b.) on LUC areas to forests was estimated with $3 \text{ m}^3 \text{ ha}^{-1}$. This value is used for the AR areas from all previous land use types. More accurate values are available with the data of the NFI 2007/09 and ARD NFI 2011/13 and will be used for the submission 2014.

The annual average loss of stemwood o.b. on D areas was estimated with $60 \text{ m}^3 \text{ ha}^{-1}$ on average for deciduous and coniferous trees. This value is used for the LUCs from forests to all other land use types. More accurate values are available with the data of the NFI 2007/09 and ARD NFI 2011/13 and will be used for the submission 2014.

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 NFI 2007/09 and ARD NFI 2011/13 carry out a very detailed measurement of the biomass gains and losses at the ARD areas so that a more accurate reassessment of the biomass gains and losses at the ARD areas will be possible for submission 2014.

Conversion factors (BEF)

In Table 275 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 biomass functions for Austria that are already used to estimate the tree biomass changes for sector 5.A.

Table 275: 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:

$$3 \cdot 0.8 \cdot 0.49 = 1.176 \text{ t C ha}^{-1} \text{ a}^{-1}$$

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:

$$60 \cdot 0.72 \cdot 0.49 = 21.168 \text{ t C ha}^{-1}$$

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 ap-

proach 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 and ARD NFI 2011/13. 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.

Litter and soil

In the submission 2012 more stratified estimates of soil and litter C stock changes were calculated for all ARD lands. The soil C stock changes were stratified according to specific soil C pools of different land use changes (like in previous submissions) and, additionally, according to five forest growth regions in Austria (Bohemian Massif, Inner Alps, Calcareous Alps, Foothills and Alpine Ridge). The calculations for the regionalised land-use-specific agricultural soil C stocks are based on the Austrian soil inventories (same sources as the results for the national values used in previous submissions). The calculations for the stratified forest soil and litter C stocks are based on the results of the EU-wide Biosoil project (BFW, 2009), which was carried out on 140 sites of the former forest soil survey (BFW, 1992). For the other land use categories than forest, cropland and grassland national estimates were applied. Table 276 gives an overview of the estimates of C stocks in mineral soils (0-50 cm) and litter according to different land uses and forest growth regions.

Table 276: Specific C-stocks ($t\ C\ ha^{-1}$) for litter and soil (0-50 cm) stratified according to five forest growth regions in Austria.

IPCC LU categories	National LU categories	Forest growth regions					Source
		Bohemian Massif	Inner alps	Calcareous alps	Foot hills	Alpine Ridge	
		t C ha ⁻¹ (0-50 cm)					
Forest - litter	Forest	40	24	24	19	26	BFW, in prep.
Forest - mi- neral soil	Forest	88	91	109	77	117	BFW, in prep.
Cropland	Cropland	56	90	80	65	90	Umweltbundes- amt, in prep.
	Vineyards	58	58	58	58	58	Gerzabek et al. 2005
	Orchards/garden land	78	78	78	78	78	Gerzabek et al. 2005
Grassland	grassland inten- sive use	75	95	100	79	94	Umweltbundes- amt, in prep.
	grassland ex- tensive use	132	130	120	139	139	Umweltbundes- amt, in prep.

Wetlands	Bogs*	500	500	500	500	500	expert judgement
	Surface waters and reed beds:	0	0	0	0	0	expert judgement
Settlements	Settlements and traffic area	60	60	60	60	60	expert judgement
	Industrial and mining areas, dumps	0	0	0	0	0	expert judgement
Other land	Alpine shrub lands	119	119	119	119	119	Körner et al. 1993
	Rocks and stone slopes:	0	0	0	0	0	expert judgement
	Other land uses	30	30	30	30	30	expert judgement

The values for forests, cropland and grassland represent regional averages which are based on Austrian soil inventories for forests (BFW 2009) 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 LANDESREGIERUNG 1994, AMT DER BURGENLÄNDISCHEN LANDESREGIERUNG 1996, AMT DER KÄRNTNER LANDESREGIERUNG 1999, compiled in the Austrian Soil Information System BORIS). The data have been stratified according to the Austrian forest growth regions (BFW, Umweltbundesamt).

The estimate and expert judgment of the soil C stocks in areas of settlements and traffic areas is based on the same approach as described in chapter 7.6.4.1.2 (1/3 of these areas are assumed to be sealed and 2/3 unsealed; unsealed areas have the same soil C stock as grassland), but the higher value for the LUCs with forests takes the higher soil depth of 0 – 50 cm into account that is used for these estimates. For the “other land uses” of “other land” (those which are not alpine shrub lands, rocks and stone slopes) we assume some C stock in soils, but due to the shallow depth of these soils only 30 t C ha⁻¹.

The NFIs 2000/02 and 2007/09 specify the LUC from and to forests in a broader range of LUC categories than the existing six major IPCC land use categories (see Table 276). Consequently, for each IPCC GPG land use change category from and to forest an area weighted mean value of C-stocks for each subcategory and growth region was calculated for each NFI period (NFI 1992/96 to 2000/02 and NFI 2000/02 to 2007/09). The area weighted mean values of C-stocks used to estimate emissions and removals from soil and litter at LUC areas from and to forest are shown in Table 277 and Table 278.

Table 277: Area weighted mean values for carbon stocks in mineral soils (0–50 cm) of ARD areas between the NFI periods 1992/96 and 2000/02 and previous NFIs

Land use categories (IPCC – GPG)	C-stocks (t ha ⁻¹) in soils (0–50 cm) ¹									
	AR areas (forest growth regions)					D areas (forest growth regions)				
	Bohemian Massif	Inner alps	Calc. alps	Foot-hills	Alpine Ridge	Bohemian Massif	Inner alps	Calc. alps	Foot-hills	Alpine Ridge
Forest	88	91	109	77	117	88	91	109	77	117
Cropland	56	90	78	65	89	56	-	-	66	83
Grassland	81	127	112	92	118	75	123	112	79	125

C-stocks (t ha ⁻¹) in soils (0–50 cm) ¹										
Land use categories (IPCC – GPG)	AR areas (forest growth regions)					D areas (forest growth regions)				
	Bohemian Massif	Inner alps	Calc. alps	Foot-hills	Alpine Ridge	Bohemian Massif	Inner alps	Calc. alps	Foot-hills	Alpine Ridge
Wetlands	0	0	0	0	0	-	0	0	0	0
Settlements	60	60	46	41	28	60	-	41	35	40
Other land	-	13	35	30	43	-	27	33	13	70

- no LUC from/to forest could be observed in these regions

Table 278: Area weighted mean values for carbon stocks in mineral soils (0–50 cm) of ARD areas between the NFI periods 2000/02 and 2007/09.

C-stocks (t ha ⁻¹) in soils (0–50 cm) ¹										
Land use categories (IPCC – GPG)	AR areas (forest growth regions)					D areas (forest growth regions)				
	Bohemian Massif	Inner alps	Calc. alps	Foot-hills	Alpine Ridge	Bohemian Massif	Inner alps	Calc. alps	Foot-hills	Alpine Ridge
Forest	88	91	109	77	117	88	91	109	77	117
Cropland	57	90	80	65	90	58	-	80	66	71
Grassland	75	124	111	86	128	75	128	108	90	130
Wetlands	0	0	0	0	0	-	0	0	-	0
Settlements	60	56	60	59	60	2	60	60	12	60
Other land	30	63	14	30	45	-	57	0	30	39

- no LUC from/to forest could be observed in these regions

The estimates of the soil C stock changes at ARD areas were split into litter (humus layer, see Table 276) and mineral soil (see Table 277 and Table 278) and follow the equations below. The changes are estimated annually on a regional basis (forest growth region) and have been summed up for each LUC subcategory in the CRF tables. For these estimates, the ARD areas consistent with the NFI results were also stratified according to the forest growth regions and the different previous or subsequent land-uses (see chapter 7.2.2.2).

Annual carbon stock changes in soils at ARD areas:

$$\Delta \text{SOC} = A * (\text{SOC}_O - \text{SOC}_{O-T}) / 20$$

ΔSOC = average annual carbon stock change in soils (t C a⁻¹) over the LUC transition period of 20 years

A = ARD area for a transition period of 20 years

SOC_O = carbon stock in soils after conversion, respectively (e.g. mineral forest soils in the Calcareous alps → 109 t C ha⁻¹, see Table 278)

SOC_{O-T} = carbon stock in soils before conversion, respectively (e.g. area weighted mean value of soil C stocks from grassland converted to forest land: 111 t C ha⁻¹, see Table 278).

Annual carbon stock changes in litter at ARD areas:

$$\Delta \text{C}_{LT} = A * (\text{C}_{LT0} - \text{C}_{LT0-t}) / T$$

ΔC_{LT} = average annual carbon stock change in litter (t C a⁻¹)

A = annual D area, respectively the AR area following a transition period of 20 years.

C_{LTo} = carbon stock in litter after conversion, (e.g. 24 t C ha⁻¹ for Calcareous alps, see Table 278)

C_{LTo-t} = carbon stock in litter before conversion, respectively

T = transition period for the litter carbon stock changes (1 year for D areas, 20 years for AR areas)

N₂O emissions from mineral soil due to D from forest land to cropland were estimated using exactly the proposed method in the IPCC GPG, chapter 3.3.2.3.1.1. The used activity data represent the total D area to cropland since 1990. The estimates are based on the related annual C stock changes in soil across 20 years transition period using the C stocks in mineral soils as given above. For the C/N ratio in the mineral soil of forests an Austrian specific value of 19 derived from the Austrian forest soil survey was taken (BFW 1992).

Planned improvements

By means of the recently carried out NFI (2007–2009) and ARD NFI (2011–2013) additional and specified data (e.g. for dead wood, detailed biomass assessments at ARD sites) are recorded to better meet the reporting requirements for Art. 3.3. This information will be available for the NIR 2014. The ARD NFI (2011-2013) will also allow a revision of the activity data for the years since the previous NFI period (2007/09).

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.

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 and ARD NFI (2011-2013). 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)

The ARD areas for the years since 2002 and the related emissions/removals were revised on basis of the new NFI results. In addition, the regionally stratified estimates of the soil and litter C stock changes of the ARD lands for the whole time series led to a revision of the related emissions/removals at ARD lands. The whole time series of D was revised due to the changed estimate assuming an oxidation of the whole litter layer in the year of D instead of 20-years decay time as in previous submissions. A mistake in the estimates of the N₂O emissions due to soil disturbance associated with D to cropland in last year's submission was corrected.

10.3.1.5 Uncertainty estimates

The assessment of the uncertainties of emissions/removals of the ARD lands is planned for submission 2014 when the ARD NFI 2011 to 2013 will have been completed.

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 2010 the following ARD activities were presumed: AR at 10 200 ha, D at 5 900 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.

In response to the Centralised Review 2010, the following Chapters (10.4.1.2–10.4.1.6) include additional information on the legal framework on forests, forest management and AR as well as a further justification related to reporting under Article 3.3 KP.

10.4.1.1 Information that demonstrates that activities under Article 3.3 began on or after 1 January 1990 and before 31 December 2012

For the ARD lands since 1 January 1990 the results of land-use changes from and to forests according to the Austrian NFI in the period 1992–96 are used. The NFI 1992–96 assessed these land use changes in comparison to the results of the previous Austrian NFI 1986–90. The resulting average annual ARD-areas were used annually from 1990 until the start of the observation period which is covered by the following NFI 2000–02. For the years after 2009 (the last year that is covered by the NFI assessment 2007–09) the average annual ARD areas of the period before are used temporarily. These areas will be changed when the results of the recently running ARD NFI 2011/13 will be available, such update is planned for the submission 2014.

10.4.1.2 Information that demonstrates that activities under Article 3.3 are direct human-induced – 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 m² 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 arboreturns, 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 land-owners 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

(2) Basal areas on which substitute afforestation (§ 18 Subsection 2) has been carried out shall be deemed to be forest within the meaning of § 13 Subsection 8 as soon as growth has been ensured.

(3) Basal areas for which funding has been granted for afforestation in accordance with the provisions of Section X shall be deemed to be forest soil from the time that promotional funds were paid out; in the case of afforestation at high altitude, i.e. the zone within five-hundred metres of altitude below the natural treeline, this shall not apply until the young plantation has been secured within the meaning of § 13 Subsection 8.

Timberline region, shelter belts

§2. (1) *The provisions of the Federal Act shall also be applied to forest plant cover in the timberline region of the forest and to shelter belts, irrespective of the nature of use of the basal areas and the site structure of the plant cover.*

(2) The timberline region of the forest shall be understood as the zone between the natural treeline and the actual line of the closed tree cover.

(3) Shelter belts are lines or rows of trees or bushes which primarily serve to protect against wind damage especially for agricultural plots and to hold snow.

Special provisions for the timberline zone and for shelterbelts

§ 25. (1) *The provisions of §§ 22 to 24 shall apply analogously to the timberline zone. In addition to this the authority shall, where local circumstances require it and this does not concern salvaging timber from acute forest damage, issue a notice stating that the felling be subject to a permit or totally prohibited. In the case of a permit, the felling shall be subject to marking performed by the authority. The notice shall be withdrawn as soon as the reasons for issuing it have ceased to apply.*

(2) Reductions in the plant cover of the timberline zone for longer than a temporary period shall require official approval. A permit shall be issued if and insofar as the plant cover does not offer a profound protective effect within the meaning of § 6 Subsection 2 lit. b. No permit is required for the removal of plant cover on basal areas which are classified as Alps or as basal areas used for agricultural purposes in the Border Land or Land Tax register and which have not become forest as a result of re-afforestation within the meaning of § 4, provided the plant cover does not offer a profound protective effect within the meaning of § 6 Subsection 2 lit. b.

(3) Official approval is also required for changing the location of the plant growth in the timberline zone by removing the plant cover and re-afforesting at another place if this plant growth of-

fers a profound protective effect within the meaning of § 6 Subsection 2 lit. b. A permit shall be granted if this change does not reduce the proportion of the sheltered area and the protective effect of the plant cover is not impaired. The permit may, if necessary, be subject to conditions and requirements.

(4) The provisions of §§ 18 to 20 shall apply analogously to the procedures to be carried out in accordance with Subsections 2 and 3.

(5) Shelterbelts are to be handled in a way that their protective function is not impaired. Felling in shelterbelts requires marking performed by the authority.

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 legal provisions out of the Austrian Forest Act are presented to demonstrate two facts:

1) It takes a defined time and/or the exceeding of defined limit values until an af-/reforestation area becomes a forest and all provisions of the Forest Act are valid for these areas, for both, AR areas that were directly planted or seeded and AR areas from natural regeneration. These provisions are also operationalized by the NFI which is the assessment system for forests and ARD. The NFI assesses forest only after exceeding defined limit values which are well in line with the legal provisions (see chapter 10.4.1.3). So, there is a time lag between the decision of stopping previous land management and the assessment as forest by the NFI as well as the counting as forest under the Austrian Forest Act. Austria does not see here any relevance with respect to “direct human induced” AR: There is no provision under Kyoto-Protocol for the AR assessment with respect to a certain (or no) time period of becoming a forest as a prerequisite for the validity as being „direct human induced“ af-/reforestation. On the contrary, directly planted AR-areas would also request some years before being assessed and accounted as forest and af-/reforestation. It is correct that a land owner can convert land that do not yet fall under the limit values of the Austrian Forest Act, however, until reaching these limit values this land is not counted as af-/reforestations, too. The decision of the land owner for af-/reforestation is only evident and accounted when the limit values are exceeded and the land is assessed as forest.

2) Certain management provisions of the Austrian Forest Act cover all areas where forest is expanding, even if the limit values given above are not yet met by the areas becoming forest. These are the provisions of section IV of the Austrian Forest Act: forest management obligations for protection from forest fire, forest pests and pollution are mandatory also before the qualification of an area as afforestation according to the related legal limit values are fulfilled (see paragraph 4 above). In addition, in the timberline zone any forest plant cover is under related forest management obligations by the Austrian Forest Act, even without meeting the limit values for plant cover or tree height (see § 2, 1 and § 25, 1-4).

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 – 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 exceeding the limit values for being forest at a land previously under different land use. 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 loses premium payments for grassland or cropland management). The provisions in the Austrian Forest Act demonstrate a general national decision by the Austri-

an legislation that any Austrian land exceeding the limit values above becomes automatically forest land with obligations for forest management. As such, the Austrian Forest Act is also a national decision that all land that is no longer cultivated (and meets the forest definition) shall be a managed forest.

Austria would also like to inform about the specific national circumstances with regard to the reward related to RMUs from afforestation. Although land-use is decided by the land-owner any RMUs generated by afforestation do not belong to the land owner but are owned by the government. Therefore there is no additional added value for the land owner linked to afforestation. The rationale behind that rule is that usually the communities and the regions want to keep the current land use, e.g. as grassland or cropland. These rules are country-specific and might be different in other countries.

10.4.1.3 Information that demonstrates that activities under Article 3.3 are direct human-induced – 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 10.4.1.2). 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 (HAUK & SCHADAUER 2009, http://bfw.ac.at/700/pdf/DA_2009_Endfassung_klein.pdf, SCHIELER & HAUK 2001, http://bfw.ac.at/700/pdf/da_ges_neu.pdf). The NFI operationalizes the provisions of the Austrian Forest Act in its technical instruction with the following limit values for tree numbers per 100 m²:

Table 279: Tree numbers per 100 m².

Age	Spruce, fir	Larch	Pine	Beech, oak	Poplar hybrids
Seedling stage	22–45	20–45	40–90		2–4
Juvenile stage	21–37	20–35	36–80	70–130	

Any land that was not forest before (in the previous NFI period) and that meets these tree number ranges 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 m², while the Forest Act defines 1000 m². 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.

It should be noted that these tree number limits used by the NFI for the assessment of forest area are used since many NFIs as they represent good approximations for the secured further forest succession of the new forest lands under Austrian conditions. As such, they are also in line with the related provisions of the Austrian Forest Act. Nevertheless, the Austrian Forest Act lists also for the situation of less tree cover forest management and protection obligations (see chapter 10.4.1.2).

In Austria the National Forest Inventory is prepared by a governmental organisation and the main objective of the NFI is to assess whether or not the forest management has been sustainable. This requires that the data on carbon stock changes are neither under nor overestimated. This requirement is fully consistent with the requirements under the UNFCCC.

10.4.1.4 Information that demonstrates that activities under Article 3.3 are direct human-induced – 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 10.4.1.5). 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 afforestation 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.

It should be noted that these provisions for sustainable forest management together with the legal prioritization of natural regeneration to other re-afforestation techniques (see chapter 10.4.1.2) give evidence for a general promotion of seed sources for the afforestation areas by the Austrian legislation. In case of AR areas with natural regeneration the seed sources are the forests adjacent to the AR lands, and these forests are managed forests and under the Austrian forest act (Austria has the opinion that Decision 16/CMP.1, para. 1 ("... promotion of seed sources") is not limited to the AR areas as such but is also valid for management measures at those areas where the seeds of the young trees at the AR areas origin. Austria interprets "on lands" in the Decision 16/CMP.1, para. 1 as being related to the "conversion of non-forested land to forested land" and not to the place of the listed activities.).

10.4.1.5 Information that demonstrates that activities under Article 3.3 are direct human-induced – 4) Reporting on forests in Austria

The forest area according to NFI is the basis for all official and 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 10.4.1.4 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 Liaison Unit and UNECE/FAO, 2003, 2007 http://www.foresteurope.org/filestore/foresteurope/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).

10.4.1.6 Information that demonstrates that activities under Article 3.3 are direct human-induced – 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 on basis of the documentations and explanations in chapters 10.4.1.2 to 10.4.1.5:

a) The issue of forest land under management

According to chapters 10.4.1.4 and 10.4.1.5 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 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 10.4.1.3 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. This is probably best expressed by 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-/reforested 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-/reforestation 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 10.4.1.4 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 10.4.1.3 informs that natural regeneration is by law an accepted and frequently desired management technique to af-/reforest land.

So, only areas are accounted as afforestation/reforestation areas that qualify as forests under the Austrian forest act and that all afforested/reforested areas that qualify as forests under the forest act are fully protected by the forest act, independent where those areas are located in Austria because in Austria all forested areas are managed forest areas (abandonment of land does in general not exist in Austria because all land has an owner who decides the land use and needs to manage the land according to the related legal obligations whereas abandoned lands according to the Revised 1996 IPCC Guidelines are by definition assumed not to be subject to ongoing human intervention (of significance to carbon stocks after abandonment). Such decision has been made by the Austrian Parliament and cannot be overruled by any authority including the land-owner. According to its general and legal nature the Austrian Forest Act is binding in its entirety. It is a mandatory requirement for any forest management plan. As such, it overrules also any forest management plan and makes it unnecessary to include in forest management plans any statement with respect to af-/reforestation. Therefore, we think that the Austrian Forest Act is the best demonstration for a generally and permanently valid national decision regulating af-/reforestation where units of land meet the forest definition of the Austrian Forest Act after the land owner has decided for the af-/reforestation of the land. Hence, the Austrian Forest Act itself is also the national decision that no longer cultivated units of land are af-/reforestation areas and forests when they meet the forest definition of the Austrian Forest Act, and it underpins the nature of a decision for af-/reforestation by the land owner of the AR lands (otherwise the land would be managed in a way that the forest definition is not met by the plant cover).

The results of the NFI with regard to the increase in the forested area are the basis for the reported af-/reforestation area. Such assessed AR areas give also evidence for a decision by the land owners for a land-use change to forests. 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 HAUKE & SCHADAUER 2009, http://bfw.ac.at/700/pdf/DA_2009_Endfassung_klein.pdf, SCHIELER & HAUKE 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. Under the Austrian law, land will be regarded as forest land wherever it meets the qualification set out in the Austrian forest act. As such a change, either by natural or artificial regeneration, is a decision taken by the land owner, Austria regards this as “direct human induced” AR activity under Article 3.3.

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.

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 reduction of their crown coverage (wind-fall, fire, beetles) 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) and ARD NFI (2011/13) of the biomass and biomass losses at the ARD areas will detect any harvest at AR areas in the commitment period it will be assessed and reported adequately.

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.

Summary overview of key categories for LULUCF 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⁾ (including LULUCF)	Other ⁽²⁾	
Specify key categories according to the national level of disaggregation used ⁽¹⁾					
<i>For example: Cropland Management</i>	CO ₂				
Afforestation and Reforestation	CO ₂	yes	yes		Category 5.A.2
Deforestation	CO ₂	yes	yes		Category 5.B.2
Deforestation	CO ₂	yes	yes		Category 5.C.2
Deforestation	CO ₂	yes	yes		Category 5.D.2
Deforestation	CO ₂	yes	yes		Category 5.E.2
Deforestation	CO ₂	yes	yes		Category 5.F.2

Source: CRF NIR 3 – Table

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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 as specified in Decision 15/CMP.1 Section E. 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, ICERs, AAUs and RMUs for the year 2011 is submitted together with this report (SEF_AT_2012_2_10-41-29 11-4-2012.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: No discrepancies occurred in 2011. See report R-2 of the document 'SIAR reports 2011-AT v1.0' (see Annex 6).
- Paragraph 13: No CDM notifications occurred in 2011. See report R-3 of the document 'SIAR reports 2011-AT v1.0' (see Annex 6).
- Paragraph 14: No CDM notifications occurred in 2011. See report R-3 of the document 'SIAR reports 2011-AT v1.0' (see Annex 6).
- Paragraph 15: No non-replacements occurred in 2011. See report R-4 of the document 'SIAR reports 2011-AT v1.0' (see Annex 6).
- Paragraph 16: No invalid units exist as at 31 December 2011. See report R-5 of the document 'SIAR reports 2011-AT v1.0' (see Annex 6).
- Paragraph 17: There were no actions necessary to correct any problem causing a discrepancy because there were no discrepancies in 2011.

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 publicly available information was temporarily unavailable between 10 January 2011 and 11 August 2011 as a consequence of the hacking attack on the Austrian registry.

The following information is 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 CO₂ equivalent in its initial review report⁸⁷. 90% of this assigned amount is 309 479 408 tonnes CO₂ equivalent. 100 per cent of five times Austria's most recent inventory (2010) would result in 422 969 693 tonnes CO₂ equivalent (~ 84 593 939 x 5), which is higher than 309 479 408 tonnes CO₂ equivalent.

Therefore Austria's commitment period reserve is **309 479 408 tonnes CO₂ equivalent**.

11.6 KP-LULUCF accounting

Austria selected accounting of the KP-LULUCF activities at the end of the commitment period.

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 Protocol⁸⁸.

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13 CHANGES IN THE NATIONAL REGISTRY

13.1 Information on changes according to Decision 15/CMP.1

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 2011.

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)

No changes concerning conformity with data exchange standards occurred during the reported period.

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, ICERs, AAUs and/or RMUs, and replacement of tCERs and ICERs, 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.

After a hacking attack on the Austrian registry on 10 January 2011 the registry was taken offline with no trading possible until 7 March 2011. After release 1.1.14.0 was implemented the registry went back online on 7 March 2011 with trading possible only via a secure on-behalf-of trader procedure, which meant that only registry administrators were allowed to carry out transactions in the Austrian registry on behalf of traders. Before the online access to the registry was made available again to all users on 4 July 2011, additional security measures to prevent unauthorized manipulations were implemented in version 1.1.14.2 of the software. The additional security features implemented in version 1.1.14.2 included the introduction of a two-factor-authentication for accessing the Austrian emissions trading registry using digital signature cards as a second factor and a requirement for each account to have an additional authorized representative who has to approve transactions which have been initiated by an authorized representative of the account. For both release 1.1.14.0 and 1.1.14.2 penetration tests were carried out by an independent body.

g) Publicly accessible information

A list of the information publicly accessible by means of the user interface to the national registry

The publicly available information was temporarily unavailable between 10 January 2011 and 11 August 2011 as a consequence of the hacking attack on the Austrian registry. The information that is publicly available has not changed.

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 system

The two new releases that were implemented in 2011 (1.1.14.0 and 1.1.14.2) were tested both using the standard test procedures (see REG_ETS_TEST_1.1.14.2_final.pdf and Test Book Smart 20110411.pdf which are submitted separately) and additional test procedures that were developed with the aim of testing the new security measures (see REG_AT_TEST_1.1.14.2_final.pdf which is submitted separately).

13.2 Previous Annual Review recommendations

Introduction

According to the 'Standard Independent Assessment Report. Reporting Requirements and Guidance for Registries'⁸⁹ v.4.7 all recommendations that are relevant to registry operations from the previous annual review report and also noted in Section 1.2 of Summary of Findings of the SIAR Part 2 Report have to be listed and an explanation of how each recommendation has been addressed in the current year's submission has to be provided.

Since the annual review report for the 2011 submission is not yet available, the following recommendations have been extracted from the SIAR Part 2 Report on the 2011 submission⁹⁰.

Table 280: Recommendations from Annual Review 2011

Ref Nr	Recommendation Ref	Recommendation description	Party response
P2.4.2.1	P.1.4.1	The SIAR assessor recommends that Party make available all Public information according to paragraphs 44 to 48 in section I.E of annex to decision 13/CMP.1.	As indicated in chapter 13.1 the publicly available information has been available again since 11 August 2011.
P2.4.2.2	P2.4.2.2	Because of the changes in security measures that were enhanced during the reported period in several areas, the submission should include an updated Security Plan as part of the Readiness documentation to demonstrate that the registry system continues to work correctly and in compliance with the technical standards. Therefore, it is recommended that the Party submits these complementary documents.	The updated Security Plan is submitted as a separate document via encrypted e-mail. This is necessary because the Security Plan contains strictly confidential information on the security procedures for the Austrian registry that should in no event be published.

⁸⁹ UNFCCC Secretariat, 2011: Standard Independent Assessment Report Reporting Requirements and Guidance for Registries. Version 4.7, 2011. Available at:

http://unfccc.int/files/kyoto_protocol/registry_systems/independent_assessment_reports/application/msword/siar_reporting_requirements_and_guidance_for_registries_v4.7.doc

⁹⁰ http://unfccc.int/files/kyoto_protocol/registry_systems/independent_assessment_reports/application/pdf/2011_aut_siar_part2_v2.0.pdf

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 its 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.ji-cdm-austria.at/en/portal/index.php>)

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 (Mineralöl-steuergesetz 2005) and the Normverbrauchsabgabengesetz (NoVA) were changed. Since 2011 the air traffic has also to contribute through the introduction of a flight fee (Flight Fee Law, December 2010).

● 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 CO₂-emission of at most 120 g/km get a bonus of 300 Euro, (2) alternatively 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 CO₂-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 alternatively 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%.

- **Flight Fee Law**

In December 2010 the Flight Fee Law was passed within the Budget Act of the Republic of Austria. From April 2011 all flights starting from an Austrian Airport will have to pay a fee at a specific amount per passenger (very few exceptions are granted, e.g. like military or humanitarian flights):

Short distance (within Austria, as well as e.g. Sweden, Cyprus): 8 Euros

Middle Distance (e.g. Iraq, Sudan): 20 Euros

Long Distance (Brazil, Indonesia): 35 Euros

Subventions Agriculture

ÖPUL 2007 (Österreichisches Programm für umweltgerechte Landwirtschaft)

Austria provides subsidies for farms 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.

(<http://www.ji-cdm-austria.at/en/portal/aboutus/cdmnafricainitiative/index.php>)

(f) Assisting developing country 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 hydro-power 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.....	Dampfkessele Datenbank 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 ₂ O, 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

CH₄.....Methane
 CO₂.....Carbon Dioxide
 N₂O.....Nitrous Oxide
 HFCsHydrofluorocarbons
 PFCsPerfluorocarbons
 SF₆Sulphur hexafluoride

Further chemical compounds

COCarbon Monoxide
 CdCadmium
 NH₃.....Ammonia
 HgMercury
 NO_x.....Nitrogen Oxides (NO plus NO₂)
 NO₂.....Nitrogen Dioxide
 NMVOCNon-Methane Volatile Organic Compounds
 PAHPolycyclic Aromatic Hydrocarbons
 PbLead
 POPPersistent Organic Pollutants
 SO₂.....Sulfur Dioxide
 SO_x.....Sulfur Oxides

Units and Metric Symbols

UNIT	Name	Unit for
g	gram	mass
t	ton	mass
W	watt	power
J	joule	calorific value
m	meter	length

Mass Unit Conversion

1g		
1kg	= 1 000 g	
1t	= 1 000 kg	= 1 Mg
1kt	= 1 000 t	= 1 Gg
1Mt	= 1 Mio t	= 1 Tg

Metric Symbol	Prefix	Factor
P	peta	10 ¹⁵
T	tera	10 ¹²
G	giga	10 ⁹
M	mega	10 ⁶
k	kilo	10 ³
h	hecto	10 ²
da	deca	10 ¹
d	deci	10 ⁻¹
c	centi	10 ⁻²
m	milli	10 ⁻³
μ	micro	10 ⁻⁶
n	nano	10 ⁻⁹

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- AMT DER OBERÖSTERREICHISCHEN LANDESREGIERUNG (1993): Oberösterreichischer Bodenkataster – Bodenzustandsinventur 1993. Amt der Oberösterreichischen Landesregierung, Linz.
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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: CO₂, CH₄, N₂O, HFC, PFC and SF₆. 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 (Tier 1 and Tier 2)
- Trend Assessment excluding LULUCF (Tier 1 and Tier 2)
- Level Assessment including LULUCF (Tier 1 and Tier 2)
- Trend Assessment including LULUCF (Tier 1 and Tier 2)
- 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 CH₄ from LULUCF, total N₂O from LULUCF and 5 B net CO₂ from lime application.

Table A 10 of Annex 1 presents the 170 defined source categories (incl. LULUCF) and their greenhouse gas emissions expressed in CO₂ equivalent emissions for the years 1990 to 2010.

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* in the NIR.

Level Assessment excluding LULUCF

For the Level Assessment the contribution of GHG emissions (expressed in CO₂ equivalent emissions) of each category to national total emissions was calculated. The calculation was performed for the years 1990 and 2010 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 2010 32 source categories comprised > 95% of the cumulative total and were thus rated as key categories. For the year 1990 35 source categories were identified as key categories in the level assessment. The result of each level assessment is presented in Tables A 2 and A 3.

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 2010 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. 31 sources were identified as key categories in the trend assessment. Results are presented in Table A 4.

Level Assessment including LULUCF

The level assessment was repeated for the full inventory including the LULUCF categories for the years 1990 and 2010 according to Equation 5.4.1 of the GPG-LULUCF. 6 (1990) respectively 7 (2010) LULUCF key categories were identified by this analysis additionally. The result of each level assessment is presented in Tables A 5 and A 6.

Trend Assessment including LULUCF

Also the trend assessment was repeated for the full inventory including the LULUCF categories for the years 1990 and 2010 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 Table A 7.

Qualitative criteria

Qualitative criteria considered were:

- categories that are close to the 95% criteria, but are not included in all years, e.g. due to fluctuating emissions/removals
- mitigation techniques,
- high expected growth of emissions/removals
- unexpected low or high emissions/removals.

No additional key source categories were identified applying 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 2010, and for the trend assessment 1990-2010, 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 2010 for these categories are included.

Table A 1: Tier 1 - Level Assessment of the key category analysis excluding LULUCF for the base year 1990.

IPCC Category Code	IPCC Category	Greenhouse Gas	Year 1990 Estimate $E_{x,t}$ [t CO ₂ -e units]	Level Assessment $L_{x,t}$	Cumulative Total of $L_{x,t}$
1 A 3 b gasoline	Road Transportation	CO ₂	7 936	10.2%	10.2%
1 A 4 stat-liquid	Other Sectors	CO ₂	7 293	9.3%	19.5%
1 A 1 a solid	Public Electricity and Heat Production	CO ₂	6 247	8.0%	27.5%
1 A 3 b diesel oil	Road Transportation	CO ₂	5 362	6.9%	34.3%
1 A 2 solid	Manufacturing Industries and Construction	CO ₂	5 016	6.4%	40.8%
1 A 2 gaseous	Manufacturing Industries and Construction	CO ₂	4 265	5.5%	46.2%
4 A 1	Cattle	CH ₄	3 551	4.5%	50.8%
2 C 1	Iron and Steel Production	CO ₂	3 546	4.5%	55.3%
6 A	SOLID WASTE DISPOSAL ON LAND	CH ₄	3 314	4.2%	59.5%
1 A 1 a gaseous	Public Electricity and Heat Production	CO ₂	3 294	4.2%	63.7%
1 A 2 stat-liquid	Manufacturing Industries and Construction	CO ₂	2 884	3.7%	67.4%
1 A 4 solid	Other Sectors	CO ₂	2 654	3.4%	70.8%
1 A 4 gaseous	Other Sectors	CO ₂	2 574	3.3%	74.1%
2 A 1	Cement Production	CO ₂	2 033	2.6%	76.7%
1 A 1 b liquid	Petroleum refining	CO ₂	1 958	2.5%	79.2%
4 D 1	Direct Soil Emissions	N ₂ O	1 909	2.4%	81.7%
4 D 3	Indirect Emissions	N ₂ O	1 352	1.7%	83.4%
1 A 1 a liquid	Public Electricity and Heat Production	CO ₂	1 229	1.6%	85.0%
2 C 3	Aluminium production	PFC	1 050	1.3%	86.3%
2 B 2	Nitric Acid Production	N ₂ O	912	1.2%	87.5%
4 B 1	Cattle	N ₂ O	759	1.0%	88.5%
1 A 4 mobile-diesel	Other Sectors	CO ₂	737	0.9%	89.4%
2 B 1	Ammonia Production	CO ₂	514	0.7%	90.1%
1 A 1 c gaseous	Manufacture of Solid fuels and Other Energy	CO ₂	506	0.6%	90.7%
2 A 7 b	Sinter Production	CO ₂	481	0.6%	91.3%
1 A 1 b gaseous	Petroleum refining	CO ₂	437	0.6%	91.9%
2 A 2	Lime Production	CO ₂	396	0.5%	92.4%
1 A 4 other	Other Sectors	CO ₂	350	0.4%	92.8%
1 A 4 biomass	Other Sectors	CH ₄	316	0.4%	93.2%
4 B 1	Cattle	CH ₄	283	0.4%	93.6%
3	SOLVENT AND OTHER PRODUCT USE	CO ₂	279	0.4%	94.0%
1 A 2 other	Manufacturing Industries and Construction	CO ₂	264	0.3%	94.3%
1 A 2 mobile-liquid	Manufacturing Industries and Construction	CO ₂	256	0.3%	94.6%
2 C 4	SF ₆ used in Al and Mg Foundries	SF ₆	253	0.3%	94.9%
3	SOLVENT AND OTHER PRODUCT USE	N ₂ O	233	0.3%	95.2%

Table A 2: Tier 1 - Level Assessment of the key category analysis excluding LULUCF for the year 2010.

IPCC Category Code	IPCC Category	Greenhouse Gas	Year 2010 Estimate $E_{x,t}$ [t CO ₂ -e units]	Level Assessment $L_{x,t}$	Cumulative Total of $L_{x,t}$
1 A 3 b diesel oil	Road Transportation	CO ₂	16 280	19.2%	19.2%
1 A 2 gaseous	Manufacturing Industries and Construction	CO ₂	6 848	8.1%	27.3%
2 C 1	Iron and Steel Production	CO ₂	5 460	6.5%	33.8%
1 A 1 a gaseous	Public Electricity and Heat Production	CO ₂	5 307	6.3%	40.1%
1 A 3 b gasoline	Road Transportation	CO ₂	5 270	6.2%	46.3%
1 A 4 stat-liquid	Other Sectors	CO ₂	5 196	6.1%	52.4%
1 A 2 solid	Manufacturing Industries and Construction	CO ₂	4 944	5.8%	58.3%
1 A 4 gaseous	Other Sectors	CO ₂	4 666	5.5%	63.8%
1 A 1 a solid	Public Electricity and Heat Production	CO ₂	3 870	4.6%	68.4%
4 A 1	Cattle	CH ₄	3 045	3.6%	72.0%
1 A 1 b liquid	Petroleum refining	CO ₂	2 195	2.6%	74.6%
1 A 2 stat-liquid	Manufacturing Industries and Construction	CO ₂	1 811	2.1%	76.7%
4 D 1	Direct Soil Emissions	N ₂ O	1 738	2.1%	78.8%
2 A 1	Cement Production	CO ₂	1 622	1.9%	80.7%
6 A	SOLID WASTE DISPOSAL ON LAND	CH ₄	1 351	1.6%	82.3%
2 F 1/2/3/4/5	ODS Substitutes	HFC/PFC	1 165	1.4%	83.7%
4 D 3	Indirect Emissions	N ₂ O	1 096	1.3%	85.0%
1 A 2 mobile-liquid	Manufacturing Industries and Construction	CO ₂	1 069	1.3%	86.2%
1 A 1 a other	Public Electricity and Heat Production	CO ₂	825	1.0%	87.2%
1 A 2 other	Manufacturing Industries and Construction	CO ₂	783	0.9%	88.1%
4 B 1	Cattle	N ₂ O	744	0.9%	89.0%
1 A 1 a liquid	Public Electricity and Heat Production	CO ₂	728	0.9%	89.9%
1 A 1 c gaseous	Manufacture of Solid fuels and Other Energy	CO ₂	719	0.9%	90.7%
1 A 4 mobile-diesel	Other Sectors	CO ₂	704	0.8%	91.5%
2 A 2	Lime Production	CO ₂	574	0.7%	92.2%
2 B 1	Ammonia Production	CO ₂	538	0.6%	92.9%
1 A 1 b gaseous	Petroleum refining	CO ₂	530	0.6%	93.5%
1 A 3 e gaseous	Other	CO ₂	320	0.4%	93.9%
2 A 7 b	Sinter Production	CO ₂	314	0.4%	94.2%
2 A 3	Limestone and Dolomite Use	CO ₂	294	0.3%	94.6%
6 B	WASTEWATER HANDLING	N ₂ O	265	0.3%	94.9%
2 F 9	Other Sources of SF ₆	PFC/SF ₆	245	0.3%	95.2%

Table A 3: Tier 1 - Trend Assessment of the key category analysis excluding LULUCF for the trend 1990–2010.

IPCC Category Code	IPCC Category	Greenhouse Gas	Base Year (1990) Estimate $E_{x,0}$	Latest Year (2010) Estimate $E_{x,t}$	Trend Assessment $T_{x,t}$	% Contribution to Trend	Cumulative Total of $L_{x,t}$
1 A 3 b diesel oil	Road Transportation	CO ₂	5 362	16 280	0.122	24.8%	24.8%
1 A 1 a solid	Public Electricity and Heat Production	CO ₂	6 247	3 870	0.041	8.4%	33.2%
1 A 3 b gasoline	Road Transportation	CO ₂	7 936	5 270	0.034	6.8%	40.1%
1 A 4 stat-liquid	Other Sectors	CO ₂	7 293	5 196	0.031	6.2%	46.3%
1 A 4 solid	Other Sectors	CO ₂	2 654	245	0.031	6.2%	52.5%
1 A 2 gaseous	Manufacturing Industries and Construction	CO ₂	4 265	6 848	0.028	5.7%	58.1%
6 A	SOLID WASTE DISPOSAL ON LAND	CH ₄	3 314	1 351	0.024	4.8%	62.9%
1 A 1 a gaseous	Public Electricity and Heat Production	CO ₂	3 294	5 307	0.018	3.7%	66.7%
1 A 2 stat-liquid	Manufacturing Industries and Construction	CO ₂	2 884	1 811	0.016	3.2%	69.8%
1 A 4 gaseous	Other Sectors	CO ₂	2 574	4 666	0.014	2.9%	72.7%
2 F 1/2/3/4/5	ODS Substitutes	HFC/PFC	24	1 165	0.013	2.6%	75.3%
2 C 1	Iron and Steel Production	CO ₂	3 546	5 460	0.012	2.4%	77.7%
1 A 2 mobile-liquid	Manufacturing Industries and Construction	CO ₂	256	1 069	0.010	2.1%	79.8%
2 B 2	Nitric Acid Production	N ₂ O	912	63	0.009	1.9%	81.7%
1 A 2 solid	Manufacturing Industries and Construction	CO ₂	5 016	4 944	0.008	1.7%	83.5%
1 A 1 a other	Public Electricity and Heat Production	CO ₂	118	825	0.008	1.6%	85.1%
4 A 1	Cattle	CH ₄	3 551	3 045	0.007	1.4%	86.5%
1 A 1 a liquid	Public Electricity and Heat Production	CO ₂	1 229	728	0.007	1.4%	87.9%
1 A 2 other	Manufacturing Industries and Construction	CO ₂	264	783	0.005	1.1%	89.0%
1 A 4 other	Other Sectors	CO ₂	350	2	0.004	0.8%	89.8%
2 A 1	Cement Production	CO ₂	2 033	1 622	0.003	0.7%	90.5%
2 C 4	SF ₆ used in Al and Mg Foundries	SF ₆	253	0	0.003	0.6%	91.1%
2 A 7 b	Sinter Production	CO ₂	481	314	0.003	0.6%	91.7%
1 A 1 b liquid	Petroleum refining	CO ₂	1 958	2 195	0.003	0.6%	92.3%
4 D 3	Indirect Emissions	N ₂ O	1 352	1 096	0.002	0.5%	92.8%
1 A 3 e gaseous	Other	CO ₂	224	320	0.002	0.5%	93.3%
6 B	WASTEWATER HANDLING	N ₂ O	109	265	0.002	0.4%	93.7%
1 A 4 biomass	Other Sectors	CH ₄	316	203	0.002	0.4%	94.0%
3	SOLVENT AND OTHER PRODUCT USE	CO ₂	279	177	0.002	0.3%	94.4%
1 A 1 b gaseous	Petroleum refining	CO ₂	437	530	0.002	0.3%	94.7%
4 D 1	Direct Soil Emissions	N ₂ O	1 909	1 738	0.002	0.3%	95.0%

Table A 4: Tier 1 - Level Assessment of the key category analysis including LULUCF for the base year 1990.

IPCC Category Code	IPCC Category	Greenhouse Gas	Year 1990 Estimate $E_{x,t}$ [t CO ₂ -e units]	Absolute Value of Year 1990 Estimate $E_{x,t}$	Level Assessment $L_{x,t}$	Cumulative Total of $L_{x,t}$
1 A 3 b gasoline	Road Transportation	CO ₂	7 936	7 936	8.6%	8.6%
5 A 1	Forest land remaining forest land	CO ₂	-7 617	7 617	8.2%	16.8%
1 A 4 stat-liquid	Other Sectors	CO ₂	7 293	7 293	7.9%	24.7%
1 A 1 a solid	Public Electricity and Heat Production	CO ₂	6 247	6 247	6.8%	31.5%
1 A 3 b diesel oil	Road Transportation	CO ₂	5 362	5 362	5.8%	37.3%
1 A 2 solid	Manufacturing Industries and Construction	CO ₂	5 016	5 016	5.4%	42.7%
1 A 2 gaseous	Manufacturing Industries and Construction	CO ₂	4 265	4 265	4.6%	47.4%
5 A 2	Land converted to forest land	CO ₂	-4 246	4 246	4.6%	51.9%
4 A 1	Cattle	CH ₄	3 551	3 551	3.8%	55.8%
2 C 1	Iron and Steel Production	CO ₂	3 546	3 546	3.8%	59.6%
6 A	SOLID WASTE DISPOSAL ON LAND	CH ₄	3 314	3 314	3.6%	63.2%
1 A 1 a gaseous	Public Electricity and Heat Production	CO ₂	3 294	3 294	3.6%	66.8%
1 A 2 stat-liquid	Manufacturing Industries and Construction	CO ₂	2 884	2 884	3.1%	69.9%
1 A 4 solid	Other Sectors	CO ₂	2 654	2 654	2.9%	72.8%
1 A 4 gaseous	Other Sectors	CO ₂	2 574	2 574	2.8%	75.6%
2 A 1	Cement Production	CO ₂	2 033	2 033	2.2%	77.8%
1 A 1 b liquid	Petroleum refining	CO ₂	1 958	1 958	2.1%	79.9%
4 D 1	Direct Soil Emissions	N ₂ O	1 909	1 909	2.1%	82.0%
4 D 3	Indirect Emissions	N ₂ O	1 352	1 352	1.5%	83.4%
1 A 1 a liquid	Public Electricity and Heat Production	CO ₂	1 229	1 229	1.3%	84.8%
2 C 3	Aluminium production	PFC	1 050	1 050	1.1%	85.9%
2 B 2	Nitric Acid Production	N ₂ O	912	912	1.0%	86.9%
5 F 2	Land converted to Other land	CO ₂	866	866	0.9%	87.8%
4 B 1	Cattle	N ₂ O	759	759	0.8%	88.6%
1 A 4 mobile-diesel	Other Sectors	CO ₂	737	737	0.8%	89.4%
2 B 1	Ammonia Production	CO ₂	514	514	0.6%	90.0%
1 A 1 c gaseous	Manufacture of Solid fuels and Other Energy	CO ₂	506	506	0.5%	90.5%
2 A 7 b	Sinter Production	CO ₂	481	481	0.5%	91.1%
1 A 1 b gaseous	Petroleum refining	CO ₂	437	437	0.5%	91.5%
2 A 2	Lime Production	CO ₂	396	396	0.4%	92.0%
5 B 2	Land converted to cropland	CO ₂	356	356	0.4%	92.3%
5 C 2	Land converted to grassland	CO ₂	353	353	0.4%	92.7%
1 A 4 other	Other Sectors	CO ₂	350	350	0.4%	93.1%
1 A 4 biomass	Other Sectors	CH ₄	316	316	0.3%	93.4%
4 B 1	Cattle	CH ₄	283	283	0.3%	93.8%
5 E 2	Land converted to Settlements	CO ₂	281	281	0.3%	94.1%
3	SOLVENT AND OTHER PRODUCT USE	CO ₂	279	279	0.3%	94.4%
1 A 2 other	Manufacturing Industries and Construction	CO ₂	264	264	0.3%	94.6%
1 A 2 mobile-liquid	Manufacturing Industries and Construction	CO ₂	256	256	0.3%	94.9%
2 C 4	SF ₆ used in Al and Mg Foundries	SF ₆	253	253	0.3%	95.2%

Table A 5: Tier 1 - Level Assessment of the key category analysis including LULUCF for the year 2010.

IPCC Category Code	IPCC Category	Greenhouse Gas	Year 2010 Estimate $E_{x,t}$ [t CO ₂ -e units]	Absolute Value of Year 2010 Estimate $E_{x,t}$	Level Assessment $L_{x,t}$	Cumulative Total of $L_{x,t}$
1 A 3 b diesel oil	Road Transportation	CO ₂	16 280	16 280	17.7%	17.7%
1 A 2 gaseous	Manufacturing Industries and Construction	CO ₂	6 848	6 848	7.4%	25.1%
2 C 1	Iron and Steel Production	CO ₂	5 460	5 460	5.9%	31.1%
1 A 1 a gaseous	Public Electricity and Heat Production	CO ₂	5 307	5 307	5.8%	36.9%
1 A 3 b gasoline	Road Transportation	CO ₂	5 270	5 270	5.7%	42.6%
1 A 4 stat-liquid	Other Sectors	CO ₂	5 196	5 196	5.6%	48.2%
1 A 2 solid	Manufacturing Industries and Construction	CO ₂	4 944	4 944	5.4%	53.6%
1 A 4 gaseous	Other Sectors	CO ₂	4 666	4 666	5.1%	58.7%
1 A 1 a solid	Public Electricity and Heat Production	CO ₂	3 870	3 870	4.2%	62.9%
4 A 1	Cattle	CH ₄	3 045	3 045	3.3%	66.2%
5 A 1	Forest land remaining forest land	CO ₂	-2 968	2 968	3.2%	69.4%
5 A 2	Land converted to forest land	CO ₂	-2 443	2 443	2.7%	72.1%
1 A 1 b liquid	Petroleum refining	CO ₂	2 195	2 195	2.4%	74.5%
1 A 2 stat-liquid	Manufacturing Industries and Construction	CO ₂	1 811	1 811	2.0%	76.4%
4 D 1	Direct Soil Emissions	N ₂ O	1 738	1 738	1.9%	78.3%
2 A 1	Cement Production	CO ₂	1 622	1 622	1.8%	80.1%
6 A	SOLID WASTE DISPOSAL ON LAND	CH ₄	1 350	1 350	1.5%	81.6%
2 F 1/2/3/4/5	ODS Substitutes	HFC/PFC	1 165	1 165	1.3%	82.8%
4 D 3	Indirect Emissions	N ₂ O	1 096	1 096	1.2%	84.0%
1 A 2 mobile-liquid	Manufacturing Industries and Construction	CO ₂	1 069	1 069	1.2%	85.2%
1 A 1 a other	Public Electricity and Heat Production	CO ₂	825	825	0.9%	86.1%
1 A 2 other	Manufacturing Industries and Construction	CO ₂	783	783	0.9%	86.9%
4 B 1	Cattle	N ₂ O	744	744	0.8%	87.7%
1 A 1 a liquid	Public Electricity and Heat Production	CO ₂	728	728	0.8%	88.5%
1 A 1 c gaseous	Manufacture of Solid fuels and Other Energy	CO ₂	719	719	0.8%	89.3%
1 A 4 mobile-diesel	Other Sectors	CO ₂	704	704	0.8%	90.1%
2 A 2	Lime Production	CO ₂	574	574	0.6%	90.7%
2 B 1	Ammonia Production	CO ₂	538	538	0.6%	91.3%
1 A 1 b gaseous	Petroleum refining	CO ₂	530	530	0.6%	91.9%
5 B 2	Land converted to cropland	CO ₂	454	454	0.5%	92.4%
5 C 2	Land converted to grassland	CO ₂	367	367	0.4%	92.8%
5 D 2	Land converted to Wetlands	CO ₂	356	356	0.4%	93.1%
5 F 2	Land converted to Other land	CO ₂	347	347	0.4%	93.5%
1 A 3 e gaseous	Other	CO ₂	320	320	0.3%	93.9%
2 A 7 b	Sinter Production	CO ₂	314	314	0.3%	94.2%
2 A 3	Limestone and Dolomite Use	CO ₂	294	294	0.3%	94.5%
6 B	WASTEWATER HANDLING	N ₂ O	265	265	0.3%	94.8%
5 E 2	Land converted to Settlements	CO ₂	248	248	0.3%	95.1%

Table A 6: Tier 1 - Trend Assessment of the key category analysis including LULUCF for the trend 1990–2010.

IPCC Category Code	IPCC Category	Greenhouse Gas	Base Year (1990) Estimate $E_{x,0}$	Latest Year (2010) Estimate $E_{x,t}$	Trend Assessment $T_{x,t}$	% Contribution to Trend	Cumulative Total of $L_{x,t}$
1 A 3 b diesel oil	Road Transportation	CO ₂	5 362	16 280	0.119	22.3%	22.3%
5 A 1	Forest land remaining forest land	CO ₂	7 617	2 968	0.050	9.4%	31.7%
1 A 3 b gasoline	Road Transportation	CO ₂	7 936	5 270	0.029	5.4%	37.1%
1 A 2 gaseous	Manufacturing Industries and Construction	CO ₂	4 265	6 848	0.028	5.3%	42.4%
1 A 4 solid	Other Sectors	CO ₂	2 654	245	0.026	4.9%	47.3%
1 A 1 a solid	Public Electricity and Heat Production	CO ₂	6 247	3 870	0.026	4.8%	52.1%
1 A 4 gaseous	Other Sectors	CO ₂	2 574	4 666	0.023	4.3%	56.3%
1 A 4 stat-liquid	Other Sectors	CO ₂	7 293	5 196	0.023	4.2%	60.6%
1 A 1 a gaseous	Public Electricity and Heat Production	CO ₂	3 294	5 307	0.022	4.1%	64.7%
6 A	SOLID WASTE DISPOSAL ON LAND	CH ₄	3 314	1 350	0.021	4.0%	68.7%
2 C 1	Iron and Steel Production	CO ₂	3 546	5 460	0.021	3.9%	72.6%
5 A 2	Land converted to forest land	CO ₂	4 246	2 443	0.019	3.6%	76.2%
2 F 1/2/3/4/5	ODS Substitutes	HFC/PFC	24	1 165	0.012	2.3%	78.6%
1 A 2 stat-liquid	Manufacturing Industries and Construction	CO ₂	2 884	1 811	0.012	2.2%	80.7%
2 B 2	Nitric Acid Production	N ₂ O	912	63	0.009	1.7%	82.4%
1 A 2 mobile-liquid	Manufacturing Industries and Construction	CO ₂	256	1 069	0.009	1.7%	84.1%
1 A 1 a other	Public Electricity and Heat Production	CO ₂	118	825	0.008	1.4%	85.6%
1 A 2 other	Manufacturing Industries and Construction	CO ₂	264	783	0.006	1.1%	86.6%
5 F 2	Land converted to Other land	CO ₂	866	347	0.006	1.0%	87.7%
1 A 1 a liquid	Public Electricity and Heat Production	CO ₂	1 229	728	0.005	1.0%	88.7%
4 A 1	Cattle	CH ₄	3 551	3 045	0.005	1.0%	89.7%
2 A 1	Cement Production	CO ₂	2 033	1 622	0.004	0.8%	90.5%
1 A 4 other	Other Sectors	CO ₂	350	2	0.004	0.7%	91.2%
2 C 4	SF ₆ used in Al and Mg Foundries	SF ₆	253	0	0.003	0.5%	91.7%
4 D 3	Indirect Emissions	N ₂ O	1 352	1 096	0.003	0.5%	92.2%
1 A 1 b liquid	Petroleum refining	CO ₂	1 958	2 195	0.003	0.5%	92.7%
1 A 1 c gaseous	Manufacture of Solid fuels and Other Energy Industries	CO ₂	506	719	0.002	0.4%	93.2%
2 A 2	Lime Production	CO ₂	396	574	0.002	0.4%	93.5%
5 D 2	Land converted to Wetlands	CO ₂	191	356	0.002	0.3%	93.9%
2 A 7 b	Sinter Production	CO ₂	481	314	0.002	0.3%	94.2%
4 D 1	Direct Soil Emissions	N ₂ O	1 909	1 738	0.002	0.3%	94.5%
6 B	WASTEWATER HANDLING	N ₂ O	109	265	0.002	0.3%	94.9%
2 F 9	Other Sources of SF ₆	PFC/SF ₆	127	245	0.001	0.2%	95.1%

Table A 7: Tier 1 - Key categories identified including their ranking in the level and trend assessment for the KCA excluding LULUCF.

IPCC Category Code	IPCC Category	Greenhouse Gas	Tier 1 Level Assessment 1990	Tier 1 Level Assessment 2010	Tier 1 Trend Assessment 1990-2010	Base Year (1990) Estimate E ₉₀	Latest Year (2010) Estimate E ₁₀	Share Latest Year (2010)
1 A 1 a gaseous	Public Electricity and Heat Production	CO2	10	4	9	3 294	5 307	6.3%
1 A 1 a liquid	Public Electricity and Heat Production	CO2	18	22	17	1 229	728	0.9%
1 A 1 a other	Public Electricity and Heat Production	CO2		19	16	118	825	1.0%
1 A 1 a solid	Public Electricity and Heat Production	CO2	3	9	3	6 247	3 870	4.6%
1 A 1 b gaseous	Petroleum refining	CO2	26	27		437	530	0.6%
1 A 1 b liquid	Petroleum refining	CO2	15	11		1 958	2 195	2.6%
1 A 1 c gaseous	Manufacture of Solid fuels and Other Energy Industries	CO2	24	23	26	506	719	0.9%
1 A 2 gaseous	Manufacturing Industries and Construction	CO2	6	2	7	4 265	6 848	8.1%
1 A 2 mobile-liquid	Manufacturing Industries and Construction	CO2	33	18	15	256	1 069	1.3%
1 A 2 other	Manufacturing Industries and Construction	CO2	32	20	19	264	783	0.9%
1 A 2 solid	Manufacturing Industries and Construction	CO2	5	7	20	5 016	4 944	5.8%
1 A 2 stat-liquid	Manufacturing Industries and Construction	CO2	11	12	11	2 884	1 811	2.1%
1 A 3 b diesel oil	Road Transportation	CO2	4	1	1	5 362	16 280	19.2%
1 A 3 b gasoline	Road Transportation	CO2	1	5	2	7 936	5 270	6.2%
1 A 3 e gaseous	Other	CO2		28		224	320	0.4%
1 A 4 biomass	Other Sectors	CH4	29		29	316	203	0.2%
1 A 4 gaseous	Other Sectors	CO2	13	8	8	2 574	4 666	5.5%
1 A 4 mobile-diesel	Other Sectors	CO2	22	24		737	704	0.8%
1 A 4 other	Other Sectors	CO2	28		21	350	2	0.0%
1 A 4 solid	Other Sectors	CO2	12		5	2 654	245	0.3%
1 A 4 stat-liquid	Other Sectors	CO2	2	6	4	7 293	5 196	6.1%
2 A 1	Cement Production	CO2	14	14	18	2 033	1 622	1.9%
2 A 2	Lime Production	CO2	27	25	28	396	574	0.7%
2 A 3	Limestone and Dolomite Use	CO2		30		203	294	0.3%
2 A 7 b	Sinter Production	CO2	25	29	25	481	314	0.4%
2 B 1	Ammonia Production	CO2	23	26		514	538	0.6%
2 B 2	Nitric Acid Production	N2O	20		13	912	63	0.1%
2 C 1	Iron and Steel Production	CO2	8	3	10	3 546	5 460	6.5%
2 C 3	Aluminium production	PFC	19			1 050	0	0.0%
2 C 4	SF6 used in Al and Mg Foundries	SF6	34		24	253	0	0.0%
2 F 1/2/3/4/5	ODS Substitutes	HFC/PFC		16	12	24	1 165	1.4%
2 F 9	Other Sources of SF6	PFC/SF6		32	31	127	245	0.3%
3	SOLVENT AND OTHER PRODUCT USE	CO2	31		30	279	177	0.2%
3	SOLVENT AND OTHER PRODUCT USE	N2O	35			233	150	0.2%
4 A 1	Cattle	CH4	7	10	14	3 551	3 045	3.6%
4 B 1	Cattle	CH4	30			283	229	0.3%
4 B 1	Cattle	N2O	21	21		759	744	0.9%
4 D 1	Direct Soil Emissions	N2O	16	13	23	1 909	1 738	2.1%
4 D 3	Indirect Emissions	N2O	17	17	22	1 352	1 096	1.3%
6 A	SOLID WASTE DISPOSAL ON LAND	CH4	9	15	6	3 314	1 350	1.6%
6 B	WASTEWATER HANDLING	N2O		31	27	109	265	0.3%

Table A 8: Tier 1 - Key categories identified including their ranking in the level and trend assessment for the KCA including LULUCF

IPCC Category Code	IPCC Category	Greenhouse Gas	Tier 1	Tier 1	Tier 1	Base Year (1990) Estimate E _{x,0}	Latest Year (2010) Estimate E _{x,1}
			Level Assessment 1990	Level Assessment 2010	Trend Assessment 1990-2010		
1 A 1 a gaseous	Public Electricity and Heat Production	CO2	12	4	9	3 294	5 307
1 A 1 a liquid	Public Electricity and Heat Production	CO2	20	24	20	1 229	728
1 A 1 a other	Public Electricity and Heat Production	CO2		21	17	118	825
1 A 1 a solid	Public Electricity and Heat Production	CO2	4	9	6	6 247	3 870
1 A 1 b gaseous	Petroleum refining	CO2	29	29		437	530
1 A 1 b liquid	Petroleum refining	CO2	17	13	26	1 958	2 195
1 A 1 c gaseous	Manufacture of Solid fuels and Other Energy Industries	CO2	27	25	27	506	719
1 A 2 gaseous	Manufacturing Industries and Construction	CO2	7	2	4	4 265	6 848
1 A 2 mobile-liquid	Manufacturing Industries and Construction	CO2	39	20	16	256	1 069
1 A 2 other	Manufacturing Industries and Construction	CO2	38	22	18	264	783
1 A 2 solid	Manufacturing Industries and Construction	CO2	6	7		5 016	4 944
1 A 2 stat-liquid	Manufacturing Industries and Construction	CO2	13	14	14	2 884	1 811
1 A 3 b diesel oil	Road Transportation	CO2	5	1	1	5 362	16 280
1 A 3 b gasoline	Road Transportation	CO2	1	5	3	7 936	5 270
1 A 3 e gaseous	Other	CO2		34		224	320
1 A 4 biomass	Other Sectors	CH4	34			316	203
1 A 4 gaseous	Other Sectors	CO2	15	8	7	2 574	4 666
1 A 4 mobile-diesel	Other Sectors	CO2	25	26		737	704
1 A 4 other	Other Sectors	CO2	33		23	350	2
1 A 4 solid	Other Sectors	CO2	14		5	2 654	245
1 A 4 stat-liquid	Other Sectors	CO2	3	6	8	7 293	5 196
2 A 1	Cement Production	CO2	16	16	22	2 033	1 622
2 A 2	Lime Production	CO2	30	27	28	396	574
2 A 3	Limestone and Dolomite Use	CO2		28		203	294
2 A 7 b	Sinter Production	CO2	28	35	30	481	314
2 B 1	Ammonia Production	CO2	26	28		514	538
2 B 2	Nitric Acid Production	N2O	22		15	912	63
2 C 1	Iron and Steel Production	CO2	10	3	11	3 546	5 460
2 C 3	Aluminium production	PFC	21			1 050	0
2 C 4	SF6 used in Al and Mg Foundries	SF6	40		24	253	0
2 F 1/2/3/4/5	ODS Substitutes	HFC/PFC		18	13	24	1 165
2 F 9	Other Sources of SF6	PFC/SF6			33	127	245
3	SOLVENT AND OTHER PRODUCT USE	CO2	37			279	177
4 A 1	Cattle	CH4	9	10	21	3 551	3 045
4 B 1	Cattle	CH4	35			283	229
4 B 1	Cattle	N2O	24	23		759	744
4 D 1	Direct Soil Emissions	N2O	18	15	31	1 909	1 738
4 D 3	Indirect Emissions	N2O	19	19	25	1 352	1 096
5 A 1	Forest land remaining forest land	CO2	2	11	2	-7 617	-2 968
5 A 2	Land converted to forest land	CO2	8	12	12	-4 246	-2 443
5 B 2	Land converted to cropland	CO2	31	30		356	454
5 C 2	Land converted to grassland	CO2	32	31		353	367
5 D 2	Land converted to Wetlands	CO2		32	29	191	356
5 E 2	Land converted to Settlements	CO2	36	38		281	248
5 F 2	Land converted to Other land	CO2	23	33	19	866	347
6 A	SOLID WASTE DISPOSAL ON LAND	CH4	11	17	10	3 314	1 350
6 B	WASTEWATER HANDLING	N2O		37	32	109	265

Table A 9: Tier 2 - Level Assessment of the key category analysis excluding LULUCF for the base year 1990.

IPCC Category Code	IPCC Category	Greenhouse Gas	Latest Year (1990) Estimate $E_{x,t}$	Level Assessment with Uncertainty $L_{Ux,t}$	Cumulative Total of $L_{x,t}$
4 D 1	Direct Soil Emissions	N ₂ O	1 909	0.248	24.8%
4 D 3	Indirect Emissions	N ₂ O	1 352	0.176	42.4%
6 A	SOLID WASTE DISPOSAL ON LAND	CH ₄	3 314	0.080	50.4%
4 A 1	Cattle	CH ₄	3 551	0.069	57.3%
4 B 1	Cattle	N ₂ O	759	0.066	63.9%
2 C 3	Aluminium production	PFC	1 050	0.046	68.4%
1 A 3 b gasoline	Road Transportation	CO ₂	7 936	0.029	71.3%
4 D 2	Pasture, Range and Paddock Manure	N ₂ O	169	0.022	73.5%
1 A 3 b diesel oil	Road Transportation	CO ₂	5 362	0.020	75.5%
1 A 4 stat-liquid	Other Sectors	CO ₂	7 293	0.019	77.4%
1 A 2 gaseous	Manufacturing Industries and Construction	CO ₂	4 265	0.019	79.3%
1 A 4 biomass	Other Sectors	CH ₄	316	0.014	80.7%
4 B 1	Cattle	CH ₄	283	0.012	81.9%
1 A 4 gaseous	Other Sectors	CO ₂	2 574	0.011	83.0%
2 A 1	Cement Production	CO ₂	2 033	0.009	84.0%
1 A 3 b gasoline	Road Transportation	N ₂ O	133	0.008	84.8%
4 B 8	Swine	N ₂ O	88	0.008	85.6%
1 A 2 stat-liquid	Manufacturing Industries and Construction	CO ₂	2 884	0.008	86.3%
2 A 2	Lime Production	CO ₂	396	0.007	87.0%
1 A 4 other	Other Sectors	CO ₂	350	0.007	87.7%
2 F 9	Other Sources of SF ₆	PFC/SF ₆	127	0.006	88.3%
1 A 1 a gaseous	Public Electricity and Heat Production	CO ₂	3 294	0.006	88.9%
4 B 8	Swine	CH ₄	123	0.005	89.5%
1 A 2 other	Manufacturing Industries and Construction	CO ₂	264	0.005	90.0%
6 B	WASTEWATER HANDLING	N ₂ O	109	0.005	90.5%
1 A 2 solid	Manufacturing Industries and Construction	CO ₂	5 016	0.005	91.0%
6 B	WASTEWATER HANDLING	CH ₄	102	0.005	91.4%
1 B 2 a	Oil	CH ₄	101	0.004	91.9%
2 B 2	Nitric Acid Production	N ₂ O	912	0.004	92.3%
4 B 9	Poultry	N ₂ O	46	0.004	92.7%
1 A 1 a solid	Public Electricity and Heat Production	CO ₂	6 247	0.004	93.1%
1 A 4 biomass	Other Sectors	N ₂ O	86	0.004	93.5%
2 A 3	Limestone and Dolomite Use	CO ₂	203	0.003	93.8%
1 A 4 mobile-diesel	Other Sectors	N ₂ O	78	0.003	94.2%
4 A 8	Swine	CH ₄	116	0.003	94.5%
3	SOLVENT AND OTHER PRODUCT USE	CO ₂	279	0.003	94.7%
1 A 4 solid	Other Sectors	CH ₄	62	0.003	95.0%

Table A 10: Tier 2 - Level Assessment of the key category analysis excluding LULUCF for the year 2010.

IPCC Category Code	IPCC Category	Greenhouse Gas	Latest Year (2010) Estimate $E_{x,t}$	Level Assessment with Uncertainty $LU_{x,t}$	Cumulative Total of $L_{x,t}$
4 D 1	Direct Soil Emissions	N ₂ O	1 738	0.241	24.1%
4 D 3	Indirect Emissions	N ₂ O	1 096	0.152	39.3%
4 B 1	Cattle	N ₂ O	744	0.069	46.2%
1 A 3 b diesel oil	Road Transportation	CO ₂	16 280	0.064	52.6%
4 A 1	Cattle	CH ₄	3 045	0.063	58.8%
2 F 1/2/3/4/5	ODS Substitutes	HFC/PFC	1 165	0.058	64.7%
6 A	SOLID WASTE DISPOSAL ON LAND	CH ₄	1 350	0.035	68.1%
1 A 2 gaseous	Manufacturing Industries and Construction	CO ₂	6 848	0.032	71.3%
1 A 4 gaseous	Other Sectors	CO ₂	4 666	0.022	73.5%
1 A 3 b gasoline	Road Transportation	CO ₂	5 270	0.021	75.5%
1 A 1 a other	Public Electricity and Heat Production	CO ₂	825	0.017	77.2%
1 A 2 other	Manufacturing Industries and Construction	CO ₂	783	0.016	78.8%
1 A 4 stat-liquid	Other Sectors	CO ₂	5 196	0.015	80.3%
4 D 2	Pasture, Range and Paddock Manure	N ₂ O	95	0.013	81.6%
6 B	WASTEWATER HANDLING	N ₂ O	265	0.013	82.9%
2 F 9	Other Sources of SF ₆	PFC/SF ₆	245	0.013	84.2%
4 B 1	Cattle	CH ₄	229	0.011	85.3%
1 A 1 a gaseous	Public Electricity and Heat Production	CO ₂	5 307	0.010	86.3%
1 A 4 biomass	Other Sectors	CH ₄	203	0.010	87.3%
1 B 2 a	Oil	CH ₄	140	0.006	87.9%
4 B 9	Poultry	N ₂ O	64	0.006	88.5%
1 A 3 b gasoline	Road Transportation	N ₂ O	84	0.005	89.0%
4 B 8	Swine	N ₂ O	58	0.005	89.6%
2 A 3	Limestone and Dolomite Use	CO ₂	294	0.005	90.1%
1 A 2 solid	Manufacturing Industries and Construction	CO ₂	4 944	0.005	90.6%
1 A 2 stat-liquid	Manufacturing Industries and Construction	CO ₂	1 811	0.005	91.1%
1 A 4 biomass	Other Sectors	N ₂ O	100	0.005	91.6%
4 B 8	Swine	CH ₄	77	0.004	92.0%
1 A 3 b diesel oil	Road Transportation	N ₂ O	130	0.004	92.3%
2 C 1	Iron and Steel Production	CO ₂	5 460	0.004	92.7%
2 A 1	Cement Production	CO ₂	1 622	0.003	93.0%
1 A 4 mobile-diesel	Other Sectors	N ₂ O	66	0.003	93.3%
1 A 2 mobile-liquid	Manufacturing Industries and Construction	CO ₂	1 069	0.003	93.6%
4 A 8	Swine	CH ₄	99	0.003	93.9%
1 A 2 mobile-liquid	Manufacturing Industries and Construction	N ₂ O	60	0.003	94.2%
2 A 2	Lime Production	CO ₂	574	0.003	94.5%
1 A 1 a biomass	Public Electricity and Heat Production	N ₂ O	60	0.003	94.8%
3	SOLVENT AND OTHER PRODUCT USE	N ₂ O	150	0.003	95.0%

Table A 11: Tier 2 - Trend Assessment of the key category analysis excluding LULUCF for the trend 1990–2010.

IPCC Category Code	IPCC Category	Greenhouse Gas	Base Year (1990) Estimate $E_{x,0}$	Latest Year (2010) Estimate $E_{x,t}$	Trend Assessment with Uncertainty $TU_{x,t}$	% Contribution to Trend	Cumulative Total of $TU_{x,t}$
6 A	SOLID WASTE DISPOSAL ON LAND	CH4	3 314	1 350	0.678	12.6%	12.6%
2 F 1/2/3/4/5	ODS Substitutes	HFC/PFC	24	1 165	0.672	12.5%	25.1%
4 D 3	Indirect Emissions	N2O	1 352	1 096	0.603	11.2%	36.3%
4 D 1	Direct Soil Emissions	N2O	1 909	1 738	0.537	10.0%	46.3%
1 A 3 b diesel oil	Road Transportation	CO2	5 362	16 280	0.486	9.0%	55.3%
4 A 1	Cattle	CH4	3 551	3 045	0.195	3.6%	58.9%
1 A 1 a other	Public Electricity and Heat Production	CO2	118	825	0.170	3.2%	62.1%
1 A 3 b gasoline	Road Transportation	CO2	7 936	5 270	0.154	2.9%	64.9%
4 D 2	Pasture, Range and Paddock Manure	N2O	169	95	0.143	2.7%	67.6%
1 A 2 gaseous	Manufacturing Industries and Construction	CO2	4 265	6 848	0.122	2.3%	69.8%
1 A 2 other	Manufacturing Industries and Construction	CO2	264	783	0.121	2.3%	72.1%
1 A 4 gaseous	Other Sectors	CO2	2 574	4 666	0.103	1.9%	74.0%
1 A 4 other	Other Sectors	CO2	350	2	0.092	1.7%	75.7%
1 A 4 stat-liquid	Other Sectors	CO2	7 293	5 196	0.090	1.7%	77.4%
6 B	WASTEWATER HANDLING	N2O	109	265	0.086	1.6%	79.0%
4 B 1	Cattle	N2O	759	744	0.085	1.6%	80.6%
1 A 4 biomass	Other Sectors	CH4	316	203	0.077	1.4%	82.0%
2 F 9	Other Sources of SF6	PFC/SF6	127	245	0.066	1.2%	83.2%
2 B 2	Nitric Acid Production	N2O	912	63	0.054	1.0%	84.2%
6 B	WASTEWATER HANDLING	CH4	102	27	0.049	0.9%	85.1%
1 A 3 b gasoline	Road Transportation	N2O	133	84	0.046	0.9%	86.0%
1 A 2 stat-liquid	Manufacturing Industries and Construction	CO2	2 884	1 811	0.044	0.8%	86.8%
4 B 1	Cattle	CH4	283	229	0.043	0.8%	87.6%
4 B 8	Swine	N2O	88	58	0.041	0.8%	88.4%
1 A 1 a gaseous	Public Electricity and Heat Production	CO2	3 294	5 307	0.039	0.7%	89.1%
1 A 4 solid	Other Sectors	CH4	62	5	0.034	0.6%	89.7%
1 A 4 solid	Other Sectors	CO2	2 654	245	0.032	0.6%	90.3%
1 A 1 a biomass	Public Electricity and Heat Production	N2O	1	60	0.032	0.6%	90.9%
4 B 8	Swine	CH4	123	77	0.031	0.6%	91.5%
1 A 3 b diesel oil	Road Transportation	N2O	41	130	0.028	0.5%	92.0%
1 A 2 mobile-liquid	Manufacturing Industries and Construction	CO2	256	1 069	0.026	0.5%	92.5%
1 A 1 a solid	Public Electricity and Heat Production	CO2	6 247	3 870	0.022	0.4%	92.9%
3	SOLVENT AND OTHER PRODUCT USE	N2O	233	150	0.022	0.4%	93.3%
1 A 3 b gasoline	Road Transportation	CH4	62	12	0.018	0.3%	93.7%
1 B 2 a	Oil	CH4	101	140	0.017	0.3%	94.0%
1 A 2 mobile-liquid	Manufacturing Industries and Construction	N2O	28	60	0.017	0.3%	94.3%
4 B 9	Poultry	N2O	46	64	0.016	0.3%	94.6%
2 A 3	Limestone and Dolomite Use	CO2	203	294	0.016	0.3%	94.9%
3	SOLVENT AND OTHER PRODUCT USE	CO2	279	177	0.015	0.3%	95.2%

Table A 12: Tier 2 - Level Assessment of the key category analysis including LULUCF for the base year 1990.

IPCC Category Code	IPCC Category	Greenhouse Gas	Latest Year (1990) Estimate $E_{x,t}$	Absolute Value of Year 1990 Estimate $E_{x,t}$	Level Assessment with Uncertainty $LUX_{x,t}$	Cumulative Total of $L_{x,t}$
5 A 1	Forest land remaining forest land	CO2	-7 617	7 617	0.357	35.7%
5 F 2	Land converted to Other land	CO2	866	866	0.152	50.9%
5 A 2	Land converted to forest land	CO2	-4 246	4 246	0.102	61.1%
5 C 2	Land converted to grassland	CO2	353	353	0.084	69.5%
4 D 1	Direct Soil Emissions	N2O	1 909	1 909	0.064	75.9%
4 D 3	Indirect Emissions	N2O	1 352	1 352	0.045	80.4%
6 A	SOLID WASTE DISPOSAL ON LAND	CH4	3 314	3 314	0.020	82.5%
5 B 2	Land converted to cropland	CO2	356	356	0.020	84.4%
4 A 1	Cattle	CH4	3 551	3 551	0.018	86.2%
4 B 1	Cattle	N2O	759	759	0.017	87.9%
5 E 2	Land converted to Settlements	CO2	281	281	0.014	89.3%
2 C 3	Aluminium production	PFC	1 050	1 050	0.012	90.4%
5 B 1	Cropland remaining cropland	CO2	-152	152	0.008	91.2%
1 A 3 b gasoline	Road Transportation	CO2	7 936	7 936	0.007	91.9%
4 D 2	Pasture, Range and Paddock Manure	N2O	169	169	0.006	92.5%
1 A 3 b diesel oil	Road Transportation	CO2	5 362	5 362	0.005	93.0%
1 A 4 stat-liquid	Other Sectors	CO2	7 293	7 293	0.005	93.5%
1 A 2 gaseous	Manufacturing Industries and Construction	CO2	4 265	4 265	0.005	94.0%
5 D 2	Land converted to Wetlands	CO2	191	191	0.004	94.4%
1 A 4 biomass	Other Sectors	CH4	316	316	0.004	94.8%
4 B 1	Cattle	CH4	283	283	0.003	95.1%

Table A 13: Tier 2 - Level Assessment of the key category analysis including LULUCF for the year 2010.

IPCC Category Code	IPCC Category	Greenhouse Gas	Latest Year (2010) Estimate $E_{x,t}$	Absolute Value of Year 2010 Estimate $E_{x,t}$	Level Assessment with Uncertainty $LUX_{x,t}$	Cumulative Total of $L_{x,t}$
5 A 1	Forest land remaining forest land	CO2	-2 968	2 968	0.418	41.8%
5 F 2	Land converted to Other land	CO2	347	347	0.081	49.9%
4 D 1	Direct Soil Emissions	N2O	1 738	1 738	0.067	56.6%
5 A 2	Land converted to forest land	CO2	-2 443	2 443	0.059	62.5%
5 C 2	Land converted to grassland	CO2	367	367	0.054	67.9%
4 D 3	Indirect Emissions	N2O	1 096	1 096	0.042	72.1%
5 B 1	Cropland remaining cropland	CO2	64	64	0.041	76.2%
5 B 2	Land converted to cropland	CO2	454	454	0.026	78.8%
5 E 2	Land converted to Settlements	CO2	248	248	0.022	81.0%
4 B 1	Cattle	N2O	744	744	0.019	83.0%
1 A 3 b diesel oil	Road Transportation	CO2	16 280	16 280	0.018	84.7%
4 A 1	Cattle	CH4	3 045	3 045	0.018	86.5%
5 D 2	Land converted to Wetlands	CO2	356	356	0.017	88.2%
2 F 1/2/3/4/5	ODS Substitutes	HFC/PFC	1 165	1 165	0.016	89.8%
6 A	SOLID WASTE DISPOSAL ON LAND	CH4	1 350	1 350	0.010	90.7%
1 A 2 gaseous	Manufacturing Industries and Construction	CO2	6 848	6 848	0.009	91.6%
1 A 4 gaseous	Other Sectors	CO2	4 666	4 666	0.006	92.2%
1 A 3 b gasoline	Road Transportation	CO2	5 270	5 270	0.006	92.8%
1 A 1 a other	Public Electricity and Heat Production	CO2	825	825	0.005	93.3%
1 A 2 other	Manufacturing Industries and Construction	CO2	783	783	0.005	93.7%
1 A 4 stat-liquid	Other Sectors	CO2	5 196	5 196	0.004	94.1%
4 D 2	Pasture, Range and Paddock Manure	N2O	95	95	0.004	94.5%
6 B	WASTEWATER HANDLING	N2O	265	265	0.004	94.9%
2 F 9	Other Sources of SF6	PFC/SF6	245	245	0.004	95.2%

Table A 14: Tier 2 - Trend Assessment of the key category analysis including LULUCF for the trend 1990–2010.

IPCC Category Code	IPCC Category	Greenhouse Gas	Base Year (1990) Estimate $E_{x,0}$	Latest Year (2010) Estimate $E_{x,t}$	Trend Assessment with Uncertainty $TU_{x,t}$	% Contribution to Trend	Cumulative Total of $TU_{x,t}$
5 A 1	Forest land remaining forest land	CO2	7 617	2 968	27.576	65.2%	65.2%
5 F 2	Land converted to Other land	CO2	866	347	5.086	12.0%	77.3%
5 B 1	Cropland remaining cropland	CO2	152	64	2.356	5.6%	82.8%
5 A 2	Land converted to forest land	CO2	4 246	2 443	1.832	4.3%	87.2%
2 F 1/2/3/4/5	ODS Substitutes	HFC/PFC	24	1 165	0.672	1.6%	88.8%
6 A	SOLID WASTE DISPOSAL ON LAND	CH4	3 314	1 350	0.590	1.4%	90.2%
1 A 3 b diesel oil	Road Transportation	CO2	5 362	16 280	0.507	1.2%	91.4%
4 D 3	Indirect Emissions	N2O	1 352	1 096	0.411	1.0%	92.3%
5 D 2	Land converted to Wetlands	CO2	191	356	0.332	0.8%	93.1%
4 D 1	Direct Soil Emissions	N2O	1 909	1 738	0.267	0.6%	93.8%
5 B 2	Land converted to cropland	CO2	356	454	0.245	0.6%	94.3%
1 A 1 a other	Public Electricity and Heat Production	CO2	118	825	0.173	0.4%	94.7%
1 A 2 gaseous	Manufacturing Industries and Construction	CO2	4 265	6 848	0.143	0.3%	95.1%

Table A 15: Tier 2 - Key categories identified including their ranking in the level and trend assessment for the KCA excluding LULUCF.

IPCC Category Code	IPCC Category	Greenhouse Gas	Tier 1 Level Assessment 1990	Tier 1 Level Assessment 2010	Tier 1 Trend Assessment 1990-2010	Tier 2 Level Assessment 1990	Tier 2 Level Assessment 2010	Tier 2 Trend Assessment 1990-2010	Base Year (1990) Estimate E ₉₀	Latest Year (2010) Estimate E ₁₀	Share Latest Year (2010)
1 A 1 a gaseous	Public Electricity and Heat Production	CO2	10	4	9	9	4	25	3 294	5 307	6.3%
1 A 1 a biomass	Public Electricity and Heat Production	N2O					37	28	1	60	0.1%
1 A 1 a liquid	Public Electricity and Heat Production	CO2	18	22	17				1 229	728	0.9%
1 A 1 a other	Public Electricity and Heat Production	CO2		19	16		17	7	118	825	1.0%
1 A 1 a solid	Public Electricity and Heat Production	CO2	3	9	3	3		32	6 247	3 870	4.6%
1 A 1 b gaseous	Petroleum refining	CO2	26	27					437	530	0.6%
1 A 1 b liquid	Petroleum refining	CO2	15	11					1 958	2 195	2.6%
1 A 1 c gaseous	Manufacture of Solid fuels and Other Energy Industries	CO2	24	23	26				506	719	0.9%
1 A 2 gaseous	Manufacturing Industries and Construction	CO2	6	2	7	6	2	10	4 265	6 848	8.1%
1 A 2 mobile-liquid	Manufacturing Industries and Construction	CO2	33	18	15		16	31	256	1 069	1.3%
1 A 2 mobile-liquid	Manufacturing Industries and Construction	N2O					36	36	28	60	0.1%
1 A 2 other	Manufacturing Industries and Construction	CO2	32	20	19	23	18	11	264	783	0.9%
1 A 2 solid	Manufacturing Industries and Construction	CO2	5	7	20	5	7		5 016	4 944	5.8%
1 A 2 stat-liquid	Manufacturing Industries and Construction	CO2	11	12	11	10	10	22	2 884	1 811	2.1%
1 A 3 b diesel oil	Road Transportation	CO2	4	1	1	4	1	5	5 362	16 280	19.2%
1 A 3 b diesel oil	Road Transportation	N2O					28	30	41	130	0.2%
1 A 3 b gasoline	Road Transportation	CO2	1	5	2	1	5	8	7 936	5 270	6.2%
1 A 3 b gasoline	Road Transportation	CH4						34	62	12	0.0%
1 A 3 b gasoline	Road Transportation	N2O				26	32	21	133	84	0.1%
1 A 3 e gaseous	Other	CO2		28					224	320	0.4%
1 A 4 biomass	Other Sectors	CH4	29		29	20	25	17	316	203	0.2%
1 A 4 biomass	Other Sectors	N2O				34	29		86	100	0.1%
1 A 4 gaseous	Other Sectors	CO2	13	8	8	11	8	12	2 574	4 666	5.5%
1 A 4 mobile-diesel	Other Sectors	CO2	22	24					737	704	0.8%
1 A 4 mobile-diesel	Other Sectors	N2O				35	34		78	66	0.1%
1 A 4 other	Other Sectors	CO2	28		21	19		13	350	2	0.0%
1 A 4 solid	Other Sectors	CO2	12		5			27	2 654	245	0.3%
1 A 4 solid	Other Sectors	CH4				36		26	62	5	0.0%
1 A 4 stat-liquid	Other Sectors	CO2	2	6	4	2	6	14	7 293	5 196	6.1%
1 B 2 a	Oil	CH4				32	27	35	101	140	0.2%
2 A 1	Cement Production	CO2	14	14	18	12	12		2 033	1 622	1.9%
2 A 2	Lime Production	CO2	27	25	28	18	20		396	574	0.7%
2 A 3	Limestone and Dolomite Use	CO2		30		24	21	38	203	294	0.3%
2 A 7 b	Sinter Production	CO2	25	29	25				481	314	0.4%
2 B 1	Ammonia Production	CO2	23	26					514	538	0.6%
2 B 2	Nitric Acid Production	N2O	20		13	16		19	912	63	0.1%
2 C 1	Iron and Steel Production	CO2	8	3	10		3		3 546	5 460	6.5%
2 C 3	Aluminium production	PFC	19			15			1 050	0	0.0%
2 C 4	SF6 used in Al and Mg Foundries	SF6	34		24				253	0	0.0%
2 F 1/2/3/4/5	ODS Substitutes	HFC/PFC		16	12		14	2	24	1 165	1.4%
2 F 9	Other Sources of SF6	PFC/SF6		32	31	27	23	18	127	245	0.3%
5	SOLVENT AND OTHER PRODUCT USE	CO2	31		30	22		39	279	177	0.2%
5	SOLVENT AND OTHER PRODUCT USE	N2O	35			26	33		233	150	0.2%
4 A 1	Cattle	CH4	7	10	14	7	9	6	3 551	3 045	3.6%
4 A 8	Swine	CH4				29	30		116	99	0.1%
4 B 1	Cattle	CH4	30			21	24	23	283	229	0.3%
4 B 1	Cattle	N2O	21	21		17	19	16	759	744	0.9%
4 B 8	Swine	N2O				33	38	24	88	58	0.1%
4 B 8	Swine	CH4				28	33	29	123	77	0.1%
4 B 9	Poultry	N2O				37	35	37	46	64	0.1%
4 D 1	Direct Soil Emissions	N2O	16	13	23	13	11	4	1 909	1 738	2.1%
4 D 2	Pasture, Range and Paddock Manure	N2O				25	31	9	169	95	0.1%
4 D 3	Indirect Emissions	N2O	17	17	22	14	15	3	1 352	1 096	1.3%
6 A	SOLID WASTE DISPOSAL ON LAND	CH4	9	15	6	8	13	1	3 314	1 350	1.6%
6 B	WASTEWATER HANDLING	N2O		31	27	30	22	15	109	265	0.3%
6 B	WASTEWATER HANDLING	CH4				31		20	102	27	0.0%

Table A 16: Tier 2 - Key categories identified including their ranking in the level and trend assessment for the KCA including LULUCF

IPCC Category Code	IPCC Category	Greenhouse Gas	Tier 1 Level Assessment 1990	Tier 1 Level Assessment 2010	Tier 1 Trend Assessment 1990-2010	Tier 2 Level Assessment 1990	Tier 2 Level Assessment 2010	Tier 2 Trend Assessment 1990-2010	Base Year (1990) Estimate E _{x,0}	Latest Year (2010) Estimate E _{x,t}
1 A 1 a gaseous	Public Electricity and Heat Production	CO2	12	4	9				3 294	5 307
1 A 1 a liquid	Public Electricity and Heat Production	CO2	20	24	20				1 229	728
1 A 1 a other	Public Electricity and Heat Production	CO2		21	17		13	12	118	825
1 A 1 a solid	Public Electricity and Heat Production	CO2	4	9	6				6 247	3 870
1 A 1 b gaseous	Petroleum refining	CO2	29	29					437	530
1 A 1 b liquid	Petroleum refining	CO2	17	13	26				1 958	2 195
1 A 1 c gaseous	Manufacture of Solid fuels and Other Energy Industries	CO2	27	25	27				506	719
1 A 2 gaseous	Manufacturing Industries and Construction	CO2	7	2	4	5	2	13	4 265	6 848
1 A 2 mobile-liquid	Manufacturing Industries and Construction	CO2	39	20	16				256	1 069
1 A 2 other	Manufacturing Industries and Construction	CO2	38	22	18		14		264	783
1 A 2 solid	Manufacturing Industries and Construction	CO2	6	7					5 016	4 944
1 A 2 stat-liquid	Manufacturing Industries and Construction	CO2	13	14	14				2 884	1 811
1 A 3 b diesel oil	Road Transportation	CO2	5	1	1	4	1	7	5 362	16 280
1 A 3 b gasoline	Road Transportation	CO2	1	5	3	1	3		7 936	5 270
1 A 3 e gaseous	Other	CO2		34					224	320
1 A 4 biomass	Other Sectors	CH4	34			16			316	203
1 A 4 gaseous	Other Sectors	CO2	15	8	7		5		2 574	4 666
1 A 4 mobile-diesel	Other Sectors	CO2	25	26					737	704
1 A 4 other	Other Sectors	CO2	33		23				350	2
1 A 4 solid	Other Sectors	CO2	14		5				2 654	245
1 A 4 stat-liquid	Other Sectors	CO2	3	6	8	3	4		7 293	5 196
1 B 2 a	Oil	CO2							43	145
2 A 1	Cement Production	CO2	16	16	22				2 033	1 622
2 A 2	Lime Production	CO2	30	27	28				396	574
2 A 3	Limestone and Dolomite Use	CO2		28					203	294
2 A 7 b	Sinter Production	CO2	28	35	30				481	314
2 B 1	Ammonia Production	CO2	26	28					514	538
2 B 2	Nitric Acid Production	N2O	22		15				912	63
2 C 1	Iron and Steel Production	CO2	10	3	11				3 546	5 460
2 C 3	Aluminium production	PFC	21			11			1 050	0
2 C 4	SF6 used in Al and Mg Foundries	SF6	40		24				253	0
2 F 1/2/3/4/5	ODS Substitutes	HFC/PFC		18	13		11	5	24	1 165
2 F 9	Other Sources of SF6	PFC/SF6			33		22		127	245
3	SOLVENT AND OTHER PRODUCT USE	CO2	37						279	177
4 A 1	Cattle	CH4	9	10	21	7	6		3 551	3 045
4 B 1	Cattle	CH4	35			17			283	229
4 B 1	Cattle	N2O	24	23		13	15		759	744
4 D 1	Direct Soil Emissions	N2O	18	15	31	9	9	10	1 909	1 738
4 D 2	Pasture, Range and Paddock Manure	N2O				20	23		169	95
4 D 3	Indirect Emissions	N2O	19	19	25	10	12	8	1 352	1 096
5 A 1	Forest land remaining forest land	CO2	2	11	2	2	7	1	-7 617	-2 968
5 A 2	Land converted to forest land	CO2	8	12	12	6	8	4	-4 246	-2 443
5 B 1	Cropland remaining cropland	CO2				21	24	3	-152	64
5 B 2	Land converted to cropland	CO2	31	30		14	16	11	356	454
5 C 2	Land converted to grassland	CO2	32	31		15	17		353	367
5 D 2	Land converted to Wetlands	CO2		32	29	19	18	9	191	356
5 E 2	Land converted to Settlements	CO2	36	38		18	21		281	248
5 F 2	Land converted to Other land	CO2	23	33	19	12	19	2	866	347
6 A	SOLID WASTE DISPOSAL ON LAND	CH4	11	17	10	8	10	6	3 314	1 350
6 B	WASTEWATER HANDLING	N2O		37	32		20		109	265

Table A 17: Source/sink categories and emissions/removals for key category analysis.

IPCC Category Code	IPCC Category	Gas	Unit	1990	1995	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010
1 A 1 a liquid	Public Electricity and Heat Production	CO2	Gg	1 229	1 558	1 183	1 574	818	1 126	1 174	1 110	987	704	694	696	728
1 A 1 a solid	Public Electricity and Heat Production	CO2	Gg	6 247	4 530	4 824	5 873	5 510	6 916	6 674	5 844	5 643	5 067	4 440	3 018	3 870
1 A 1 a gaseous	Public Electricity and Heat Production	CO2	Gg	3 294	3 439	3 455	3 501	3 807	4 477	4 284	5 217	4 336	3 954	4 481	4 853	5 307
1 A 1 a other	Public Electricity and Heat Production	CO2	Gg	118	191	227	325	427	493	587	574	713	682	679	777	825
1 A 1 b liquid	Petroleum refining	CO2	Gg	1 958	2 169	1 847	1 810	2 207	2 304	2 505	2 447	2 459	2 524	2 403	2 233	2 195
1 A 1 b gaseous	Petroleum refining	CO2	Gg	437	421	352	409	358	384	339	380	371	344	403	576	530
1 A 1 c liquid	Manufacture of Solid fuels and Other Energy Industries	CO2	Gg	4	0	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
1 A 1 c gaseous	Manufacture of Solid fuels and Other Energy Industries	CO2	Gg	506	611	333	334	346	588	762	703	651	567	528	599	719
1 A 2 mobile-liquid	Manufacturing Industries and Construction	CO2	Gg	256	356	550	518	503	535	592	811	977	1 052	1 152	1 108	1 069
1 A 2 stat-liquid	Manufacturing Industries and Construction	CO2	Gg	2 884	2 689	2 060	2 274	1 772	1 989	2 260	2 276	2 169	2 072	1 850	1 674	1 811
1 A 2 solid	Manufacturing Industries and Construction	CO2	Gg	5 016	4 459	4 637	4 381	4 842	4 978	4 974	5 578	5 601	5 496	5 411	4 427	4 944
1 A 2 gaseous	Manufacturing Industries and Construction	CO2	Gg	4 265	5 517	6 149	5 975	6 257	6 349	6 408	6 944	6 610	6 621	6 750	6 620	6 848
1 A 2 other	Manufacturing Industries and Construction	CO2	Gg	264	467	464	568	672	828	864	758	745	690	769	710	783
1 A 3 a aviation gasoline	Civil Aviation	CO2	Gg	8	7	6	6	8	8	8	9	9	9	9	10	9
1 A 3 a jet kerosene	Civil Aviation	CO2	Gg	24	51	61	54	55	54	57	58	63	65	62	57	54
1 A 3 b gasoline	Road Transportation	CO2	Gg	7 936	7 432	6 109	6 152	6 620	6 770	6 588	6 396	6 138	5 993	5 381	5 357	5 270
1 A 3 b diesel oil	Road Transportation	CO2	Gg	5 362	7 768	11 916	13 211	14 833	16 431	17 137	17 609	16 480	16 823	16 058	15 429	16 280
1 A 3 b LPG	Road Transportation	CO2	Gg	27	32	46	53	71	72	60	62	64	62	64	97	100
1 A 3 b gaseous	Road Transportation	CO2	Gg	NO	NO	NO	NO	NO	NO	1	1	1	6	10	12	12
1 A 3 c liquid	Railways	CO2	Gg	171	143	133	128	139	139	139	160	156	154	153	147	148
1 A 3 c solid	Railways	CO2	Gg	7	6	2	2	2	1	1	0	1	1	0	1	0
1 A 3 d gas/diesel oil	Navigation	CO2	Gg	4	4	4	4	3	3	5	5	5	5	3	2	3
1 A 3 d gasoline	Navigation	CO2	Gg	10	10	10	10	10	9	9	9	9	9	9	9	9
1 A 3 e gaseous	Other	CO2	Gg	224	227	338	497	277	371	372	365	476	451	574	425	320
1 A 4 mobile-liquid	Other Sectors	CO2	Gg	144	145	141	142	141	141	141	138	135	132	129	126	124
1 A 4 mobile-diesel	Other Sectors	CO2	Gg	737	720	757	781	777	744	767	808	785	787	791	717	704
1 A 4 mobile-gasoline	Other Sectors	CO2	Gg	33	31	31	31	32	34	33	33	35	37	37	32	33
1 A 4 stat-liquid	Other Sectors	CO2	Gg	7 293	7 162	6 987	7 348	7 197	7 650	6 897	6 887	6 479	5 219	5 800	4 941	5 196
1 A 4 solid	Other Sectors	CO2	Gg	2 654	1 746	959	921	726	648	599	468	437	335	335	222	245
1 A 4 gaseous	Other Sectors	CO2	Gg	2 574	4 125	4 059	4 916	4 536	4 922	5 239	4 850	4 824	4 381	4 473	3 789	4 666
1 A 4 other	Other Sectors	CO2	Gg	350	181	144	65	64	68	54	41	28	58	47	45	2
1 A 5 liquid	Other	CO2	Gg	35	33	41	41	42	42	43	44	44	45	45	46	46
1 B 2 a	Oil	CO2	Gg	43	38	72	88	84	133	122	122	140	142	135	163	145
1 B 2 b	Natural gas	CO2	Gg	59	89	93	95	83	100	88	83	92	95	77	102	92
2 A 1	Cement Production	CO2	Gg	2 033	1 631	1 712	1 720	1 736	1 754	1 790	1 797	1 954	2 131	2 133	1 799	1 622
2 A 2	Lime Production	CO2	Gg	396	395	498	507	547	577	601	579	586	596	621	507	574

IPCC Category Code	IPCC Category	Gas	Unit	1990	1995	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010
2 A 3	Limestone and Dolomite Use	CO2	Gg	203	230	258	250	272	272	282	271	275	280	281	222	294
2 A 4	Soda Ash Production and use	CO2	Gg	5	6	8	7	8	8	16	13	12	11	10	9	10
2 A 7 a	Bricks and Tiles (decarbonizing)	CO2	Gg	116	149	116	124	120	116	134	128	130	130	110	94	81
2 A 7 b	Sinter Production	CO2	Gg	481	410	339	334	374	311	329	310	312	329	332	244	314
2 A 7 c	Glass Production	CO2	Gg	39	42	36	43	38	42	28	35	37	40	44	41	40
2 B 1	Ammonia Production	CO2	Gg	514	537	520	475	489	529	529	499	536	468	526	480	538
2 B 2	Nitric Acid Production	CO2	Gg	0	0	0	0	0	0	0	0	0	0	0	0	0
2 B 4	Carbide Production	CO2	Gg	38	26	48	47	41	41	36	36	31	36	41	42	43
2 B 5	Other	CO2	Gg	31	20	21	20	24	24	24	24	27	21	26	16	27
2 C 1	Iron and Steel Production	CO2	Gg	3 546	3 921	4 202	4 159	4 607	4 523	4 446	4 995	5 193	5 482	5 810	4 579	5 460
2 C 2	Ferroalloys Production	CO2	Gg	21	21	19	18	17	17	17	19	19	20	17	17	20
2 C 3	Aluminium production	CO2	Gg	158	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
3	SOLVENT AND OTHER PRODUCT USE	CO2	Gg	279	190	193	204	218	221	189	213	251	228	211	153	177
6 C	WASTE INCINERATION	CO2	Gg	27	11	12	12	12	12	12	12	10	8	6	4	2
1 A 1 a liquid	Public Electricity and Heat Production	CH4	Gg CO2 e	0	0	0	0	0	0	0	0	0	0	0	0	0
1 A 1 a solid	Public Electricity and Heat Production	CH4	Gg CO2 e	2	1	0	0	0	0	0	0	0	0	0	0	0
1 A 1 a gaseous	Public Electricity and Heat Production	CH4	Gg CO2 e	0	1	1	1	1	1	1	1	1	1	1	1	1
1 A 1 a biomass	Public Electricity and Heat Production	CH4	Gg CO2 e	0	0	1	1	1	1	1	1	1	2	2	2	2
1 A 1 a other	Public Electricity and Heat Production	CH4	Gg CO2 e	1	1	1	1	2	2	3	3	3	3	3	4	4
1 A 1 c liquid	Manufacture of Solid fuels and Other Energy Industries	CH4	Gg CO2 e	0	0	NO	NO	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	0	0	0	0	0	0	0	0	0	0	0	0
1 A 2 mobile-liquid	Manufacturing Industries and Construction	CH4	Gg CO2 e	0	0	1	0	0	0	0	0	1	1	1	1	1
1 A 2 stat-liquid	Manufacturing Industries and Construction	CH4	Gg CO2 e	1	1	1	1	1	1	1	1	1	1	1	1	1
1 A 2 solid	Manufacturing Industries and Construction	CH4	Gg CO2 e	2	1	2	2	2	2	2	2	3	3	2	2	2
1 A 2 gaseous	Manufacturing Industries and Construction	CH4	Gg CO2 e	2	3	3	3	3	3	4	4	4	4	4	4	4
1 A 2 biomass	Manufacturing Industries and Construction	CH4	Gg CO2 e	1	2	2	2	2	2	2	2	2	3	3	3	3
1 A 2 other	Manufacturing Industries and Construction	CH4	Gg CO2 e	1	1	2	2	2	3	4	3	3	3	4	4	5
1 A 3 a jet kerosene	Civil Aviation	CH4	Gg CO2 e	0	0	0	0	0	0	0	0	0	0	0	0	0
1 A 3 b gasoline	Road Transportation	CH4	Gg CO2 e	62	62	37	34	33	31	28	24	21	18	15	13	12
1 A 3 b diesel oil	Road Transportation	CH4	Gg CO2 e	2	3	3	3	3	3	3	3	3	3	3	3	3
1 A 3 c liquid	Railways	CH4	Gg CO2 e	0	0	0	0	0	0	0	0	0	0	0	0	0
1 A 3 c solid	Railways	CH4	Gg CO2 e	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
1 A 3 d gasoline	Navigation	CH4	Gg CO2 e	0	0	0	0	0	0	0	0	0	0	0	0	0
1 A 3 e gaseous	Other	CH4	Gg CO2 e	0	0	0	0	0	0	0	0	0	0	0	0	0
1 A 4 mobile-diesel	Other Sectors	CH4	Gg CO2 e	1	1	1	1	1	1	1	1	1	1	1	1	1
1 A 4 mobile-gasoline	Other Sectors	CH4	Gg CO2 e	1	1	1	1	1	1	1	1	1	1	1	1	1
1 A 4 mobile-liquid	Other Sectors	CH4	Gg CO2 e	1	1	1	1	1	1	1	1	1	1	1	1	1
1 A 4 stat-liquid	Other Sectors	CH4	Gg CO2 e	1	1	1	1	1	1	1	1	1	0	0	0	0

IPCC Category Code	IPCC Category	Gas	Unit	1990	1995	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010
1 A 4 solid	Other Sectors	CH4	Gg CO2 e	62	43	20	19	15	14	13	10	9	7	7	5	5
1 A 4 gaseous	Other Sectors	CH4	Gg CO2 e	4	1	1	1	1	1	2	1	1	1	1	1	1
1 A 4 biomass	Other Sectors	CH4	Gg CO2 e	316	303	238	242	221	216	205	214	194	186	190	181	203
1 A 4 other	Other Sectors	CH4	Gg CO2 e	1	0	0	0	0	0	0	0	0	0	0	0	0
1 A 5 liquid	Other	CH4	Gg CO2 e	0	0	0	0	0	0	0	0	0	0	0	0	0
1 B 1 a	Coal Mining	CH4	Gg CO2 e	11	6	6	5	6	5	1	0	0	NO	NO	NO	NO
1 B 2 a	Oil	CH4	Gg CO2 e	101	98	90	92	94	88	113	115	121	124	121	131	140
1 B 2 b	Natural gas	CH4	Gg CO2 e	96	122	117	114	110	119	116	120	124	130	135	142	139
2 B	CHEMICAL INDUSTRY	CH4	Gg CO2 e	15	14	15	14	15	15	15	16	19	19	19	18	18
2 C	METAL PRODUCTION	CH4	Gg CO2 e	0	0	0	0	0	0	0	0	0	0	0	0	0
4 A 1	Cattle	CH4	Gg CO2 e	3 551	3 390	3 206	3 159	3 097	3 062	3 065	3 023	3 016	3 017	3 020	3 056	3 045
4 A 3	Sheep	CH4	Gg CO2 e	52	61	57	54	51	55	55	55	52	59	56	58	60
4 A 4	Goats	CH4	Gg CO2 e	4	6	6	6	6	6	6	6	6	6	7	7	8
4 A 6	Horses	CH4	Gg CO2 e	19	27	31	31	31	33	33	33	33	33	33	33	33
4 A 8	Swine	CH4	Gg CO2 e	116	117	105	108	104	102	98	100	99	104	97	99	99
4 A 9	Poultry	CH4	Gg CO2 e	6	6	5	5	5	5	5	5	5	5	5	5	5
4 A-10	Other	CH4	Gg CO2 e	6	7	6	6	6	7	7	7	7	7	7	7	7
4 B 1	Cattle	CH4	Gg CO2 e	283	266	247	242	237	232	231	228	227	227	226	230	229
4 B 3	Sheep	CH4	Gg CO2 e	1	1	1	1	1	1	1	1	1	1	1	1	1
4 B 4	Goats	CH4	Gg CO2 e	0	0	0	0	0	0	0	0	0	0	0	0	0
4 B 6	Horses	CH4	Gg CO2 e	1	2	2	2	2	2	2	2	2	2	2	2	2
4 B 8	Swine	CH4	Gg CO2 e	123	117	96	98	93	90	84	85	82	84	77	78	77
4 B 9	Poultry	CH4	Gg CO2 e	23	23	19	20	20	20	20	20	20	20	20	20	20
4 B-10	Other	CH4	Gg CO2 e	0	0	0	0	0	0	0	0	0	0	0	0	0
4 D	AGRICULTURAL SOILS	CH4	Gg CO2 e	7	9	9	9	8	9	8	8	9	9	9	9	10
4 F	FIELD BURNING OF AGRICULTURAL RESIDUES	CH4	Gg CO2 e	1	1	1	1	1	1	1	1	1	1	1	1	1
6 A	SOLID WASTE DISPOSAL ON LAND	CH4	Gg CO2 e	3 314	2 806	2 206	2 123	2 134	2 176	2 034	1 911	1 819	1 704	1 576	1 458	1 351
6 B	WASTEWATER HANDLING	CH4	Gg CO2 e	102	88	56	51	46	41	38	34	31	29	27	27	27
6 C	WASTE INCINERATION	CH4	Gg CO2 e	0	0	0	0	0	0	0	0	0	0	0	0	0
6 D	OTHER WASTE	CH4	Gg CO2 e	11	22	26	30	33	37	45	49	51	53	53	53	53
1 A 1 a liquid	Public Electricity and Heat Production	N2O	Gg CO2 e	7	7	6	7	4	6	6	6	5	4	4	4	4
1 A 1 a solid	Public Electricity and Heat Production	N2O	Gg CO2 e	23	20	21	24	23	27	29	26	27	26	24	16	21
1 A 1 a gaseous	Public Electricity and Heat Production	N2O	Gg CO2 e	9	10	8	9	9	10	10	15	12	11	12	13	14
1 A 1 a biomass	Public Electricity and Heat Production	N2O	Gg CO2 e	1	4	9	12	15	16	19	21	32	42	50	53	60
1 A 1 a other	Public Electricity and Heat Production	N2O	Gg CO2 e	1	2	2	2	3	3	4	4	6	5	5	6	7
1 A 1 b liquid	Petroleum refining	N2O	Gg CO2 e	4	5	4	4	5	5	5	6	6	6	6	6	5
1 A 1 b gaseous	Petroleum refining	N2O	Gg CO2 e	0	0	0	0	0	0	0	0	0	0	0	0	0
1 A 1 c liquid	Manufacture of Solid fuels and Other Energy Industries	N2O	Gg CO2 e	0	0	NO	NO	NO	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	0	0	0	0	0	0	0	0	0	0	0	0

IPCC Category Code	IPCC Category	Gas	Unit	1990	1995	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010
1 A 2 mobile-liquid	Manufacturing Industries and Construction	N2O	Gg CO2 e	28	41	69	65	62	60	57	64	70	68	68	65	60
1 A 2 stat-liquid	Manufacturing Industries and Construction	N2O	Gg CO2 e	11	10	8	9	8	8	10	9	9	8	8	7	8
1 A 2 solid	Manufacturing Industries and Construction	N2O	Gg CO2 e	16	16	19	17	18	18	18	20	21	21	20	17	18
1 A 2 gaseous	Manufacturing Industries and Construction	N2O	Gg CO2 e	2	3	3	3	4	4	4	4	4	4	4	4	4
1 A 2 biomass	Manufacturing Industries and Construction	N2O	Gg CO2 e	22	27	31	34	28	32	32	43	43	52	52	51	50
1 A 2 other	Manufacturing Industries and Construction	N2O	Gg CO2 e	1	2	3	4	4	5	6	5	5	5	7	6	8
1 A 3 a jet kerosene	Civil Aviation	N2O	Gg CO2 e	0	1	1	1	1	1	1	1	1	1	1	1	1
1 A 3 b gasoline	Road Transportation	N2O	Gg CO2 e	133	196	193	191	200	198	183	168	148	131	107	95	84
1 A 3 b diesel oil	Road Transportation	N2O	Gg CO2 e	41	58	95	105	120	134	142	148	143	144	137	131	130
1 A 3 c liquid	Railways	N2O	Gg CO2 e	19	16	15	14	16	16	16	18	18	17	17	17	16
1 A 3 c solid	Railways	N2O	Gg CO2 e	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	0	0	0	0	0	0	1	1	1	1	0	0	0
1 A 3 d gasoline	Navigation	N2O	Gg CO2 e	0	0	0	0	0	0	0	0	0	0	0	0	0
1 A 3 e gaseous	Other	N2O	Gg CO2 e	0	0	0	0	0	0	0	0	0	0	0	0	0
1 A 4 mobile-liquid	Other Sectors	N2O	Gg CO2 e	7	8	8	8	7	7	6	6	6	5	5	5	4
1 A 4 mobile-diesel	Other Sectors	N2O	Gg CO2 e	78	79	89	93	92	86	87	90	87	84	81	71	66
1 A 4 mobile-gasoline	Other Sectors	N2O	Gg CO2 e	0	0	0	0	0	0	0	0	0	0	0	0	0
1 A 4 stat-liquid	Other Sectors	N2O	Gg CO2 e	26	27	27	28	28	29	27	27	25	21	23	20	21
1 A 4 solid	Other Sectors	N2O	Gg CO2 e	21	13	8	7	6	5	5	4	3	3	3	2	2
1 A 4 gaseous	Other Sectors	N2O	Gg CO2 e	14	23	23	28	25	28	29	27	27	25	25	21	26
1 A 4 biomass	Other Sectors	N2O	Gg CO2 e	86	90	86	91	87	88	87	96	86	87	90	90	100
1 A 4 other	Other Sectors	N2O	Gg CO2 e	1	1	1	0	0	0	0	0	0	0	0	0	0
1 A 5 liquid	Other	N2O	Gg CO2 e	1	1	1	1	1	1	1	1	1	1	1	1	1
2 B 2	Nitric Acid Production	N2O	Gg CO2 e	912	857	952	786	807	883	281	274	280	270	326	165	63
3	SOLVENT AND OTHER PRODUCT USE	N2O	Gg CO2 e	233	233	233	221	209	197	185	174	164	160	157	146	150
4 B 1	Cattle	N2O	Gg CO2 e	759	759	748	741	731	729	735	726	728	732	737	746	744
4 B 3	Sheep	N2O	Gg CO2 e	20	23	22	20	19	21	21	21	20	22	21	22	23
4 B 4	Goats	N2O	Gg CO2 e	2	3	3	4	3	3	3	3	3	4	4	4	4
4 B 6	Horses	N2O	Gg CO2 e	18	26	29	28	28	30	29	29	29	29	28	29	29
4 B 8	Swine	N2O	Gg CO2 e	88	86	71	73	70	68	64	64	63	64	59	59	58
4 B 9	Poultry	N2O	Gg CO2 e	46	55	51	54	55	58	59	61	62	63	64	64	64
4 B-10	Other	N2O	Gg CO2 e	2	3	2	2	2	3	3	3	3	3	3	3	3
4 D 1	Direct Soil Emissions	N2O	Gg CO2 e	1 909	2 167	1 822	1 842	1 846	1 721	1 681	1 694	1 744	1 771	1 878	1 822	1 738
4 D 2	Pasture, Range and Paddock Manure	N2O	Gg CO2 e	169	153	130	123	116	113	111	106	100	99	94	95	95
4 D 3	Indirect Emissions	N2O	Gg CO2 e	1 352	1 411	1 240	1 231	1 226	1 183	1 126	1 131	1 135	1 152	1 199	1 180	1 096
4 F	FIELD BURNING OF AGRICULTURAL RESIDUES	N2O	Gg CO2 e	0	0	0	0	0	0	0	0	0	0	0	0	0
6 B	WASTEWATER HANDLING	N2O	Gg CO2 e	109	125	205	229	229	227	226	238	252	256	260	262	265
6 C	WASTE INCINERATION	N2O	Gg CO2 e	0	0	0	0	0	0	0	0	0	0	0	0	0
6 D	OTHER WASTE	N2O	Gg CO2 e	24	45	53	60	67	73	92	100	105	109	108	108	108

IPCC Category Code	IPCC Category	Gas	Unit	1990	1995	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010
2 F 8	Electrical equipment	SF6	Gg CO2 e	12	16	17	18	19	19	20	22	22	24	27	27	31
2 C 3	Aluminium production	PFC	Gg CO2 e	1 050	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	443	37	29	7	4	0	5	13	0	0	1	0
2 F 7	Semiconductor manufacture	HFC/ PFC/ SF6	Gg CO2 e	133	506	404	445	446	484	510	298	309	288	280	105	134
2 F 1/2/3/4/5	ODS Substitutes	HFC/ PFC	Gg CO2 e	24	406	915	935	979	960	962	991	966	1 061	1 057	1 061	1 165
2 F 9	Other Sources of SF6	PFC/ SF6	Gg CO2 e	127	266	208	247	250	166	96	312	263	253	251	247	245
5 A 1_CO2	Forest land remaining forest land	CO2	Gg	-7 617	-8 977	-13 461	-15 488	-9 846	73	-5 038	-6 519	-732	268	1 135	-2 965	-2 968
5 A 2_CO2	Land converted to forest land	CO2	Gg	-4 246	-4 166	-2 991	-2 865	-2 806	-2 686	-2 658	-2 630	-2 602	-2 574	-2 546	-2 495	-2 443
5 B 1_CO2	Cropland remaining cropland	CO2	Gg	-152	-66	-6	3	11	23	45	43	49	60	52	72	64
5 B 2_CO2	Land converted to cropland	CO2	Gg	356	320	300	297	365	363	363	360	365	385	414	445	454
5 C 1_CO2	Grassland remaining grassland	CO2	Gg	-96	-95	-95	-94	-93	-91	-90	-89	-89	-88	-86	-86	-86
5 C 2_CO2	Land converted to grassland	CO2	Gg	353	148	198	204	396	397	398	399	398	400	398	374	367
5 D 2_CO2	Land converted to Wetlands	CO2	Gg	191	241	286	296	314	324	335	329	332	347	346	347	356
5 E 2_CO2	Land converted to Settlements	CO2	Gg	281	211	91	95	164	171	179	249	250	250	250	252	248
5 F 2_CO2	Land converted to Other land	CO2	Gg	866	747	606	592	479	458	442	425	408	391	374	361	347
5_CH4	Total land use categories	CH4	Gg CO2 e	1	0	0	0	1	1	0	0	0	0	0	0	0
5_N2O	Total land use categories	N2O	Gg CO2 e	41	39	37	36	36	36	36	36	39	43	48	49	50

ANNEX 2: SECTOR 1.A FUEL COMBUSTION

This annex includes detailed information about category 1.A (trend information by sub-category), a description of the national energy balance (including fuel and fuel categories) and a description of the methodology applied to extract activity data from the energy balance for the calculation of emissions for Sector 1.A Fuel Combustion (e.g. correspondence of categories of the energy balance to IPCC categories). Activity data used for estimating emissions in the sectoral approach as taken from the energy balance is also presented.

Furthermore, the revision of the national energy balance as well as the implication of this revision on activity data is described.

Trend information by sub category

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

Table A 18: Greenhouse gas emissions from Category 1.A.1.a

	CO ₂ [Gg]	CH ₄ [Gg]	N ₂ O [Gg]	CO ₂ equiv. [Gg]
1990	10 888	0.15	0.13	10 932
1991	11 645	0.17	0.15	11 697
1992	8 403	0.14	0.12	8 443
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	10 958	0.18	0.13	11 002
1998	10 017	0.17	0.15	10 067
1999	9 974	0.16	0.15	10 023
2000	9 689	0.15	0.15	9 738
2001	11 273	0.19	0.17	11 331
2002	10 562	0.19	0.17	10 620
2003	13 012	0.22	0.20	13 080
2004	12 719	0.25	0.22	12 794
2005	12 745	0.23	0.23	12 822
2006	11 679	0.28	0.27	11 767
2007	10 407	0.28	0.28	10 501
2008	10 294	0.30	0.31	10 395
2009	9 344	0.33	0.30	9 443
2010	10 730	0.35	0.34	10 843
<i>Trend 1990-2010</i>	-1.5%	138.8%	156.9%	-0.8%

Solid fossil fuels and natural gas are dominant compared to other fuel types. Since 2000 liquid fossil fuels became less important. The share in CO₂ emissions from waste incineration in district heating plants which are reported as 'other fuels' increased from 1% in 1990 to 8% in 2009.

Table A 19: Share of fuel types on total CO₂ emissions from Category 1.A.1.a

	Liquid	Solid	Gaseous	Other
1990	11%	57%	30%	1%
1991	13%	59%	27%	1%
1992	18%	48%	33%	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%	36%	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	8%	48%	37%	6%
2007	7%	49%	38%	7%
2008	7%	43%	44%	7%
2009	7%	32%	52%	8%
2010	7%	36%	49%	8%

1.A.1.b Petroleum Refining

Table A 20: Greenhouse gas emissions from Category 1.A.1.b.

	CO ₂ [Gg]	CH ₄ [Gg]	N ₂ O [Gg]	CO ₂ equiv. [Gg]
1990	2 394	IE	0,015	2 399
1991	2 428	IE	0,016	2 433
1992	2 389	IE	0,016	2 394
1993	2 732	IE	0,018	2 737
1994	2 709	IE	0,018	2 715
1995	2 590	IE	0,017	2 596
1996	2 647	IE	0,017	2 652
1997	2 640	IE	0,017	2 645
1998	2 633	IE	0,017	2 639
1999	2 152	IE	0,015	2 156
2000	2 199	IE	0,015	2 204
2001	2 219	IE	0,015	2 224

	CO ₂ [Gg]	CH ₄ [Gg]	N ₂ O [Gg]	CO ₂ equiv. [Gg]
2002	2 565	IE	0,017	2 570
2003	2 687	IE	0,017	2 693
2004	2 844	IE	0,016	2 848
2005	2 827	IE	0,019	2 833
2006	2 830	IE	0,019	2 836
2007	2 868	IE	0,020	2 874
2008	2 806	IE	0,019	2 812
2009	2 809	IE	0,019	2 815
2010	2 724	IE	0,017	2 730
<i>Trend 1990-2010</i>	13,8%	-	12,4%	13,8%

Table A 21 presents the share of CO₂ emissions on the different fuel types.

Table A 21: Share of fuel types on total CO₂ 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	87%	13%
2000	84%	16%
2001	82%	18%
2002	86%	14%
2003	86%	14%
2004	88%	12%
2005	87%	13%
2006	87%	13%
2007	88%	12%
2008	86%	14%
2009	80%	20%
2010	81%	19%

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

Table A 22: Greenhouse gas emissions from Category 1.A.1.c.

	CO ₂ [Gg]	CH ₄ [Gg]	N ₂ O [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	277
1998	352	0.010	0.0006	352
1999	402	0.011	0.0007	402
2000	333	0.009	0.0006	334
2001	334	0.009	0.0006	334
2002	346	0.009	0.0006	347
2003	588	0.016	0.0011	589
2004	762	0.021	0.0014	763
2005	703	0.019	0.0013	704
2006	651	0.018	0.0012	651
2007	567	0.015	0.0010	568
2008	528	0.014	0.0010	528
2009	599	0.016	0.0011	599
2010	719	0.019	0.0013	720
<i>Trend 1990-2010</i>	41.0%	42.0%	33.2%	41.0%

Almost all emissions of category 1.A.1.c originated from natural gas combustion.

Table A 23: Share of fuel types on total CO₂ 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%
2009	NO	100%
2010	NO	100%

1.A.2.a Iron and Steel

Table A 24: Greenhouse gas emissions from Category 1.A.2.a.

	CO₂ [Gg]	CH₄ [Gg]	N₂O [Gg]	CO₂ 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	4 838	0.030	0.049	4 853
2000	5 217	0.038	0.056	5 235
2001	5 192	0.036	0.053	5 209
2002	5 515	0.038	0.053	5 532
2003	5 630	0.078	0.054	5 649
2004	5 858	0.089	0.055	5 876
2005	6 462	0.101	0.059	6 483
2006	6 357	0.109	0.062	6 379
2007	6 317	0.101	0.063	6 339
2008	6 199	0.091	0.061	6 220
2009	5 091	0.095	0.049	5 108
2010	5 835	0.080	0.058	5 855
<i>Trend 1990-2010</i>	18.0%	216.5%	36.2%	18.1%

CO₂ emissions from category 1.A.2.a mainly arise from solid fossil fuels (coke oven coke for blast furnaces).

Table A 25: Share of fuel types in total CO₂ 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%

	Liquid	Solid	Gaseous
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	17.0%	63.8%	19.2%
2002	11.9%	69.3%	18.8%
2003	9.9%	72.0%	18.1%
2004	12.0%	68.8%	19.2%
2005	12.3%	69.6%	18.1%
2006	12.1%	69.5%	18.4%
2007	13.6%	69.2%	17.2%
2008	12.8%	70.4%	16.8%
2009	11.6%	67.9%	20.5%
2010	11.6%	71.2%	17.2%

1.A.2.b Non-Ferrous Metals

Table A 26: Greenhouse gas emissions from Category 1.A.2.b.

	CO₂ [Gg]	CH₄ [Gg]	N₂O [Gg]	CO₂ 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	190	0.004	0.0011	191
2000	193	0.004	0.0010	194
2001	207	0.005	0.0010	207
2002	208	0.005	0.0010	209
2003	213	0.005	0.0010	214
2004	221	0.005	0.0009	221
2005	221	0.005	0.0009	221
2006	226	0.006	0.0009	226
2007	254	0.006	0.0009	255
2008	257	0.006	0.0008	257
2009	272	0.007	0.0009	273
2010	243	0.006	0.0007	243
<i>Trend 1990-2010</i>	84.0%	100.6%	-17.9%	83.8%

CO₂ emissions arise from combustion of natural gas and residual fuel oil.

Table A 27: Share of fuel types in total CO₂ emissions from Category 1.A.2.b

	Liquid	Solid	Gaseous
1990	27%	17%	57%
1991	29%	15%	56%
1992	25%	6%	69%
1993	21%	12%	67%
1994	15%	6%	79%
1995	16%	4%	80%
1996	28%	9%	63%
1997	32%	9%	59%
1998	30%	8%	62%
1999	25%	12%	63%
2000	24%	10%	66%
2001	26%	5%	70%
2002	21%	8%	71%
2003	19%	8%	73%
2004	17%	7%	76%
2005	15%	6%	79%
2006	14%	6%	80%
2007	11%	6%	83%
2008	9%	6%	85%
2009	9%	6%	85%
2010	8%	5%	87%

1.A.2.c Chemicals

Table A 28: Greenhouse gas emissions from Category 1.A.2.c.

	CO ₂ [Gg]	CH ₄ [Gg]	N ₂ O [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	1 349	0,065	0,028	1 359
2000	1 376	0,071	0,023	1 384
2001	1 417	0,074	0,016	1 424
2002	1 439	0,088	0,017	1 446
2003	1 542	0,109	0,021	1 551

	CO ₂ [Gg]	CH ₄ [Gg]	N ₂ O [Gg]	CO ₂ equiv. [Gg]
2004	1 523	0,125	0,022	1 532
2005	1 643	0,108	0,020	1 652
2006	1 367	0,091	0,018	1 374
2007	1 275	0,072	0,018	1 282
2008	1 393	0,084	0,018	1 401
2009	1 306	0,072	0,016	1 312
2010	1 360	0,086	0,019	1 368
<i>Trend 1990-2010</i>	54,2%	91,9%	10,4%	53,9%

In 2010 natural gas was still the main source of CO₂ emissions from category 1.A.2.c while CO₂ emissions from solid and liquid fossil fuel combustion got less important.

Table A 29: Share of fuel types in total CO₂ emissions from Category 1.A.2.c

	Liquid	Solid	Gaseous	Other
1990	9%	12%	59%	20%
1991	10%	15%	51%	24%
1992	6%	19%	50%	26%
1993	7%	18%	58%	16%
1994	9%	15%	56%	19%
1995	9%	15%	55%	22%
1996	8%	17%	51%	24%
1997	11%	21%	50%	18%
1998	10%	22%	52%	16%
1999	5%	23%	60%	12%
2000	4%	18%	64%	15%
2001	5%	18%	60%	16%
2002	4%	17%	58%	21%
2003	4%	16%	54%	25%
2004	4%	16%	55%	25%
2005	4%	9%	64%	23%
2006	3%	8%	64%	25%
2007	5%	6%	69%	20%
2008	4%	5%	70%	21%
2009	8%	5%	67%	19%
2010	6%	6%	65%	23%

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

Table A 30: Greenhouse gas emissions from Category 1.A.2.d.

	CO ₂ [Gg]	CH ₄ [Gg]	N ₂ O [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

	CO ₂ [Gg]	CH ₄ [Gg]	N ₂ O [Gg]	CO ₂ equiv.[Gg]
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	2 219	0.14	0.08	2 247
2002	2 214	0.13	0.06	2 236
2003	2 384	0.13	0.07	2 408
2004	2 262	0.13	0.07	2 285
2005	2 299	0.15	0.09	2 329
2006	2 208	0.14	0.08	2 236
2007	2 187	0.14	0.08	2 215
2008	2 198	0.14	0.08	2 225
2009	2 101	0.14	0.08	2 129
2010	2 229	0.15	0.08	2 257
<i>Trend 1990-2010</i>	0.7%	25.9%	40.0%	1.1%

Natural gas combustion is the main source of CO₂ emissions from category 1.A.2.d. Liquid fuel consumption decreased since 1990 whereas the share of solid fuels in total CO₂ emissions is quite constant.

Table A 31: Share of fuel types in total CO₂ 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%	75%	0%
2006	6%	21%	73%	0%
2007	4%	17%	78%	1%

	Liquid	Solid	Gaseous	Other
2008	4%	15%	81%	0%
2009	5%	16%	78%	0%
2010	3%	15%	82%	0%

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

Table A 32: Greenhouse gas emissions from Category 1 A 2 e.

	CO ₂ [Gg]	CH ₄ [Gg]	N ₂ O [Gg]	CO ₂ equiv. [Gg]
1990	870	0.018	0.005	872
1991	933	0.020	0.006	935
1992	854	0.018	0.005	856
1993	886	0.016	0.005	888
1994	916	0.019	0.005	918
1995	931	0.019	0.005	933
1996	888	0.019	0.004	889
1997	1 042	0.022	0.004	1 043
1998	943	0.021	0.004	944
1999	826	0.020	0.004	828
2000	883	0.022	0.004	885
2001	926	0.022	0.005	928
2002	1 101	0.028	0.005	1 103
2003	945	0.022	0.005	947
2004	948	0.021	0.005	950
2005	967	0.023	0.006	970
2006	946	0.023	0.006	948
2007	895	0.022	0.005	897
2008	884	0.022	0.005	886
2009	952	0.023	0.005	954
2010	1 021	0.025	0.005	1 023
<i>Trend 1990-2010</i>	17.4%	37.4%	3.2%	17.3%

The share of natural gas consumption is increasing and is the main source of CO₂ emissions from category 1.A.2.e. The share of liquid fossil fuel combustion in total CO₂ emissions decreased since 1990.

Table A 33: Share of fuel types in total CO₂ emissions from Category 1 A 2 e.

	Liquid	Solid	Gaseous	Other
1990	40%	2%	58%	40%
1991	42%	2%	55%	42%
1992	40%	1%	59%	40%
1993	44%	2%	54%	44%
1994	38%	2%	59%	38%

	Liquid	Solid	Gaseous	Other
1995	37%	1%	63%	37%
1996	29%	1%	70%	29%
1997	30%	1%	69%	30%
1998	26%	1%	72%	26%
1999	20%	1%	79%	20%
2000	19%	3%	79%	19%
2001	26%	1%	73%	26%
2002	16%	1%	82%	16%
2003	24%	2%	75%	24%
2004	27%	1%	72%	27%
2005	25%	1%	74%	25%
2006	26%	1%	73%	26%
2007	23%	1%	75%	23%
2008	22%	1%	77%	22%
2009	22%	1%	76%	22%
2010	26%	1%	73%	26%

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

Table A 34: Greenhouse gas emissions from Category 1.A.2.f.

	CO₂ [Gg]	CH₄ [Gg]	N₂O [Gg]	CO₂ equiv. [Gg]
1990	3 644	0.130	0.137	3 689
1991	3 827	0.143	0.152	3 877
1992	3 882	0.154	0.156	3 934
1993	3 954	0.146	0.163	4 008
1994	4 078	0.149	0.168	4 133
1995	4 178	0.154	0.176	4 236
1996	4 428	0.166	0.220	4 500
1997	4 669	0.163	0.202	4 735
1998	4 375	0.171	0.239	4 453
1999	3 652	0.160	0.252	3 733
2000	3 844	0.175	0.282	3 935
2001	3 754	0.184	0.271	3 842
2002	3 570	0.175	0.259	3 654
2003	3 964	0.176	0.262	4 049
2004	4 288	0.200	0.258	4 372
2005	4 775	0.223	0.296	4 871
2006	4 996	0.250	0.324	5 102
2007	5 005	0.276	0.341	5 116
2008	5 002	0.308	0.347	5 116
2009	4 816	0.303	0.332	4 926
2010	4 768	0.332	0.313	4 872
<i>Trend 1990-2010</i>	30.9%	155.4%	128.6%	32.1%

Natural gas and liquid fossil fuel combustion is the main source of CO₂ emissions from category 1 A 2 f. The share of fossil fuel types on total CO₂ emissions is quite constant over the years.

Table A 35: Share of fuel types in total CO₂ emissions from category 1 A 2 f.

	Liquid	Solid	Gaseous	Other
1990	38%	17%	43%	2%
1991	39%	15%	43%	4%
1992	33%	16%	46%	4%
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	35%	13%	45%	7%
2001	36%	12%	43%	9%
2002	33%	9%	48%	10%
2003	37%	7%	45%	11%
2004	39%	6%	44%	11%
2005	38%	10%	44%	8%
2006	39%	12%	42%	8%
2007	37%	13%	41%	8%
2008	37%	12%	41%	9%
2009	36%	11%	43%	9%
2010	37%	8%	46%	10%

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

Table A 36: Greenhouse gas emissions from Category 1.A.2.f stationary sources.

	CO ₂ [Gg]	CH ₄ [Gg]	N ₂ O [Gg]	CO ₂ equiv. [Gg]
1990	3 388	0.12	0.05	3 405
1991	3 538	0.13	0.05	3 556
1992	3 576	0.14	0.05	3 594
1993	3 633	0.13	0.05	3 651
1994	3 742	0.13	0.05	3 759
1995	3 822	0.14	0.04	3 839
1996	3 986	0.15	0.05	4 004
1997	4 250	0.14	0.04	4 265
1998	3 883	0.15	0.04	3 899
1999	3 181	0.14	0.06	3 204
2000	3 294	0.15	0.06	3 315
2001	3 237	0.16	0.06	3 259

	CO ₂ [Gg]	CH ₄ [Gg]	N ₂ O [Gg]	CO ₂ equiv. [Gg]
2002	3 067	0.15	0.06	3 088
2003	3 429	0.16	0.07	3 454
2004	3 695	0.18	0.07	3 722
2005	3 964	0.20	0.09	3 995
2006	4 020	0.22	0.10	4 055
2007	3 953	0.25	0.12	3 996
2008	3 850	0.28	0.13	3 896
2009	3 708	0.28	0.12	3 753
2010	3 699	0.31	0.12	3 742
<i>Trend 1990-2010</i>	9.2%	163.7%	151.9%	9.9%

Natural gas and liquid fossil fuel combustion is the main stationary source of CO₂ emissions from category 1 A 2 f. Solid and liquid fuels got less important but CO₂ emissions from combustion of natural gas and industrial waste which is reported as “Other fuels” are increasing.

Table A 37: Share of fuel types on total CO₂ emissions from Category 1.A.2.f stationary sources.

	Liquid	Solid	Gaseous	Other
1990	33%	18%	46%	2%
1991	34%	16%	46%	4%
1992	28%	18%	50%	5%
1993	37%	15%	45%	3%
1994	34%	11%	50%	6%
1995	30%	12%	53%	5%
1996	31%	14%	50%	5%
1997	40%	14%	39%	7%
1998	37%	15%	42%	6%
1999	30%	15%	47%	9%
2000	24%	16%	52%	8%
2001	26%	14%	50%	10%
2002	22%	11%	56%	12%
2003	27%	8%	53%	12%
2004	29%	7%	51%	12%
2005	25%	12%	53%	9%
2006	24%	15%	52%	10%
2007	21%	17%	52%	11%
2008	18%	16%	54%	12%
2009	17%	14%	56%	12%
2010	19%	10%	59%	12%

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

Table A 38: Greenhouse gas emissions from Category 1.A.2.f - cement clinker production.

	CO ₂ [Gg]	CH ₄ [Gg]	N ₂ O [Gg]	CO ₂ equiv. [Gg]
1990	1 055	0.06	0.02	1 061
1991	1 038	0.06	0.02	1 044
1992	1 107	0.06	0.02	1 114
1993	1 038	0.06	0.02	1 045
1994	1 089	0.06	0.02	1 095
1995	867	0.05	0.01	872
1996	848	0.06	0.01	853
1997	932	0.06	0.01	938
1998	853	0.07	0.02	859
1999	826	0.06	0.01	832
2000	866	0.07	0.02	872
2001	807	0.08	0.02	813
2002	830	0.08	0.02	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
2009	931	0.11	0.02	939
2010	820	0.10	0.02	828
Trend 1990-2010	-22.2%	83.1%	11.1%	-22.0%

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

Table A 39: Greenhouse gas emissions from Category 1 A 2 f mobile sources.

	CO ₂ [Gg]	CH ₄ [Gg]	N ₂ O [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

	CO ₂ [Gg]	CH ₄ [Gg]	N ₂ O [Gg]	CO ₂ equiv. [Gg]
2002	503	0.02	0.20	565
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	1 220
2009	1 108	0.03	0.21	1 173
2010	1 069	0.02	0.19	1 130
<i>Trend 1990-2010</i>	318.1%	83.2%	116.4%	298.1%

All emissions from mobile machinery of industry arise from liquid fuels.

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

Table A 40: Greenhouse gas emissions from Category 1.A.3.e.

	CO ₂ [Gg]	CH ₄ [Gg]	N ₂ O [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	338	0.009	0.0006	338
2001	497	0.013	0.0009	497
2002	277	0.008	0.0005	277
2003	371	0.010	0.0007	372
2004	372	0.010	0.0007	372
2005	365	0.010	0.0007	366
2006	476	0.013	0.0009	477
2007	451	0.012	0.0008	452
2008	574	0.016	0.0010	575
2009	425	0.011	0.0008	425
2010	320	0.009	0.0006	321
<i>Trend 1990-2010</i>	42.8%	42.8%	42.8%	42.8%

Combustion of natural gas is the only source of CO₂ emissions from category 1.A.3.e.

1.A.4 Other sectors

Table A 41: Greenhouse gas emissions from Category 1.A.4.

	CO ₂ [Gg]	CH ₄ [Gg]	N ₂ O [Gg]	CO ₂ equiv. [Gg]
1990	13 785	18.40	0.75	14 405
1991	14 883	19.90	0.81	15 551
1992	14 439	18.12	0.78	15 063
1993	14 258	17.78	0.79	14 876
1994	12 979	16.10	0.75	13 549
1995	14 112	16.76	0.78	14 705
1996	15 260	17.76	0.83	15 890
1997	13 773	13.44	0.81	14 305
1998	13 724	12.93	0.79	14 241
1999	14 256	13.31	0.81	14 788
2000	13 079	12.53	0.78	13 583
2001	14 204	12.66	0.82	14 725
2002	13 474	11.48	0.79	13 960
2003	14 206	11.16	0.79	14 684
2004	13 730	10.58	0.78	14 194
2005	13 225	10.85	0.81	13 703
2006	12 723	9.88	0.76	13 165
2007	10 949	9.37	0.72	11 371
2008	11 612	9.58	0.74	12 041
2009	9 871	9.01	0.67	10 269
2010	10 970	10.07	0.71	11 401
<i>Trend 1990-2010</i>	-20.4%	-45.3%	-6.1%	-20.9%

As can be seen from Table A 35 liquid fossil fuels are the main source of CO₂ 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 CO₂ emissions from natural gas combustion more than doubled.

Table A 42: Share of fuel types on total CO₂ 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	61%	7%	30%	1%

	Liquid	Solid	Gaseous	Other
2000	61%	7%	31%	1%
2001	58%	6%	35%	0%
2002	60%	5%	34%	0%
2003	60%	5%	35%	0%
2004	57%	4%	38%	0%
2005	59%	4%	37%	0%
2006	58%	3%	38%	0%
2007	56%	3%	40%	1%
2008	58%	3%	39%	0%
2009	59%	2%	38%	0%
2010	55%	2%	43%	0%

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 43: Greenhouse gas emissions from Category 1.A.4 stationary sources.

	CO ₂ [Gg]	CH ₄ [Gg]	N ₂ O [Gg]	CO ₂ equiv. [Gg]	Heating degree days ⁽¹⁾
1990	12 870	18.26	0.48	13 402	3 237
1991	13 971	19.77	0.53	14 550	3 612
1992	13 519	17.98	0.50	14 053	3 356
1993	13 334	17.65	0.51	13 861	3 414
1994	12 048	15.97	0.46	12 526	3 138
1995	13 215	16.63	0.50	13 718	3 415
1996	14 334	17.63	0.54	14 871	3 820
1997	12 810	13.32	0.49	13 243	3 485
1998	12 778	12.80	0.48	13 196	3 309
1999	13 302	13.19	0.50	13 733	3 253
2000	12 149	12.42	0.46	12 554	2 958
2001	13 250	12.55	0.50	13 668	3 294
2002	13 250	12.55	0.50	13 668	3 191
2003	13 287	11.05	0.48	13 670	3 463
2004	12 789	10.47	0.48	13 157	3 322
2005	12 246	10.74	0.50	12 626	3 527
2006	11 768	9.78	0.46	12 115	3 315
2007	9 993	9.27	0.44	10 323	3 025
2008	10 655	9.48	0.46	10 996	3 131
2009	8 997	8.93	0.43	9 317	3 138
2010	10 109	9.99	0.48	10 468	3 557
<i>Trend 1990-2010</i>	-21.5%	-45.3%	0.7%	-21.9%	9.9%

⁽¹⁾ Source: STATISTIK AUSTRIA

Liquid fossil fuels are the main stationary source of CO₂ 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 CO₂ emissions from natural gas combustion more than doubled.

Table A 44: Share of fuel types in total CO₂ 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%	29%	2.1%
1997	58%	10%	30%	2.1%
1998	58%	9%	32%	1.3%
1999	59%	8%	32%	1.1%
2000	58%	8%	33%	1.2%
2001	55%	7%	37%	0.5%
2002	54%	5%	34%	0.5%
2003	58%	5%	37%	0.5%
2004	54%	5%	41%	0.4%
2005	56%	4%	40%	0.3%
2006	55%	4%	41%	0.2%
2007	52%	3%	44%	0.6%
2008	54%	3%	42%	0.4%
2009	55%	2%	42%	0.5%
2010	51%	2%	46%	0.0%

1.A.4.a Commercial/Institutional – stationary sources

The following table presents greenhouse gas emissions from 1.A.4.a Commercial/Institutional - stationary sources.

Table A 45: Greenhouse gas emissions from Category 1.A.4.a Commercial/Institutional- stationary sources.

	CO ₂ [Gg]	CH ₄ [Gg]	N ₂ O [Gg]	CO ₂ equiv. [Gg]
1990	2 568	0.22	0.04	2 585
1991	2 608	0.24	0.04	2 627
1992	3 124	0.23	0.05	3 145
1993	3 183	0.20	0.06	3 205
1994	2 672	0.18	0.05	2 691
1995	3 263	0.16	0.06	3 284
1996	3 526	0.16	0.06	3 547
1997	3 575	0.48	0.06	3 605

	CO ₂ [Gg]	CH ₄ [Gg]	N ₂ O [Gg]	CO ₂ equiv. [Gg]
1998	3 274	0.44	0.06	3 301
1999	3 750	0.72	0.07	3 786
2000	2 984	0.78	0.06	3 019
2001	3 898	0.51	0.07	3 930
2002	3 756	0.41	0.07	3 784
2003	4 436	0.46	0.08	4 470
2004	4 226	0.43	0.08	4 260
2005	3 441	0.23	0.07	3 466
2006	3 669	0.23	0.07	3 694
2007	2 831	0.22	0.06	2 853
2008	3 311	0.23	0.06	3 335
2009	1 956	0.19	0.04	1 972
2010	2 303	0.21	0.05	2 322
<i>Trend 1990-2010</i>	-10.3%	-5.9%	16.5%	-10.2%

1.A.4.b Residential – stationary sources

The following table presents greenhouse gas emissions from *1.A.4.b Residential – stationary sources*.

Table A 46: Greenhouse gas emissions from Category 1.A.4.b Residential – stationary sources.

	CO ₂ [Gg]	CH ₄ [Gg]	N ₂ O [Gg]	CO ₂ equiv. [Gg]
1990	9 820	17.90	0.42	10 325
1991	10 919	19.37	0.46	11 470
1992	9 996	17.61	0.43	10 499
1993	9 862	17.31	0.43	10 359
1994	9 154	15.67	0.40	9 606
1995	9 714	16.33	0.42	10 188
1996	10 548	17.32	0.46	11 053
1997	8 973	12.05	0.41	9 353
1998	9 230	11.61	0.40	9 598
1999	9 258	11.66	0.40	9 628
2000	8 906	10.86	0.38	9 252
2001	9 094	11.24	0.40	9 454
2002	8 552	10.25	0.38	8 884
2003	8 614	9.88	0.38	8 938
2004	8 336	9.37	0.37	8 647
2005	8 656	9.92	0.40	8 987
2006	7 963	8.98	0.36	8 262
2007	7 050	8.50	0.34	7 334
2008	7 230	8.68	0.35	7 521
2009	6 958	8.19	0.35	7 237
2010	7 689	9.16	0.38	8 001
<i>Trend 1990-2010</i>	-21.7%	-48.8%	-7.8%	-22.5%

1.A.4.c Agriculture/Forestry/Fisheries – stationary sources

The following table presents greenhouse gas emissions from 1.A.4.c Agriculture/Forestry/Fisheries – stationary sources.

Table A 47: Greenhouse gas emissions from Category 1.A.4.c Agriculture/Forestry/Fisheries – stationary sources.

	CO ₂ [Gg]	CH ₄ [Gg]	N ₂ O [Gg]	CO ₂ equiv. [Gg]
1990	482	0.14	0.02	491
1991	443	0.16	0.02	453
1992	399	0.15	0.02	409
1993	289	0.14	0.02	298
1994	222	0.12	0.02	230
1995	237	0.13	0.02	246
1996	261	0.14	0.02	271
1997	262	0.79	0.02	286
1998	274	0.75	0.02	297
1999	294	0.80	0.02	318
2000	259	0.78	0.02	283
2001	258	0.80	0.03	283
2002	217	0.71	0.03	240
2003	237	0.70	0.03	261
2004	227	0.67	0.03	251
2005	148	0.59	0.04	172
2006	136	0.56	0.04	159
2007	111	0.55	0.04	135
2008	114	0.57	0.04	139
2009	83	0.55	0.04	108
2010	117	0.62	0.05	145
<i>Trend 1990-2010</i>	-75.7%	340.9%	147.5%	-70.4%

Activity Data Recalculations

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

- **Hard coal**
Revision of final consumption 2009 (-0.5 PJ) which affects category 1.A.4 Other Sectors.
- **Coking coke**
Revision of final consumption 2009 (-0.6 PJ) which affects category 1.A.4 Other Sectors.
Revision of non energy use 2009 (-2.6 PJ) which affects category 1.A.2.a Iron and Steel.
- **Residual fuel oil**
Revision of final consumption 2009 (-2.7 PJ) which affects categories 1.A.2 Manufacturing industries and construction and 1.A.4 Other Sectors.
- **Kerosene**
Harmonization of international bunkers fuel consumption with the output of the inventory bottom up model for air transport.
- **Motor Gasoline**
Revision of final consumption 2009 (-3.0 PJ) which affects category 1.A.3.b Road Transportation.
- **Natural Gas**
Revision of gross inland consumption 2002 – 2005 (between -3.8 PJ to +10 PJ) and 2009 (+1.5 PJ). For the year 2009 final energy consumption (1.A.4 and 1.A.2) has been revised by -12.3 PJ, the transformation sector (1.A.1.a) has been revised by +0.9 PJ, energy industries (1.A.1.b and 1.A.1.c) has been revised by +9.0 PJ and non energy use has been revised by +4.0 PJ.
For 2005 to 2009 the non energy use of natural gas which could not be allocated to process emissions under 2.B.1 Ammonia Production is now considered under 1.A.2.f Other Manufacturing Industries.
- **Biomass**
Revision of log wood final consumption 2001 – 2009 (-3.3 PJ) which affects category 1.A.4 Other Sectors. Revision of other solid biomass gross consumption 2005 (-4.0 PJ) and 2009 (+3.7 PJ). This affects the transformation sector (1.A.1.a) as well as final consumption allocated to 1.A.2 Manufacturing Industries and Construction and 1.A.4 Other Sectors.

Table A 48: Activity data recalculations by sub categories with respect to previous submission [PJ absolute values].

IPCC Category/ Fuel Group	Fuel Consumption [PJ]								
	1990			2008			2009		
	Subm. 2011	Subm. 2012	Difference	Subm. 2011	Subm. 2012	Difference	Subm. 2011	Subm. 2012	Difference
1 A FUEL COMBUSTION ACTIVITIES	826.80	827.69	0.88	1 115.07	115.75 ¹	0.67	1 067.58	062.75 ¹	-4.83
1 A liquid	379.09	379.06	-0.03	468.97	470.06	1.09	447.44	443.71	-3.74
1 A solid	139.89	139.89	0.00	104.90	105.32	0.42	81.53	78.79	-2.74
1 A gaseous	203.98	203.98	0.00	310.71	310.89	0.19	303.56	304.63	1.06

IPCC Category/ Fuel Group	Fuel Consumption [PJ]								
	1990			2008			2009		
	Subm. 2011	Subm. 2012	Differ- ence	Subm. 2011	Subm. 2012	Differ- ence	Subm. 2011	Subm. 2012	Differ- ence
1 A biomass	94.85	95.77	0.92	202.23	201.25	-0.98	205.49	205.91	0.42
1 A other	8.99	8.99	0.00	28.27	28.22	-0.04	29.55	29.72	0.16
1 A 1 Energy In- dustries	188.37	188.37	0.00	245.57	246.91	1.34	239.59	244.33	4.73
1 A 1 liquid	46.45	46.45	-	42.15	43.41	1.26	46.77	41.08	-5.70
1 A 1 solid	61.40	61.40	-	47.87	47.87	-	32.44	32.44	-
1 A 1 gaseous	76.48	76.48	0.00	98.05	97.67	-0.38	99.65	108.81	9.15
1 A 1 biomass	1.63	1.63	-	45.05	45.46	0.41	46.56	47.54	0.98
1 A 1 other	2.41	2.41	-	12.45	12.49	0.04	14.17	14.47	0.30
1 A 1 a Public Electricity and Heat Production	140.54	140.54	-	195.48	195.53	0.05	189.59	190.97	1.37
1 A 1 a liquid	15.63	15.63	-	8.86	8.83	-0.03	9.00	8.92	-0.09
1 A 1 a solid	61.40	61.40	-	47.87	47.87	-	32.44	32.44	-
1 A 1 a gaseous	59.46	59.46	-	81.25	80.88	-0.38	87.43	87.61	0.18
1 A 1 a biomass	1.63	1.63	-	45.05	45.46	0.41	46.56	47.54	0.98
1 A 1 a other	2.41	2.41	-	12.45	12.49	0.04	14.17	14.47	0.30
1 A 1 b Petro- leum refining	38.63	38.63	0.00	40.56	41.85	1.29	40.73	42.55	1.82
1 A 1 b liquid	30.75	30.75	-	33.29	34.58	1.29	37.77	32.16	-5.61
1 A 1 b solid	NO	NO	-	NO	NO	-	NO	NO	-
1 A 1 b gaseous	7.88	7.88	0.00	7.27	7.27	-	2.96	10.39	7.43
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 Manu- facture of Solid fuels and Other Energy Indus- tries	9.20	9.20	0.00	9.53	9.53	-	9.27	10.81	1.54
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	0.00	9.53	9.53	-	9.27	10.81	1.54
1 A 1 c biomass	NO	NO	-	NO	NO	-	NO	NO	-
1 A 1 c other	NO	NO	-	NO	NO	-	NO	NO	-
1 A 2 Manufac- turing Indus- tries and Con- struction	199.85	200.81	0.96	290.13	292.65	2.53	270.18	276.22	6.05
1 A 2 liquid	40.64	40.68	0.04	39.30	39.55	0.24	33.75	36.77	3.01
1 A 2 solid	50.28	50.28	0.00	53.34	53.86	0.52	45.43	43.99	-1.44
1 A 2 gaseous	76.99	76.99	-	120.12	121.93	1.81	115.76	119.55	3.79
1 A 2 biomass	28.71	29.63	0.92	61.99	62.03	0.04	60.28	61.11	0.83
1 A 2 other	3.22	3.22	0.00	15.37	15.28	-0.09	14.95	14.82	-0.13
1 A 2 a Iron and Steel	55.63	55.63	0.00	71.17	71.70	0.52	61.11	60.19	-0.93
1 A 2 a liquid	5.79	5.79	-	10.19	10.20	0.01	7.02	7.57	0.55
1 A 2 a solid	38.11	38.11	0.00	42.11	42.63	0.52	35.13	33.69	-1.44

IPCC Category/ Fuel Group	Fuel Consumption [PJ]								
	1990			2008			2009		
	Subm. 2011	Subm. 2012	Differ- ence	Subm. 2011	Subm. 2012	Differ- ence	Subm. 2011	Subm. 2012	Differ- ence
1 A 2 a gaseous	11.73	11.73	-	18.87	18.86	0.00	18.96	18.92	-0.04
1 A 2 a biomass	NO	NO	-	0.01	0.01	-	0.01	0.00	0.00
1 A 2 a other	NO	NO	-	NO	NO	-	NO	NO	-
1 A 2 b Non-ferrous Metals	2.08	2.08	-	4.41	4.41	0.00	4.64	4.68	0.04
1 A 2 b liquid	0.51	0.51	-	0.31	0.32	0.00	0.29	0.33	0.03
1 A 2 b solid	0.21	0.21	-	0.14	0.14	-	0.16	0.16	-
1 A 2 b gaseous	1.35	1.35	-	3.95	3.95	0.00	4.19	4.19	0.00
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	-	25.40	25.55	0.15	23.08	23.52	0.44
1 A 2 c liquid	1.06	1.06	-	0.59	0.71	0.12	0.78	1.38	0.60
1 A 2 c solid	1.10	1.10	-	0.75	0.75	-	0.74	0.74	-
1 A 2 c gaseous	9.36	9.36	-	17.49	17.48	-0.01	16.00	15.90	-0.10
1 A 2 c biomass	2.90	2.90	-	2.54	2.52	-0.01	2.11	2.18	0.07
1 A 2 c other	1.67	1.67	-	4.03	4.09	0.05	3.46	3.32	-0.13
1 A 2 d Pulp, Paper and Print	54.15	54.15	-	72.42	72.43	0.01	71.85	70.20	-1.65
1 A 2 d liquid	10.94	10.94	-	1.07	1.07	0.00	1.32	1.32	0.01
1 A 2 d solid	4.12	4.12	-	3.68	3.68	-	3.80	3.80	-
1 A 2 d gaseous	17.01	17.01	-	32.06	32.06	0.00	31.37	29.68	-1.69
1 A 2 d biomass	21.88	21.88	-	35.48	35.50	0.01	35.25	35.29	0.03
1 A 2 d other	0.19	0.19	-	0.13	0.13	-	0.12	0.12	-
1 A 2 e Food Processing, Beverages and Tobacco	13.91	13.91	-	15.35	15.40	0.05	15.45	16.48	1.03
1 A 2 e liquid	4.45	4.45	-	2.49	2.50	0.01	2.39	2.80	0.41
1 A 2 e solid	0.18	0.18	-	0.12	0.12	-	0.14	0.14	-
1 A 2 e gaseous	9.15	9.15	-	12.30	12.30	0.00	12.49	13.10	0.61
1 A 2 e biomass	0.13	0.13	-	0.44	0.48	0.04	0.43	0.44	0.01
1 A 2 e other	NO	NO	-	NO	NO	-	NO	NO	-
1 A 2 f Other	58.00	58.96	0.96	101.37	103.16	1.79	94.03	101.15	7.11
1 A 2 f liquid	17.89	17.93	0.04	24.64	24.75	0.11	21.95	23.36	1.41
1 A 2 f solid	6.56	6.56	-	6.55	6.55	-	5.47	5.47	-
1 A 2 f gaseous	28.38	28.38	-	35.45	37.27	1.82	32.76	37.75	4.99
1 A 2 f biomass	3.81	4.73	0.92	23.53	23.53	0.00	22.48	23.20	0.71
1 A 2 f other	1.36	1.36	0.00	11.20	11.06	-0.14	11.38	11.38	-
1 A 3 Transport	186.34	186.68	0.34	322.82	323.82	1.00	314.71	317.07	2.36
1 A 3 liquid	182.22	182.56	0.34	295.04	295.66	0.62	285.23	287.09	1.86
1 A 3 solid	0.07	0.07	-	0.01	0.00	0.00	0.00	0.01	0.00
1 A 3 gaseous	4.05	4.05	-	10.37	10.56	0.19	7.71	7.87	0.17
1 A 3 biomass	NO	NO	-	17.41	17.60	0.19	21.77	22.10	0.33
1 A 3 other	NO	NO	-	NO	NO	-	NO	NO	-

IPCC Category/ Fuel Group	Fuel Consumption [PJ]								
	1990			2008			2009		
	Subm. 2011	Subm. 2012	Differ- ence	Subm. 2011	Subm. 2012	Differ- ence	Subm. 2011	Subm. 2012	Differ- ence
1 A 3 a Civil Aviation	0.44	0.44	-	0.97	0.97	0.00	0.93	0.93	0.00
1 A 3 a aviation gasoline	0.11	0.11	-	0.13	0.13	-	0.14	0.14	-
1 A 3 a jet kero-sene	0.33	0.33	-	0.84	0.84	0.00	0.79	0.79	0.00
1 A 3 b Road Transportation	179.00	179.61	0.61	308.76	310.10	1.33	303.38	306.14	2.76
1 A 3 b gasoline	106.83	106.76	-0.08	73.93	73.48	-0.45	73.81	73.06	-0.74
1 A 3 b diesel oil	72.17	72.44	0.27	217.58	217.97	0.39	208.01	209.43	1.42
1 A 3 b LPG	NO	0.41	0.41	NO	1.00	1.00	NO	1.51	1.51
1 A 3 b other liq-uid	NO	NO	-	NO	NO	-	NO	NO	-
1 A 3 b gaseous	NO	NO	-	NO	0.19	0.19	NO	0.21	0.21
1 A 3 b biomass	NO	NO	-	17.25	17.46	0.21	21.57	21.92	0.35
1 A 3 b other	NO	NO	-	NO	NO	-	NO	NO	-
1 A 3 c Railways	2.38	2.38	-	2.22	2.22	0.00	2.18	2.18	0.00
1 A 3 c solid	2.32	2.32	-	2.08	2.08	0.00	2.00	2.00	0.00
1 A 3 c liquid	0.07	0.07	-	0.01	0.00	0.00	0.00	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 Naviga-tion	0.46	0.19	-0.27	0.50	0.17	-0.33	0.52	0.16	-0.36
1 A 3 d residual oil	NO	NO	-	NO	NO	-	NO	NO	-
1 A 3 d gas/diesel oil	0.33	0.05	-0.27	0.35	0.04	-0.31	0.36	0.03	-0.33
1 A 3 d gasoline	0.14	0.14	0.00	0.12	0.12	-	0.12	0.12	0.00
1 A 3 d other liq-uid	NO	NO	-	NO	NO	-	NO	NO	-
1 A 3 d solid	NO	NO	-	NO	NO	-	NO	NO	-
1 A 3 d gaseous	NO	NO	-	NO	NO	-	NO	NO	-
1 A 3 d other	NO	NO	-	NO	NO	-	NO	NO	-
1 A 3 e Other	4.05	4.05	-	10.37	10.37	0.00	7.71	7.66	-0.04
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	-	10.37	10.37	0.00	7.71	7.66	-0.04
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 Sec-tors	251.76	251.35	-0.42	255.94	251.74	-4.19	242.47	224.50	-17.97
1 A 4 liquid	109.30	108.88	-0.42	91.87	90.82	-1.05	81.06	78.15	-2.91
1 A 4 solid	28.14	28.14	-	3.68	3.58	-0.10	3.66	2.36	-1.30
1 A 4 gaseous	46.46	46.46	0.00	82.17	80.74	-1.43	80.44	68.40	-12.04
1 A 4 biomass	64.51	64.51	-	77.77	76.16	-1.62	76.88	75.16	-1.72
1 A 4 other	3.36	3.36	-	0.45	0.45	-	0.43	0.43	-
1 A 4 a Comme-	39.22	37.80	-1.43	58.76	56.38	-2.38	45.43	33.52	-11.91

IPCC Category/ Fuel Group	Fuel Consumption [PJ]								
	1990			2008			2009		
	Subm. 2011	Subm. 2012	Differ- ence	Subm. 2011	Subm. 2012	Differ- ence	Subm. 2011	Subm. 2012	Differ- ence
Industrial/Institutional									
1 A 4 a liquid	19.10	18.69	-0.41	20.84	20.83	-0.01	11.22	13.41	2.19
1 A 4 a solid	0.95	0.95	-	0.24	0.25	0.00	0.25	0.19	-0.06
1 A 4 a gaseous	13.77	12.75	-1.01	32.86	30.57	-2.29	30.27	16.22	-14.05
1 A 4 a biomass	2.05	2.05	-	4.37	4.29	-0.09	3.25	3.27	0.01
1 A 4 a other	3.36	3.36	-	0.45	0.45	-	0.43	0.43	-
1 A 4 b Residential	191.68	192.70	1.01	175.75	174.14	-1.61	176.02	170.75	-5.27
1 A 4 b liquid	74.45	74.45	0.00	58.64	57.71	-0.93	58.07	53.95	-4.12
1 A 4 b solid	26.64	26.64	-	3.36	3.27	-0.10	3.34	2.13	-1.21
1 A 4 b gaseous	32.33	33.34	1.01	48.76	49.60	0.84	49.60	51.59	1.98
1 A 4 b biomass	58.27	58.27	-	64.99	63.56	-1.42	65.01	63.09	-1.92
1 A 4 b other	NO	NO	-	NO	NO	-	NO	NO	-
1 A 4 c Agriculture/Forestry/Fisheries	20.86	20.86	0.00	21.42	21.22	-0.20	21.02	20.23	-0.79
1 A 4 c liquid	15.75	15.75	0.00	12.39	12.28	-0.10	11.77	10.79	-0.98
1 A 4 c solid	0.55	0.55	-	0.07	0.07	0.00	0.07	0.05	-0.02
1 A 4 c gaseous	0.37	0.37	-	0.55	0.56	0.01	0.56	0.58	0.02
1 A 4 c biomass	4.19	4.19	-	8.41	8.31	-0.10	8.61	8.81	0.19
1 A 4 c other	NO	NO	-	NO	NO	-	NO	NO	-
1 A 5 Other	0.48	0.48	-	0.62	0.62	0.00	0.63	0.63	0.00
1 A 5 liquid	0.48	0.48	-	0.62	0.62	0.00	0.63	0.63	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	-	0.00	0.00	-	0.00	0.00	-
1 A 5 other	NO	NO	-	NO	NO	-	NO	NO	-
International Aviation Bunkers	12.26	12.26	-	29.97	29.97	0.00	26.00	26.00	0.00
International Marine Bunkers	0.25	0.52	0.27	0.43	0.69	0.26	0.42	0.57	0.16

A “-” indicates that no recalculations were carried out or recalculations are lower than ± 0.005 TJ (mostly due to rounding) .

Methodology

Emissions from *1.A Fuel Combustion* have been calculated using the CORINAIR methodology. The fuel consumption based on the energy balance is multiplied with source specific emission factors for CO₂, CH₄ and N₂O. 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 2009 has been submitted to IEA and EUROSTAT in October 2010 by STATISTIK AUSTRIA.

There are five different IEA questionnaires for each of: oil; natural gas; coal; renewable fuels; electricity and heat. Table A 39 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 49: Categories of the national energy balance (JQ 2011) 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			
Public CHP plants	In the inventory plant specific data are considered.	0101 0102	1 A 1 a Public Electricity and Heat Production
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 <i>Coking Coal</i> to <i>Coke Oven Coke</i> .		
Blast furnaces	Coke Oven Coke.	030326	1 A 2 a Iron and Steel
Gas Works	Transformation of <i>Other Oil Products</i> to <i>Gas Works Gas</i> .		
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	<i>Coke Oven Gas and Blast Furnace Gas.</i>	0301	1 A 2 a Iron and Steel
Blast furnaces	<i>Coke Oven Coke.</i>	030326	1 A 2 a Iron and Steel
Gas Works	<i>Natural Gas.</i>	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		07	1 A 2 f Manuf. Ind. and Constr. - Other
Road	Division to SNAP categories is performed by means of studies.	08	1 A 3 Transport
Rail		0201	1 A 4 b Residential
Inland Waterways			1 A 4 c Agriculture/ Forestry/ Fisheries
Pipeline Transport	<i>Natural Gas.</i>	010506	1 A 3 e Transport-Other
Non Specified	<i>Other biofuels and Lubricants.</i>	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 Revised 4 codes cited in this table are consistent with the NACE Revision 2 nomenclature.			

Table A 50: Categories of the national energy balance (JQ 2011) 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

Auto Producers (Electricity + CHP + Heat), of which:		
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 41.

Table A 51: Fuel categories used for the inventory and correspondence to IPCC fuel categories.

Inventory Fuel Category		IEA Fuel Category	Average Net Calorific Value⁽²⁾	IPCC Fuel Category⁽³⁾
Code⁽¹⁾	Category	Category		
102 A	Hard Coal	Bituminous Coal and Anthracite	27.00	Solid (coal)
104 A	Hard Coal Briquettes	Patent Fuel	31.00	Solid (coal)
105 A	Brown Coal	Lignite/Brown Coal	19.67	Solid (coal)
106 A	Brown Coal Briquettes	BKB/PB	19.31	Solid (coal)
107 A	Coke	Coke Oven Coke	29.00	Solid (coal)

Inventory Fuel Category		IEA Fuel Category	Average Net Calorific Value ⁽²⁾	IPCC Fuel Category ⁽³⁾
Code ⁽¹⁾	Category	Category		
113 A	Peat	Peat	8.80	Solid
304 A	Coke Oven Gas	Coke Oven Gas	16.90	Solid
305 A	Blast Furnace Gas	Blast Furnace Gas	4.03	Solid
110 A	Petrol Coke	Petrol Coke	32.21	Liquid
203 B	Light Fuel Oil Sulphur Content < 0,2 %	Residual Fuel Oil	40.93	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 gaso- line)
208 0	Motor Gasoline	Motor Gasoline	43.14	Liquid (gasoline)
224 A	Other Petroleum Products	Other Products	43.83	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	36.62	Gaseous (natural gas)
114 B	Municipal Waste	Municipal Solid Waste Re- newable	⁽⁴⁾ 10.19	Other Fuels
		Municipal Solid Waste Non Renewable	9.99	Other Fuels
115 A	Industrial Waste	Industrial Wastes	⁽⁵⁾ 21.14	Other Fuels
111 A	Fuel Wood	<i>Wood/Wood wastes/Other Solid Wastes, of which: Wood</i>	14.31	Biomass
116 A	Wood Wastes, Wood Chips, Pellets, Straw.	<i>Wood/Wood wastes/Other Solid Wastes, of which: Other vegetal materials and waste (including straw, sawdust, wood chips)</i>	12.24	Biomass
118 A	Sewage Sludge (dry sub- stance)	<i>Wood/Wood wastes/Other Solid Wastes, of which: Other vegetal materials and waste (including straw, sawdust, wood chips)</i>	12.00	Biomass
215 A	Black Liquor	<i>Wood/Wood wastes/Other Solid Wastes, of which: Black Liquor</i>	⁽⁴⁾ 8.42	Biomass
309 A	Biogas	Biogas	⁽⁴⁾ 20.96	Biomass

Inventory Fuel Category		IEA Fuel Category	IPCC Fuel Category ⁽³⁾	
Code ⁽¹⁾	Category	Category	Average Net Calorific Value ⁽²⁾	
309 B	Sewage Sludge Gas	Sewage Sludge Gas	⁽⁴⁾ 19.21	Biomass
310 A	Landfill Gas	Landfill Gas	⁽⁴⁾ 16.92	Biomass

(1) First three digits are based on CORINAIR / NAPFUE 94–Code

(2) Units: [MJ / kg] or [MJ / m³ Gas] respectively, for the Year 2010 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 CO₂ Emissions by Sectors and Fuel Types

The following tables show detailed data on fuel consumption and CO₂ emissions for each fuel type according to Table A 41 and each sector of 1 A Fuel Combustion are provided for the period from 1990 to 2010. For information on completeness, in particular on CO₂ 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 52: 2010 energy consumption and CO₂ 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	41.47	48.94	0.00	2.60	93.02	3.87	4.94	0.00	0.24	9.06
102A Hard Coal	41.47	6.09	0.00	0.16	47.72	3.87	0.56	0.00	0.01	4.44
104A Hard Coal Briquettes				0.40	0.40				0.04	0.04
105A Brown Coal		1.57		0.10	1.67		0.15		0.01	0.16
106A Brown Coal Briquettes				0.57	0.57				0.06	0.06
107A Coke		34.90		1.37	36.27		3.63		0.13	3.76
113A Peat				0.00	0.00				0.00	0.00
304A Coke Oven Gas		6.38			6.38		0.60			0.60
Total Liquid	40.16	38.02	298.09	81.25	457.52	2.92	2.88	21.87	6.06	33.78
110A Petrol Coke	2.00	1.28			3.28	0.20	0.12			0.33
203B Light Fuel Oil	0.21	4.01		6.67	10.89	0.02	0.31		0.51	0.84
203C Medium Fuel Oil	1.79				1.79	0.14				0.14
203D Heavy Fuel Oil	7.37	12.55			19.92	0.58	0.98			1.56
204A Gasoil	0.14	2.86		59.78	62.78	0.01	0.21		4.48	4.71
2050 Diesel	0.01	14.40	223.06	10.29	247.76	0.00	1.06	16.43	0.76	18.25
206A Other Kerosene		0.01		0.06	0.07		0.00		0.00	0.01
206B Jet Kerosene			1.36		1.36			0.05		0.10
207A Aviation Gasoline			0.13		0.13			0.01		0.01
2080 Motor Gasoline		0.12	71.99	1.40	73.51		0.01	5.28	0.10	5.39
224A Other Petroleum Products	11.27				11.27	0.88				0.88
303A Liquified Petroleum Gas (LPG)	1.30	2.80	1.56	3.05	8.71	0.08	0.18	0.10	0.20	0.56
308A Refinery Gas	16.07				16.07	1.01				1.01
301A Total Gaseous (Natural Gas)	118.34	123.68	6.00	84.22	332.24	6.56	6.85	0.33	4.67	18.40
Total Other Fuel	15.26	19.06		0.02	34.34	0.82	0.78		0.00	1.61
114B Municipal Waste	13.83				13.83	0.68				0.68
115A Industrial Waste	1.43	19.06		0.02	20.51	0.15	0.78		0.00	0.93
Total Biomass⁽¹⁾	53.27	60.92	21.81	83.97	219.96	(6.62)	(1.54)	(8.58)	(0.00)	(22.61)
111A Fuel Wood	0.05	3.66		62.59	66.31	0.01	0.37		6.26	6.63
116A Wood Wastes	46.53	26.14		20.04	92.71	5.12	2.88		2.20	10.20
118A Sewage Sludge	0.71	0.52			1.23	0.08	0.06			0.13
215A Black Liquor		28.53			28.53		3.14			3.14
250A Liquid Biofuels		1.15	21.81	0.90	23.86		0.08	1.54	0.06	1.69
309A Biogas	5.51	0.40		0.10	6.02	0.62	0.05		0.01	0.67
309B Sewage Sludge Gas	0.32	0.51		0.27	1.10	0.04	0.06		0.03	0.12
310A Landfill Gas	0.14			0.07	0.21	0.02			0.01	0.02
Total⁽¹⁾	268.50	290.61	325.90	252.07	1 137.08	14.17	15.46	22.21	10.97	62.85

Table A 53: 2009 energy consumption and CO₂ 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	Transport	Other Sectors	Total	Energy Ind.	Industry	Transport	Other Sectors	Total
Total Solid	32.44	43.99	0.01	2.36	78.79	3.02	4.43	0.00	0.22	7.67
102A Hard Coal	32.44	7.47	0.01	0.06	39.97	3.02	0.69	0.00	0.01	3.71
104A Hard Coal Briquettes				0.46	0.46				0.04	0.04
105A Brown Coal		1.66		0.10	1.76		0.16		0.01	0.17
106A Brown Coal Briquettes		0.00		0.52	0.52		0.00		0.05	0.05
107A Coke		29.71		1.22	30.93		3.09		0.11	3.20
113A Peat				0.00	0.00				0.00	0.00
304A Coke Oven Gas		5.14			5.14		0.49			0.49
Total Liquid	41.08	36.77	287.71	78.15	443.71	2.93	2.78	21.11	5.82	32.68
110A Petrol Coke	2.11	0.89			3.00	0.21	0.08			0.30
203B Light Fuel Oil	0.18	5.21		2.46	7.84	0.01	0.41		0.19	0.61
203C Medium Fuel Oil	1.66				1.66	0.13				0.13
203D Heavy Fuel Oil	7.09	10.73			17.82	0.55	0.84			1.39
204A Gasoil	0.20	2.97		60.59	63.76	0.01	0.22		4.54	4.78
2050 Diesel	0.01	14.92	211.49	10.47	236.90	0.00	1.10	15.58	0.77	17.45
206A Other Kerosene		0.01		0.07	0.08		0.00		0.01	0.01
206B Jet Kerosene			1.39		1.39			0.06		0.10
207A Aviation Gasoline			0.14		0.14			0.01		0.01
2080 Motor Gasoline		0.12	73.18	1.41	74.71		0.01	5.37	0.10	5.48
224A Other Petroleum Products	10.82				10.82	0.84				0.84
303A Liquified Petroleum Gas (LPG)	3.93	1.91	1.51	3.15	10.50	0.25	0.12	0.10	0.20	0.67
308A Refinery Gas	15.09				15.09	0.91				0.91
301A Total Gaseous (Natural Gas)	108.81	119.55	7.87	68.40	304.63	6.03	6.62	0.44	3.79	16.87
Total Other Fuel	14.47	14.82		0.43	29.72	0.78	0.71		0.05	1.53
114B Municipal Waste	13.21				13.21	0.65				0.65
115A Industrial Waste	1.26	14.82		0.43	16.51	0.13	0.71		0.05	0.89
Total Biomass⁽¹⁾	47.54	61.11	22.10	75.16	205.91	(6.64)	(1.56)	(7.67)	(0.00)	(21.11)
111A Fuel Wood	0.04	3.51		55.98	59.53	0.00	0.35		5.60	5.95
116A Wood Wastes	41.20	28.12		17.93	87.26	4.53	3.09		1.97	9.60
118A Sewage Sludge	0.67	0.40			1.07	0.07	0.04			0.12
215A Black Liquor		26.83			26.83		2.95			2.95
250A Liquid Biofuels		1.29	22.10	0.98	24.38		0.09	1.56	0.07	1.73
309A Biogas	5.04	0.53		0.11	5.68	0.56	0.06		0.01	0.64
309B Sewage Sludge Gas	0.50	0.41		0.04	0.95	0.06	0.05		0.00	0.11
310A Landfill Gas	0.08			0.12	0.21	0.01			0.01	0.02
Total⁽¹⁾	244.33	276.22	317.70	224.50	1 062.75	12.75	14.54	21.54	9.87	58.75

Table A 54: 2008 energy consumption and CO₂ 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	53.86	0.00	3.58	105.32	4.44	5.41	0.00	0.34	10.19
102A Hard Coal	47.87	8.71	0.00	0.22	56.80	4.44	0.80	0.00	0.02	5.26
104A Hard Coal Briquettes				0.79	0.79				0.07	0.07
105A Brown Coal		1.84		0.07	1.91		0.18		0.01	0.19
106A Brown Coal Briquettes				0.76	0.76				0.07	0.07
107A Coke		35.83		1.74	37.56		3.73		0.16	3.89
113A Peat				0.00	0.00				0.00	0.00
304A Coke Oven Gas		7.48			7.48		0.71			0.71
Total Liquid	43.41	39.55	296.28	90.82	470.06	3.10	3.00	21.74	6.76	34.64
110A Petrol Coke	2.08	1.16			3.24	0.21	0.11			0.32
203B Light Fuel Oil	0.15	4.51		5.20	9.86	0.01	0.35		0.40	0.76
203C Medium Fuel Oil	1.81				1.81	0.14				0.14
203D Heavy Fuel Oil	6.83	13.55			20.37	0.54	1.06			1.60
204A Gasoil	0.19	3.00		68.24	71.43	0.01	0.22		5.12	5.36
2050 Diesel	0.05	15.51	220.12	11.50	247.18	0.00	1.14	16.21	0.85	18.21
206A Other Kerosene		0.01		0.08	0.10		0.00		0.01	0.01
206B Jet Kerosene			1.44		1.44			0.06		0.10
207A Aviation Gasoline			0.13		0.13			0.01		0.01
2080 Motor Gasoline		0.13	73.60	1.50	75.23		0.01	5.39	0.11	5.51
224A Other Petroleum Products	11.64				11.64	0.91				0.91
303A Liquified Petroleum Gas (LPG)	2.78	1.68	1.00	4.29	9.75	0.18	0.11	0.06	0.27	0.62
308A Refinery Gas	17.88				17.88	1.09				1.09
301A Total Gaseous (Natural Gas)	97.67	121.93	10.56	80.74	310.89	5.41	6.75	0.58	4.47	17.22
Total Other Fuel	12.49	15.28		0.45	28.22	0.68	0.77		0.05	1.50
114B Municipal Waste	11.25				11.25	0.55				0.55
115A Industrial Waste	1.24	15.28		0.45	16.97	0.13	0.77		0.05	0.95
Total Biomass⁽¹⁾	45.46	62.03	17.60	76.16	201.25	(6.77)	(1.25)	(7.77)	(0.00)	(20.79)
111A Fuel Wood	0.03	1.75		57.92	59.70	0.00	0.17		5.79	5.97
116A Wood Wastes	38.67	30.21		17.08	85.95	4.25	3.32		1.88	9.46
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	17.60	0.82	19.44		0.07	1.25	0.06	1.38
309A Biogas	5.37	0.55		0.11	6.03	0.60	0.06		0.01	0.68
309B Sewage Sludge Gas	0.60	0.39		0.08	1.07	0.07	0.04		0.01	0.12
310A Landfill Gas	0.05			0.15	0.20	0.01			0.02	0.02
Total⁽¹⁾	246.91	292.65	324.44	251.74	1115.75	13.63	15.93	22.32	11.61	63.54

⁽¹⁾ CO₂ emissions of Biomass are not included in Total.

Table A 55: 2007 energy consumption and CO₂ 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	Transport	Other Sectors	Total	Energy Ind.	Industry	Transport	Other Sectors	Total
Total Solid	54.46	54.67	0.01	3.57	112.71	5.07	5.50	0.00	0.33	10.90
102A Hard Coal	54.46	9.57	0.01	0.76	64.79	5.07	0.88	0.00	0.07	6.02
104A Hard Coal Briquettes				0.27	0.27				0.03	0.03
105A Brown Coal	0.00	2.01		0.08	2.09	0.00	0.20		0.01	0.20
106A Brown Coal Briquettes				0.74	0.74				0.07	0.07
107A Coke		36.34		1.72	38.05		3.78		0.16	3.94
113A Peat				0.00	0.00				0.00	0.00
304A Coke Oven Gas		6.76			6.76		0.64			0.64
Total Liquid	46.58	41.01	315.17	83.09	485.85	3.23	3.12	23.12	6.18	35.69
110A Petrol Coke	2.30	1.23			3.53	0.23	0.12			0.35
203B Light Fuel Oil	0.21	5.26		6.55	12.03	0.02	0.41		0.50	0.93
203C Medium Fuel Oil	1.88				1.88	0.15				0.15
203D Heavy Fuel Oil	6.87	14.88			21.74	0.54	1.16			1.71
204A Gasoil	0.18	3.68		58.79	62.66	0.01	0.28		4.41	4.70
2050 Diesel	0.01	14.15	230.54	11.48	256.18	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	82.06	1.52	83.71		0.01	6.00	0.11	6.12
224A Other Petroleum Products	13.08				13.08	1.02				1.02
303A Liquified Petroleum Gas (LPG)	3.02	1.66	0.97	4.63	10.28	0.19	0.11	0.06	0.30	0.66
308A Refinery Gas	19.04				19.04	1.06				1.06
301A Total Gaseous (Natural Gas)	87.82	119.60	8.25	79.08	294.74	4.87	6.62	0.46	4.38	16.32
Total Other Fuel	12.35	11.85		0.56	24.75	0.68	0.69		0.06	1.43
114B Municipal Waste	10.92				10.92	0.53				0.53
115A Industrial Waste	1.43	11.85		0.56	13.83	0.15	0.69		0.06	0.90
Total Biomass⁽¹⁾	38.12	60.99	14.13	73.14	186.39	(6.66)	(1.00)	(7.46)	(0.00)	(19.33)
111A Fuel Wood	0.02	1.72		56.09	57.82	0.00	0.17		5.61	5.78
116A Wood Wastes	32.07	29.95		16.03	78.05	3.53	3.29		1.76	8.59
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	14.13	0.68	15.63		0.06	1.00	0.05	1.11
309A Biogas	4.71	0.51		0.12	5.34	0.53	0.06		0.01	0.60
309B Sewage Sludge Gas	0.51	0.61		0.07	1.18	0.06	0.07		0.01	0.13
310A Landfill Gas	0.05			0.15	0.20	0.01			0.02	0.02
Total⁽¹⁾	239.33	288.13	337.55	239.44	1 104.45	13.84	15.93	23.58	10.95	64.34

⁽¹⁾CO₂ emissions of Biomass are not included in Total.

Table A 56: 2006 energy consumption and CO₂ 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	55.85	0.01	4.64	120.69	5.64	5.60	0.00	0.44	11.68
102A Hard Coal	53.98	10.27	0.01	1.31	65.56	5.01	0.94	0.00	0.12	6.07
104A Hard Coal Briquettes				0.02	0.02				0.00	0.00
105A Brown Coal	6.22	1.82		0.24	8.28	0.63	0.17		0.03	0.83
106A Brown Coal Briquettes		0.00		0.92	0.92		0.00		0.09	0.09
107A Coke		36.40		2.14	38.54		3.79		0.20	3.98
113A Peat				0.00	0.00				0.00	0.00
304A Coke Oven Gas		7.36			7.36		0.70			0.70
Total Liquid	47.81	41.29	312.59	99.81	501.51	3.45	3.15	22.92	7.43	36.99
110A Petrol Coke	2.02	1.30			3.32	0.20	0.12			0.33
203B Light Fuel Oil	0.23	5.97		12.05	18.26	0.02	0.47		0.93	1.41
203C Medium Fuel Oil	2.30				2.30	0.18				0.18
203D Heavy Fuel Oil	9.96	14.25			24.21	0.79	1.11			1.90
204A Gasoil	0.19	4.58		69.32	74.09	0.01	0.34		5.20	5.56
2050 Diesel	0.02	13.13	225.91	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	84.11	1.52	85.76		0.01	6.15	0.11	6.27
224A Other Petroleum Products	13.21				13.21	1.03				1.03
303A Liquified Petroleum Gas (LPG)	2.04	1.92	1.00	5.31	10.27	0.13	0.12	0.06	0.34	0.66
308A Refinery Gas	17.84				17.84	1.08				1.08
301A Total Gaseous (Natural Gas)	96.71	119.40	8.61	87.08	311.80	5.36	6.61	0.48	4.82	17.27
Total Other Fuel	12.91	12.29		0.27	25.48	0.71	0.74		0.03	1.49
114B Municipal Waste	11.44				11.44	0.56				0.56
115A Industrial Waste	1.48	12.29		0.27	14.04	0.15	0.74		0.03	0.93
Total Biomass⁽¹⁾	30.35	53.94	11.80	72.96	169.05	(5.90)	(0.84)	(7.42)	(0.00)	(17.50)
111A Fuel Wood	0.02	1.04		58.38	59.44	0.00	0.10		5.84	5.94
116A Wood Wastes	24.17	23.63		13.53	61.32	2.66	2.60		1.49	6.75
118A Sewage Sludge	0.77	0.06			0.83	0.08	0.01			0.09
215A Black Liquor		27.35			27.35		3.01			3.01
250A Liquid Biofuels		0.68	11.80	0.59	13.07		0.05	0.84	0.04	0.93
309A Biogas	5.07	0.56		0.22	5.85	0.57	0.06		0.02	0.66
309B Sewage Sludge Gas	0.29	0.62		0.07	0.98	0.03	0.07		0.01	0.11
310A Landfill Gas	0.04			0.17	0.20	0.00			0.02	0.02
Total⁽¹⁾	247.99	282.77	333.02	264.76	1 128.53	15.16	16.10	23.40	12.72	67.43

⁽¹⁾ CO₂ emissions of Biomass are not included in Total.

Table A 57: 2005 energy consumption and CO₂ 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	Transport	Other Sectors	Total	Energy Ind.	Industry	Transport	Other Sectors	Total
Total Solid	61.63	55.89	0.01	4.98	122.50	5.84	5.58	0.00	0.47	11.89
102A Hard Coal	51.51	7.74	0.01	1.46	60.72	4.81	0.72	0.00	0.14	5.66
104A Hard Coal Briquettes				0.03	0.03				0.00	0.00
105A Brown Coal	10.12	2.54		0.20	12.86	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		2.31	37.19		3.63		0.21	3.84
113A Peat				0.00	0.00				0.00	0.00
304A Coke Oven Gas		10.72			10.72		1.01			1.01
Total Liquid	46.20	40.23	329.90	105.65	521.98	3.56	3.09	24.31	7.87	38.86
110A Petrol Coke	2.07	2.05			4.12	0.21	0.19			0.40
203B Light Fuel Oil	0.17	6.93		9.23	16.32	0.01	0.54		0.71	1.26
203C Medium Fuel Oil	2.29	0.00			2.29	0.18	0.00			0.18
203D Heavy Fuel Oil	12.41	13.76			26.17	0.98	1.07			2.06
204A Gasoil	0.19	4.94		77.61	82.74	0.01	0.37		5.82	6.21
2050 Diesel	0.02	10.90	241.27	11.80	263.98	0.00	0.80	17.77	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	86.17	1.49	87.77		0.01	6.41	0.11	6.52
224A Other Petroleum Products	11.03				11.03	0.86				0.86
303A Liquified Petroleum Gas (LPG)	3.91	1.52	0.97	5.39	11.79	0.25	0.10	0.06	0.34	0.75
308A Refinery Gas	14.13				14.13	1.05				1.05
301A Total Gaseous (Natural Gas)	113.71	125.44	6.62	87.54	333.30	6.30	6.94	0.37	4.85	18.46
Total Other Fuel	10.22	12.12		0.40	22.74	0.57	0.76		0.04	1.37
114B Municipal Waste	8.88				8.88	0.43				0.43
115A Industrial Waste	1.34	12.12		0.40	13.86	0.14	0.76		0.04	0.94
Total Biomass(1)	20.24	53.04	3.35	76.56	153.19	(5.82)	(0.24)	(7.80)	(0.00)	(16.09)
111A Fuel Wood	0.05	1.14		61.74	62.93	0.01	0.11		6.17	6.29
116A Wood Wastes	16.05	23.80		14.27	54.12	1.77	2.62		1.57	5.95
118A Sewage Sludge	0.75	0.04			0.79	0.08	0.00			0.09
215A Black Liquor		26.65			26.65		2.93			2.93
250A Liquid Biofuels		0.14	3.35	0.16	3.65		0.01	0.24	0.01	0.26
309A Biogas	2.66	0.68		0.14	3.48	0.30	0.08		0.02	0.39
309B Sewage Sludge Gas	0.69	0.59		0.06	1.34	0.08	0.07		0.01	0.15
310A Landfill Gas	0.04			0.19	0.23	0.00			0.02	0.03
Total(1)	252.01	286.72	339.87	275.12	1 153.72	16.27	16.37	24.68	13.23	70.59

⁽¹⁾ CO₂ emissions of Biomass are not included in Total.

Table A 58: 2004 energy consumption and CO₂ emissions from category 1 A Fuel Combustion by fuel type and sector.

	Consumption (PJ)					CO ₂ emissions (Tg)				
	1 A 1	1 A 2	1 A 3 + 1 A 5	1 A 4	1 A	1 A 1	1 A 2	1 A 3 + 1 A 5	1 A 4	1 A
	Energy Ind.	Industry	Trans- port	Other Sectors	Total	Energy Ind.	Industry	Trans- port	Other Sectors	Total
Total Solid	69.07	49.41	0.01	6.37	124.86	6.67	4.97	0.00	0.60	12.25
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		0.32	11.41	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		3.17	35.07		3.32		0.29	3.61
113A Peat				0.00	0.00				0.00	0.00
304A Coke Oven Gas		8.29			8.29		0.78			0.78
Total Liquid	43.29	36.59	325.94	105.13	510.95	3.68	2.85	24.00	7.84	38.42
110A Petrol Coke	1.96	3.11			5.07	0.20	0.31			0.51
203B Light Fuel Oil	1.34	7.35		12.50	21.19	0.10	0.57		0.96	1.64
203C Medium Fuel Oil				2.29	2.29				0.18	0.18
203D Heavy Fuel Oil	13.57	11.89			25.45	1.08	0.93			2.01
204A Gasoil	0.09	4.84		71.71	76.64	0.01	0.36		5.38	5.75
2050 Diesel	0.03	7.93	234.62	11.25	253.82	0.00	0.58	17.28	0.83	18.70
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	88.93	1.51	90.55		0.01	6.60	0.11	6.72
224A Other Petroleum Pro- ducts	12.79				12.79	1.00				1.00
303A Liquified Petroleum Gas (LPG)	0.15	1.35	0.94	5.72	8.15	0.01	0.09	0.06	0.37	0.52
308A Refinery Gas	13.37				13.37	1.28				1.28
301A Total Gaseous (Natu- ral Gas)	97.20	115.67	6.73	94.56	314.16	5.39	6.41	0.37	5.24	17.40
Total Other Fuel	10.09	13.95		0.52	24.56	0.59	0.86		0.05	1.51
114B Municipal Waste	8.39				8.39	0.41				0.41
115A Industrial Waste	1.70	13.95		0.52	16.17	0.18	0.86		0.05	1.10
Total Biomass(1)	15.84	41.55		66.75	124.14	(4.56)		(6.81)		(13.10)
111A Fuel Wood	0.05	1.56		53.78	55.39	0.00	0.16		5.38	5.54
116A Wood Wastes	14.73	15.28		12.49	42.50	1.62	1.68		1.37	4.68
118A Sewage Sludge	0.81				0.81	0.09				0.09
215A Black Liquor		24.24			24.24		2.67			2.67
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)	235.49	257.17	332.67	273.34	1 098.68	16.32	15.10	24.38	13.73	69.57

⁽¹⁾ CO₂ emissions of Biomass are not included in Total.

Table A 59: 2003 energy consumption and CO₂ emissions from category 1 A Fuel Combustion by fuel type and sector.

	Consumption (PJ)					CO ₂ emissions (Tg)				
	1 A 1	1 A 2	1 A 3 + 1 A 5	1 A 4	1 A	1 A 1	1 A 2	1 A 3 + 1 A 5	1 A 4	1 A
	Energy Ind.	Industry	Trans- port	Other Sectors	Total	Energy Ind.	Industry	Trans- port	Other Sectors	Total
Total Solid	70.88	49.35	0.02	6.89	127.14	6.92	4.98	0.00	0.65	12.54
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		0.33	15.73	1.51	0.17		0.04	1.71
106A Brown Coal Briquettes		0.00		1.38	1.38		0.00		0.13	0.13
107A Coke		32.89		3.35	36.24		3.42		0.31	3.73
113A Peat				0.00	0.00				0.00	0.00
304A Coke Oven Gas		7.62			7.62		0.72			0.72
Total Liquid	43.65	32.67	318.96	114.64	509.92	3.43	2.52	23.49	8.57	38.05
110A Petrol Coke	1.85	2.13			3.98	0.19	0.21			0.40
203B Light Fuel Oil	0.68	5.86		17.46	23.99	0.05	0.46		1.34	1.85
203C Medium Fuel Oil				2.25	2.25				0.18	0.18
203D Heavy Fuel Oil	14.31	11.59			25.90	1.14	0.90			2.05
204A Gasoil	0.17	3.98		77.14	81.28	0.01	0.30		5.79	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	91.41	1.53	93.05		0.01	6.78	0.11	6.90
224A Other Petroleum Products	12.24				12.24	0.95				0.95
303A Liquified Petroleum Gas (LPG)	1.78	1.83	1.13	5.14	9.88	0.11	0.12	0.07	0.33	0.63
308A Refinery Gas	12.45				12.45	0.95				0.95
301A Total Gaseous (Natural Gas)	98.35	114.61	6.70	88.85	308.51	5.45	6.35	0.37	4.92	17.09
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)	14.01	40.84		67.99	122.83	(4.48)		(6.92)		(12.94)
111A Fuel Wood		1.42		55.87	57.28		0.14		5.59	5.73
116A Wood Wastes	12.39	15.99		11.82	40.20	1.36	1.76		1.30	4.42
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)	234.75	248.36	325.68	279.01	1 087.81	16.29	14.68	23.86	14.21	69.08

⁽¹⁾ CO₂ emissions of Biomass are not included in Total.

Table A 60: 2002 energy consumption and CO₂ emissions from category 1 A Fuel Combustion by fuel type and sector.

	Consumption (PJ)					CO ₂ emissions (Tg)				
	1 A 1	1 A 2	1 A 3 + 1 A 5	1 A 4	1 A	1 A 1	1 A 2	1 A 3 + 1 A 5	1 A 4	1 A
	Energy Ind.	Industry	Trans- port	Other Sectors	Total	Energy Ind.	Industry	Trans- port	Other Sectors	Total
Total Solid	56.13	48.10	0.02	7.74	111.99	5.51	4.84	0.00	0.73	11.08
102A Hard Coal	42.89	8.36	0.02	1.89	53.16	4.05	0.79	0.00	0.18	5.02
104A Hard Coal Briquettes				0.02	0.02				0.00	0.00
105A Brown Coal	13.24	1.60		0.37	15.21	1.46	0.16		0.04	1.65
106A Brown Coal Briquettes		0.00		1.26	1.26		0.00		0.12	0.12
107A Coke		31.15		4.19	35.35		3.24		0.39	3.63
113A Peat				0.00	0.00				0.00	0.00
304A Coke Oven Gas		6.99			6.99		0.66			0.66
Total Liquid	38.45	29.43	295.20	109.02	472.10	3.02	2.27	21.74	8.15	35.23
110A Petrol Coke	2.54	2.05			4.59	0.26	0.20			0.46
203B Light Fuel Oil	0.96	3.05		16.86	20.87	0.07	0.24		1.30	1.61
203C Medium Fuel Oil				1.91	1.91				0.15	0.15
203D Heavy Fuel Oil	9.58	12.84			22.42	0.76	1.00			1.76
204A Gasoil	0.03	2.75		72.35	75.13	0.00	0.21		5.43	5.63
2050 Diesel	0.03	6.73	203.30	11.37	221.44	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	89.39	1.51	91.00		0.01	6.63	0.11	6.75
224A Other Petroleum Pro- ducts	11.21				11.21	0.87				0.87
303A Liquified Petroleum Gas (LPG)	0.13	1.90	1.10	4.83	7.96	0.01	0.12	0.07	0.31	0.51
308A Refinery Gas	13.99				13.99	1.05				1.05
301A Total Gaseous (Natu- ral Gas)	81.44	112.94	5.00	81.89	281.27	4.51	6.26	0.28	4.54	15.58
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)	13.07	37.77		67.89	118.72	(4.14)		(6.89)		(12.47)
111A Fuel Wood		1.42		57.63	59.05		0.14		5.76	5.91
116A Wood Wastes	11.85	13.10		9.96	34.91	1.30	1.44		1.10	3.84
118A Sewage Sludge	1.12				1.12	0.12				0.12
215A Black Liquor		22.72			22.72		2.50			2.50
250A Liquid Biofuels										
309A Biogas		0.35			0.35		0.04			0.04
309B Sewage Sludge Gas	0.04	0.17			0.21	0.00	0.02			0.02
310A Landfill Gas	0.06			0.30	0.36	0.01			0.03	0.04
Total(1)	195.86	237.63	300.22	267.15	1 000.86	13.47	14.05	22.02	13.47	63.05

⁽¹⁾ CO₂ emissions of Biomass are not included in Total.

Table A 61: 2001 energy consumption and CO₂ emissions from category 1 A Fuel Combustion by fuel type and sector.

	Consumption (PJ)					CO ₂ emissions (Tg)				
	1 A 1	1 A 2	1 A 3 + 1 A 5	1 A 4	1 A	1 A 1	1 A 2	1 A 3 + 1 A 5	1 A 4	1 A
	Energy Ind.	Industry	Trans- port	Other Sectors	Total	Energy Ind.	Industry	Trans- port	Other Sectors	Total
Total Solid	59.77	43.42	0.02	9.79	113.00	5.87	4.38	0.00	0.92	11.18
102A Hard Coal	45.15	9.36	0.02	2.08	56.61	4.27	0.88	0.00	0.19	5.34
104A Hard Coal Briquettes				0.02	0.02				0.00	0.00
105A Brown Coal	14.63	1.30		0.46	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		29.38		5.14	34.52		3.06		0.47	3.53
113A Peat				0.00	0.00				0.00	0.00
304A Coke Oven Gas		3.38			3.38		0.32			0.32
Total Liquid	47.44	36.56	266.45	110.86	461.30	3.38	2.79	19.62	8.30	34.14
110A Petrol Coke	2.27	0.67			2.94	0.23	0.07			0.30
203B Light Fuel Oil	3.15	6.15		19.92	29.22	0.25	0.48		1.53	2.26
203C Medium Fuel Oil				1.41	1.41				0.11	0.11
203D Heavy Fuel Oil	16.29	15.77		0.00	32.06	1.29	1.23		0.00	2.52
204A Gasoil	0.78	4.75		72.88	78.41	0.06	0.36		5.47	5.88
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	83.10	1.50	84.70		0.01	6.16	0.11	6.28
224A Other Petroleum Products	9.90				9.90	0.77				0.77
303A Liquified Petroleum Gas (LPG)		2.19	0.83	3.66	6.69		0.14	0.05	0.23	0.43
308A Refinery Gas	15.01				15.01	0.78				0.78
301A Total Gaseous (Natural Gas)	76.61	107.85	8.97	88.74	282.17	4.24	5.97	0.50	4.92	15.63
Total Other Fuel	5.58	8.28		0.63	14.49	0.32	0.57		0.07	0.96
114B Municipal Waste	4.65				4.65	0.23				0.23
115A Industrial Waste	0.94	8.28		0.63	9.84	0.10	0.57		0.07	0.73
Total Biomass(1)	11.08	45.17		72.33	128.58	(4.96)		(7.34)		(13.51)
111A Fuel Wood		1.15		61.98	63.13		0.11		6.20	6.31
116A Wood Wastes	8.62	17.38		9.90	35.91	0.95	1.91		1.09	3.95
118A Sewage Sludge	2.35				2.35	0.26				0.26
215A Black Liquor		26.06			26.06		2.87			2.87
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)	200.48	241.27	275.44	282.35	999.54	13.83	13.72	20.12	14.20	61.90

⁽¹⁾ CO₂ emissions of Biomass are not included in Total.

Table A 62: 2000 energy consumption and CO₂ emissions from category 1 A Fuel Combustion by fuel type and sector.

	Consumption (PJ)					CO ₂ emissions (Tg)				
	1 A 1	1 A 2	1 A 3 + 1 A 5	1 A 4	1 A	1 A 1	1 A 2	1 A 3 + 1 A 5	1 A 4	1 A
	Energy Ind.	Industry	Trans- port	Other Sectors	Total	Energy Ind.	Industry	Trans- port	Other Sectors	Total
Total Solid	49.16	45.87	0.03	10.21	105.27	4.82	4.64	0.00	0.96	10.42
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		0.43	13.61	1.29	0.13		0.05	1.48
106A Brown Coal Briquettes		0.00		2.06	2.06		0.00		0.20	0.20
107A Coke		32.05		5.44	37.49		3.33		0.50	3.83
113A Peat				0.00	0.00				0.00	0.00
304A Coke Oven Gas		2.12			2.12		0.20			0.20
Total Liquid	42.99	34.16	248.29	105.82	431.26	3.03	2.61	18.28	7.92	31.88
110A Petrol Coke	1.61	0.81			2.42	0.16	0.08			0.24
203B Light Fuel Oil	1.81	5.52		15.69	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	14.58	16.18		0.14	30.90	1.16	1.26		0.01	2.44
204A Gasoil	0.01	1.61		71.98	73.59	0.00	0.12		5.40	5.52
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	82.48	1.49	84.08		0.01	6.12	0.11	6.24
224A Other Petroleum Products	9.74				9.74	0.76				0.76
303A Liquified Petroleum Gas (LPG)	0.94	2.54	0.72	3.70	7.90	0.06	0.16	0.05	0.24	0.51
308A Refinery Gas	14.26				14.26	0.74				0.74
301A Total Gaseous (Natural Gas)	74.73	111.00	6.10	73.27	265.10	4.14	6.15	0.34	4.06	14.69
Total Other Fuel	4.64	6.25		1.38	12.27	0.23	0.46		0.14	0.83
114B Municipal Waste	4.64				4.64	0.23				0.23
115A Industrial Waste		6.25		1.38	7.63		0.46		0.14	0.61
Total Biomass(1)	8.05	40.83		69.68	118.56	(4.48)		(7.07)		(12.44)
111A Fuel Wood		0.95		59.22	60.17		0.10		5.92	6.02
116A Wood Wastes	6.98	15.15		9.96	32.09	0.77	1.67		1.10	3.53
118A Sewage Sludge	0.96				0.96	0.11				0.11
215A Black Liquor		24.06			24.06		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)	179.57	238.11	254.42	260.37	932.46	12.22	13.86	18.63	13.08	57.83

⁽¹⁾ CO₂ emissions of Biomass are not included in Total.

Table A 63: 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	42.95	0.03	11.31	92.17	3.79	4.34	0.00	1.06	9.19
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		29.58		5.90	35.48		3.08		0.54	3.62
113A Peat				0.00	0.00				0.00	0.00
304A Coke Oven Gas		3.18			3.18		0.30			0.30
Total Liquid	49.22	33.59	236.11	116.96	435.88	3.62	2.58	17.39	8.76	32.40
110A Petrol Coke	2.14	1.19			3.32	0.22	0.12			0.34
203B Light Fuel Oil	1.13	7.20		18.89	27.21	0.09	0.56		1.45	2.10
203C Medium Fuel Oil	0.09	0.00		2.18	2.26	0.01	0.00		0.17	0.18
203D Heavy Fuel Oil	21.65	15.41		0.17	37.24	1.73	1.20		0.01	2.94
204A Gasoil	0.31	1.05		78.27	79.62	0.02	0.08		5.87	5.97
2050 Diesel	0.03	6.34	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	85.38	1.50	86.97		0.01	6.33	0.11	6.45
224A Other Petroleum Pro- ducts	9.40				9.40	0.73				0.73
303A Liquified Petroleum Gas (LPG)	0.20	2.27	0.62	3.85	6.94	0.01	0.15	0.04	0.25	0.44
308A Refinery Gas	14.29				14.29	0.81				0.81
301A Total Gaseous (Natu- ral Gas)	88.12	104.94	7.84	77.30	278.19	4.88	5.81	0.43	4.28	15.41
Total Other Fuel	4.74	5.39		1.46	11.59	0.23	0.44		0.15	0.83
114B Municipal Waste	4.74				4.74	0.23				0.23
115A Industrial Waste	0.01	5.39		1.46	6.85	0.00	0.44		0.15	0.60
Total Biomass(1)	6.47	45.81		73.57	125.85	(5.02)		(7.45)		(13.19)
111A Fuel Wood		1.87		64.10	65.97		0.19		6.41	6.60
116A Wood Wastes	5.49	19.83		8.94	34.26	0.60	2.18		0.98	3.77
118A Sewage Sludge	0.96				0.96	0.11				0.11
215A Black Liquor		23.56			23.56		2.59			2.59
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)	186.45	232.67	243.97	280.59	943.68	12.53	13.18	17.83	14.26	57.83

⁽¹⁾ CO₂ emissions of Biomass are not included in Total.

Table A 64: 1998 energy consumption and CO₂ 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	Transport	Other Sectors	Total	Energy Ind.	Industry	Transport	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	243.99	111.70	461.68	4.38	3.45	18.00	8.37	34.25
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	91.85	1.50	93.45		0.01	6.82	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	0.59	2.97	6.74	0.01	0.19	0.04	0.19	0.43
308A Refinery Gas	17.04				17.04	0.87				0.87
301A Total Gaseous (Natural Gas)	88.20	105.48	6.34	73.34	273.36	4.89	5.84	0.35	4.06	15.14
Total Other Fuel	4.78	5.89		1.61	12.28	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)	6.81	32.97		70.47	110.25	(3.63)		(7.11)		(11.48)
111A Fuel Wood		0.15		64.52	64.67		0.02		6.45	6.47
116A Wood Wastes	5.91	9.38		5.29	20.58	0.65	1.03		0.58	2.26
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)	196.57	231.85	250.37	269.14	947.93	13.00	13.99	18.35	13.72	59.11

⁽¹⁾ CO₂ emissions of Biomass are not included in Total.

Table A 65: 1997 energy consumption and CO₂ 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	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	57.30	47.50	217.07	111.30	433.18	4.08	3.65	16.02	8.34	32.12
110A Petrol Coke	2.15	0.49			2.64	0.22	0.05			0.27
203B Light Fuel Oil	2.54	16.33		12.59	31.47	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	23.23	21.02		0.17	44.42	1.84	1.64		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	87.80	1.52	89.40		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	0.53	2.72	6.12	0.01	0.18	0.03	0.17	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)	6.15	34.31		72.22	112.68	(3.77)		(7.28)		(11.72)
111A Fuel Wood		0.27		66.93	67.21		0.03		6.69	6.72
116A Wood Wastes	5.29	11.82		4.65	21.75	0.58	1.30		0.51	2.39
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)	201.46	247.05	221.30	269.84	939.65	13.87	15.24	16.25	13.77	59.18

⁽¹⁾ CO₂ emissions of Biomass are not included in Total.

Table A 66: 1996 energy consumption and CO₂ 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	Transport	Other Sectors	Total	Energy Ind.	Industry	Transport	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	230.28	122.71	444.50	3.73	2.95	17.00	9.20	32.92
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	92.62	1.53	94.23		0.01	6.88	0.11	7.00
224A Other Petroleum Products	11.02				11.02	0.86				0.86
303A Liquefied Petroleum Gas (LPG)	0.38	3.10	0.67	3.16	7.31	0.02	0.20	0.04	0.20	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	14.01	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	34.54		76.52	117.18	(3.79)		(7.69)		(12.16)
111A Fuel Wood		0.78		72.50	73.29		0.08		7.25	7.33
116A Wood Wastes	5.32	12.31		3.34	20.97	0.59	1.35		0.37	2.31
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	228.43	234.55	293.71	960.86	13.80	13.70	17.24	15.26	60.04

⁽¹⁾ CO₂ emissions of Biomass are not included in Total.

Table A 67: 1995 energy consumption and CO₂ 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	Transport	Other Sectors	Total	Energy Ind.	Industry	Transport	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	209.06	107.66	408.37	3.73	3.04	15.45	8.06	30.31
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	100.14	1.52	101.73		0.00	7.44	0.11	7.56
224A Other Petroleum Products	8.88			0.01	8.89	0.69			0.00	0.69
303A Liquefied Petroleum Gas (LPG)	1.06	2.87	0.50	4.18	8.61	0.07	0.18	0.03	0.27	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	7.01		0.47		0.18	0.65
Total Biomass(1)	4.02	35.89		70.04	109.95	(3.94)		(7.04)		(11.42)
111A Fuel Wood		1.08		66.28	67.35		0.11		6.63	6.74
116A Wood Wastes	3.25	13.03		3.10	19.39	0.36	1.43		0.34	2.13
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	224.82	213.21	272.47	896.56	12.92	13.49	15.68	14.11	56.23

⁽¹⁾ CO₂ emissions of Biomass are not included in Total.

Table A 68: 1994 energy consumption and CO₂ 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	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	205.33	99.37	405.81	4.23	3.22	15.18	7.43	30.10
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	103.68	1.53	105.27		0.00	7.70	0.11	7.82
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	0.46	4.49	8.06	0.01	0.19	0.03	0.29	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	35.10		64.71	103.20	(3.85)		(6.50)		(10.73)
111A Fuel Wood		0.91		61.49	62.39		0.09		6.15	6.24
116A Wood Wastes	2.65	14.52		2.49	19.67	0.29	1.60		0.27	2.16
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	220.62	209.17	248.73	851.26	11.76	13.24	15.39	12.98	53.41

⁽¹⁾ CO₂ emissions of Biomass are not included in Total.

Table A 69: 1993 energy consumption and CO₂ 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	30.81	43.33	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	204.51	107.06	413.67	4.24	3.32	15.12	8.01	30.73
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	107.53	1.51	109.10		0.00	7.99	0.11	8.11
224A Other Petroleum Pro- ducts	9.86			0.03	9.90	0.77			0.00	0.77
303A Liquified Petroleum Gas (LPG)	0.22	2.54	0.45	4.62	7.84	0.01	0.16	0.03	0.30	0.50
308A Refinery Gas	15.65				15.65	0.77				0.77
301A Total Gaseous (Natu- ral Gas)	71.43	77.79	3.87	71.70	224.79	3.96	4.31	0.21	3.97	12.45
Total Other Fuel	3.76	4.18		1.84	9.78	0.18	0.30		0.19	0.67
114B Municipal Waste	3.76				3.76	0.18				0.18
115A Industrial Waste		4.18		1.84	6.02		0.30		0.19	0.49
Total Biomass(1)	3.12	34.13		69.88	107.14	(3.75)		(7.02)		(11.11)
111A Fuel Wood		0.80		66.38	67.18		0.08		6.64	6.72
116A Wood Wastes	2.35	14.58		2.80	19.73	0.26	1.60		0.31	2.17
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	202.43	208.43	272.58	851.66	11.47	12.25	15.34	14.26	53.35

⁽¹⁾CO₂ emissions of Biomass are not included in Total.

Table A 70: 1992 energy consumption and CO₂ 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	Transport	Other Sectors	Total	Energy Ind.	Industry	Transport	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	202.50	107.62	395.19	3.40	2.83	14.98	8.08	29.32
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	112.09	1.50	113.65		0.00	8.33	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	0.44	4.64	7.54	0.01	0.14	0.03	0.30	0.48
308A Refinery Gas	16.60				16.60	0.84				0.84
301A Total Gaseous (Natural Gas)	67.45	81.76	3.97	63.44	216.61	3.74	4.53	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	31.09		67.80	101.89	(3.41)		(6.81)		(10.55)
111A Fuel Wood		0.71		65.28	65.98		0.07		6.53	6.60
116A Wood Wastes	2.34	12.11		2.52	16.97	0.26	1.33		0.28	1.87
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)	162.31	196.38	206.53	268.81	834.03	11.31	11.95	15.21	14.44	52.95

⁽¹⁾ CO₂ emissions of Biomass are not included in Total.

Table A 71: 1991 energy consumption and CO₂ 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	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	202.81	114.10	411.62	3.41	3.56	15.00	8.58	30.59
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	117.24	1.49	118.78		0.00	8.71	0.11	8.83
224A Other Petroleum Pro- ducts	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	0.43	3.15	7.67	0.04	0.22	0.03	0.20	0.49
308A Refinery Gas	16.00				16.00	0.81				0.81
301A Total Gaseous (Natu- ral Gas)	76.80	78.77	4.07	55.89	215.53	4.25	4.36	0.23	3.10	11.94
Total Other Fuel	2.90	4.56		2.62	10.08	0.14	0.39		0.27	0.81
114B Municipal Waste	2.90				2.90	0.14				0.14
115A Industrial Waste		4.56		2.62	7.18		0.39		0.27	0.66
Total Biomass(1)	2.57	30.20		71.65	104.42	(3.31)		(7.19)		(10.79)
111A Fuel Wood		0.74		69.23	69.96		0.07		6.92	7.00
116A Wood Wastes	1.91	11.52		2.43	15.86	0.21	1.27		0.27	1.75
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	207.31	206.94	275.43	887.81	14.62	13.07	15.24	14.88	57.85

⁽¹⁾CO₂ emissions of Biomass are not included in Total.

Table A 72: 1990 energy consumption and CO₂ emissions from category 1 A Fuel Combustion by fuel type and sector.

	Consumption (PJ)					CO ₂ emissions (Tg)				
	1 A 1	1 A 2	1 A 3 + 1 A 5	1 A 4	1 A	1 A 1	1 A 2	1 A 3 + 1 A 5	1 A 4	1 A
	Energy Ind.	Industry	Trans- port	Other Sectors	Total	Energy Ind.	Industry	Trans- port	Other Sectors	Total
Total Solid	61.40	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	183.04	108.88	379.06	3.19	3.14	13.54	8.21	28.11
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	74.84	10.81	89.06	0.00	0.25	5.54	0.80	6.59
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	106.89	1.54	108.48		0.00	7.95	0.11	8.06
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	0.41	2.32	6.14	0.03	0.19	0.03	0.15	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	29.63		64.51	95.77	(3.25)		(6.47)		(9.90)
111A Fuel Wood		0.66		62.46	63.12		0.07		6.25	6.31
116A Wood Wastes	0.97	10.99		2.05	14.01	0.11	1.21		0.23	1.54
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	200.81	187.16	251.35	827.69	13.79	12.69	13.77	13.78	54.07

⁽¹⁾ CO₂ emissions of Biomass are not included in Total.

ANNEX 3: CO₂ REFERENCE APPROACH

In this annex the results, methodology and detailed data for the CO₂ 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) except for natural gas and coal, where country specific values have been used. The selected values are presented in Table A 66.

Fraction of carbon oxidised

The default values of table 1-6 of the IPCC Reference Manual have been used. Selected values are presented Table A 66.

Activity data

Production, Imports, Exports, Stock Change

Activity data are taken from the national energy balance (IEA JQ 2010) (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.

Conversion factors

For the most important solid and liquid fuels country specific conversion factors in the unit TJ/Gg have been selected. Selected values are presented below.

International Bunkers

International bunkers are relevant for aviation and international navigation on rivers (mostly Danube), the Neusiedler lake and the lake 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:

$$\text{Carbon stored in steel [Mg]} = \text{raw steel production [Mg]} * 0.0015 + \text{electric steel [Mg]} * 0.01$$

which leads to an average fraction of carbon stored of 0.007 of total inland coke consumption.

In the Sectoral Approach the release of stored carbon as emissions is considered as quoted in the NIR, chapter 3.4 *Feedstock*.

Recalculations

Activity data

Imports, Exports and Production are updated according to the new version of the energy balance (IEA JQ 2010). Changes of activity data are based on energy balance recalculations as described in Annex 2.

Net calorific values and carbon contents

In response to the UNFCCC review more country specific values are now used. The selected values and IPCC default values are shown in Table A 67.

Results of the Reference Approach

Table A 62-Table A 67 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 62 presents the calculation results for each fuel type of the Reference Approach for selected years.

Table A 73: Actual CO₂ emissions (Gg CO₂) for selected years.

Fuel Type	1990	1995	2000	2005	2006	2007	2008	2009	2010
Crude Oil	24 536	26 594	25 435	26 985	26 285	26 225	27 006	25 727	23 975
Orimulsion	0	0	0	0	0	0	0	0	0
Natural Gas Liquids	109	114	284	207	234	488	214	347	359
Gasoline	-217	366	491	822	1 177	732	213	289	845
Jet Kerosene	-843	-1 209	-1 571	-1 718	-1 509	-1 746	-1 345	-860	-1 364
Other Kerosene	-43	-7	15	8	7	6	5	4	4
Shale Oil	0	0	0	0	0	0	0	0	0
Gas / Diesel Oil	1 766	3 645	7 068	13 326	12 675	13 067	11 457	10 771	13 066
Residual Fuel Oil	1 015	1 221	1 132	323	571	389	143	-307	426
LPG	246	365	394	326	380	317	213	260	293
Ethane	0	0	0	0	0	0	0	0	0
Naphtha	-1 060	-1 233	-1 429	-1 323	-2 146	-2 192	-2 153	-2 211	-1 926
Bitumen	-898	-848	-1 194	-1 614	-1 369	-1 449	-1 591	-1 480	-1 023
Lubricants	169	-87	-172	-214	-244	-257	-298	-224	-192
Petroleum Coke	-19	13	18	153	107	83	78	46	56
Refinery Feedstocks	2 987	1 645	1 519	1 622	1 344	1 031	1 264	1 395	1 069
Other Oil	274	-127	-140	-176	-125	-271	-31	-285	-497
Liquid Fossil Totals	28 022	30 454	31 849	38 728	37 388	36 422	35 175	33 472	35 092
Anthracite	40	44	7	12	244	516	7	1	4

Fuel Type	1990	1995	2000	2005	2006	2007	2008	2009	2010
Coking Coal	6 994	5 638	5 514	5 531	5 485	5 500	4 697	4 321	4 631
Other Bit. Coal	4 713	3 828	4 809	5 630	5 900	5 676	5 683	4 100	4 760
Sub- Bit. Coal	0	0	79	134	163	171	167	153	144
Lignite	2 729	1 900	1 319	1 211	753	28	16	14	23
Oil Shale	0	0	0	0	0	0	0	0	0
Peat	0	0	0	0	0	0	0	0	0
BKB & Patent Fuel	548	308	197	92	87	84	159	80	76
Coke Oven / Gas Coke	2 014	2 696	3 147	4 046	4 223	3 986	4 020	2 598	3 610
Solid Fuel Totals	17 039	14 414	15 072	16 657	16 855	15 963	14 750	11 267	13 248
Gaseous Fossil	12 146	14 935	15 273	19 116	17 949	16 927	17 887	17 515	19 246
TOTAL	57 207	59 804	62 194	74 502	72 192	69 312	67 812	62 255	67 585
Biomass Total	9 197	10 550	11 392	14 230	14 810	16 302	17 419	17 396	18 951
Solid Biomass	9 197	10 458	11 254	13 715	14 084	15 603	16 644	16 669	18 172
Liquid Biomass	0	0	0	0	0	0	0	0	0
Gas Biomass	0	92	138	516	726	699	776	726	779

Table A 63 presents the apparent fuel consumption for each fuel type of the Reference Approach.

Table A 74: Apparent Consumption (PJ).

Fuel Type	1990	1995	2000	2005	2006	2007	2008	2009	2010
Crude Oil	337 966	366 311	350 349	371 694	362 056	361 230	371 981	354 366	330 237
Orimulsion	0	0	0	0	0	0	0	0	0
Natural Gas Liquids	1 743	1 828	4 553	3 317	3 753	7 812	3 427	5 553	5 749
Gasoline	-3 169	5 341	7 150	11 983	17 161	10 670	3 111	4 217	12 319
Jet Kerosene	-11 914	-17 078	-22 198	-24 273	-21 321	-24 669	-19 000	-12 154	-19 274
Other Kerosene	-607	-102	211	109	101	80	65	60	50
Shale Oil	0	0	0	0	0	0	0	0	0
Gas/Diesel Oil	24 087	49 716	96 387	181 734	172 855	178 203	156 254	146 895	178 197
Residual Fuel Oil	13 251	15 948	14 778	4 222	7 456	5 081	1 860	-4 003	5 557
LPG	3 943	5 847	6 307	5 224	6 088	5 075	3 417	4 166	4 696
Ethane	0	0	0	0	0	0	0	0	0
Naphtha	90	0	0	450	-5 626	-2 746	-5 356	-4 906	-135
Bitumen	11 244	7 775	10 634	8 031	12 838	5 088	2 745	3 626	6 955
Lubricants	5 938	575	-115	-1 278	-1 712	-1 973	-2 588	-1 840	-1 264
Petroleum Coke	2 889	809	2 068	3 313	2 349	2 229	2 765	1 802	3 331
Refinery Feedstocks	41 140	22 664	20 918	22 346	18 512	14 201	17 406	19 211	14 729
Other Oil	3 780	-972	-1 208	-770	2 474	-1 999	1 692	-2 864	-5 978
Liquid Fossil Totals	430 382	458 662	489 835	586 101	576 984	558 282	537 779	514 127	535 171
Anthracite	448	476	84	140	2 548	5 376	84	28	56
Coking Coal	67 923	55 469	54 589	55 195	54 983	55 240	54 173	49 217	53 453
Other Bit. Coal	50 568	41 076	51 604	60 398	63 239	60 989	61 273	44 138	51 116
Sub- Bit. Coal	0	0	844	1 421	1 732	1 820	1 776	1 621	1 532
Lignite	27 294	18 999	13 188	11 915	7 429	285	166	146	236
Oil Shale	0	0	0	0	0	0	0	0	0
Peat	4	4	4	4	4	4	4	4	4
BKB & Patent Fuel	5 912	3 323	2 127	997	939	908	1 716	865	820

Fuel Type	1990	1995	2000	2005	2006	2007	2008	2009	2010
Coke Oven / Gas Coke	19 304	25 821	30 110	38 999	40 163	38 034	37 847	24 563	34 100
Solid Fuel Totals	171 453	145 168	152 550	169 069	171 037	162 657	157 040	120 581	141 317
Gaseous Fossil	219 239	269 583	275 681	345 059	323 987	305 533	322 871	316 162	347 395
TOTAL	821 073	873 413	918 066	1 100 229	1 072 009	1 026 472	1 017 690	950 871	1 023 883
Biomass Total	95 324	109 244	117 925	146 906	152 673	168 172	179 661	179 470	195 535
Solid Biomass	95 324	108 395	116 650	142 155	145 987	161 728	172 513	172 780	188 355
Liquid Biomass	IE	IE	IE	IE	IE	IE	IE	IE	IE
Gas Biomass	0	849	1 275	4 751	6 686	6 444	7 148	6 691	7 180

Table A 64 presents the carbon stored for each fuel type of the Reference Approach.

Table A 75: Carbon Stored (Gg C)

Fuel Type	1990	1995	2000	2005	2006	2007	2008	2009	2010
Crude Oil	0	0	0	0	0	0	0	0	0
Orimulsion	0	0	0	0	0	0	0	0	0
Natural Gas Liquids	0	0	0	0	0	0	0	0	0
Gasoline	0	0	0	0	0	0	0	0	0
Jet Kerosene	0	0	0	0	0	0	0	0	0
Other Kerosene	0	0	0	0	0	0	0	0	0
Shale Oil	0	0	0	0	0	0	0	0	0
Gas / Diesel Oil	0	0	0	0	0	0	0	0	0
Residual Fuel Oil	0	0	0	0	0	0	0	0	0
LPG	0	0	0	0	0	0	0	0	0
Ethane	0	0	0	0	0	0	0	0	0
Naphtha	294	340	394	373	479	549	486	511	528
Bitumen	495	405	563	621	660	511	499	488	435
Lubricants	72	35	45	33	33	31	30	25	27
Petroleum Coke	85	19	52	49	35	39	55	37	76
Refinery Feedstocks	0	0	0	0	0	0	0	0	0
Other Oil	0	16	14	33	84	35	42	21	17
Liquid Fossil Totals	945	814	1 068	1 110	1 290	1 165	1 112	1 082	1 084
Anthracite	1	0	0	0	0	0	0	0	0
Coking Coal	40	53	62	81	82	78	76	50	69
Other Bit. Coal	0	0	0	0	0	0	0	0	0
Sub- Bit. Coal	0	0	0	0	0	0	0	0	0
Lignite	0	0	0	0	0	0	0	0	0
Oil Shale	0	0	0	0	0	0	0	0	0
Peat	0	0	0	0	0	0	0	0	0
BKB & Patent Fuel	0	0	0	0	0	0	0	0	0
Coke Oven/ Gas Coke	5	6	6	7	7	7	7	6	6
Solid Fuel Totals	45	59	68	88	89	85	83	56	76
Gaseous Fossil	0	0	0	0	0	0	0	0	0
TOTAL	990	873	1 136	1 198	1 380	1 250	1 195	1 137	1 159
Biomass Total	0	0	0	0	0	0	0	0	0
Solid Biomass	0	0	0	0	0	0	0	0	0
Liquid Biomass	0	0	0	0	0	0	0	0	0
Gas Biomass	0	0	0	0	0	0	0	0	0

Table A 65 presents international bunker fuels for the relevant fuel types of the Reference Approach.

Table A 76: International Bunkers [Gg fuel].

Fuel Type	1990	1995	2000	2005	2006	2007	2008	2009	2010
Jet Kerosene	281	421	538	622	650	690	692	601	650
Diesel	6	6	6	21	14	12	11	11	11

Table A 66 presents conversion factors, carbon emission factors and the fraction of carbon oxidised for all fuel types of the Reference Approach.

Table A 77: 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]
	Default value	Country specific value 2010	Default value	Country specific value 2010	
Crude Oil	42.75	42.79	20.00	-	0.99
Orimulsion	-	-	-	-	-
Natural Gas Liquids	45.22	42.79	17.20	-	0.99
Gasoline	44.80	43.15	18.90	-	0.99
Jet Kerosene	44.59	43.30	19.50	-	0.99
Other Kerosene	44.75	43.30	19.60	-	0.99
Shale Oil	-	-	-	-	-
Gas / Diesel Oil	43.33	42.80	20.20	-	0.99
Residual Fuel Oil	40.19	40.94	21.10	-	0.99
LPG	47.31	46.00	17.20	-	0.99
Ethane	-	-	-	-	-
Naphtha	45.01	-	20.00	-	0.99
Bitumen	40.19	43.83	22.00	-	0.99
Lubricants	40.19	41.80	20.00	-	0.99
Petroleum Coke	31.00	32.22	27.50	-	0.99
Refinery Feedstocks	42.50	42.59	20.00	-	0.99
Other Oil	40.19	43.83	20.00	-	0.99
Anthracite	28.00		26.80	-	0.98
Coking Coal	28.00	29.08	25.80	25.40	0.98
Other Bit. Coal	28.00	27.00	25.80	25.91	0.98
Sub- Bit. Coal	22.20	-	26.20	-	0.98
Lignite	10.90	19.68	27.60	26.89	0.98
Oil Shale	-	-	-	-	-
Peat	8.80	8.80	28.90	-	0.98
BKB & Patent Fuel	19.30	-	25.80	-	0.98
Coke Oven / Gas	28.20	29.00	29.50	29.65	0.98

Fuel Type	Conversion Factor [TJ/Gg]		Carbon emission factor [t C/TJ]		Fraction of carbon oxidised [t C/t C]
	Default value	Country specific value 2010	Default value	Country specific value 2010	
Coke					
Natural Gas	-	-	15.30	15.19	1.00
Solid Biomass	-	-	29.90	-	0.88
Liquid Biomass	-	-	-	-	-
Gas Biomass	-	-	29.90	-	0.99

Table A 67 presents selected country specific conversion factors. From 2010 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 78: Country specific conversion factors for selected fuels [TJ/Gg]

Fuel Type	1990	1995	2000	2005	2006	2007	2008	2009	2010
Other Bit. Coal	28.00	28.00	27.99	28.14	28.07	27.99	28.46	28.10	27.00
Lignite	10.90	10.90	9.82	9.84	10.94	21.93	20.76	20.86	19.67
Coke	28.50	28.50	28.67	29.00	29.00	29.00	29.00	29.00	29.00

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 2011.

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 79: National Energy Balance 1990-2010 Coking Coal [1000 tons].

101A Coking Coal	1990	1995	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010
Indigenous Production	0	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	1 661
Total Exports (Balance)	0	0	0	0	0	0	0	0	0	0	0	0	0	0
International Marine Bunkers	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Stock Change (National Territory)	-39	130	83	45	139	30	34	40	115	-164	86	41	-68	32
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	1 693
Statistical Difference	0	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	1 693
Public Electricity	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Public Combined Heat and Power	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Public Heat Plants	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Auto Producers of Electricity	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Auto Producers for CHP	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Auto Producer Heat Plants	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Gas Works (Transformation)	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Coke Ovens (Transformation)	2 337	1 908	2 172	2 191	1 878	1 892	1 898	1 898	1 905	1 899	1 891	1 900	1 863	1 693
Blast Furnaces (Transformation)	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Patent Fuel Plants	0	0	0	0	0	0	0	0	0	0	0	0	0	0
BKB (Transformation)	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Non Specified (Transformation)	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Total Energy Sector	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Coal Mines	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Patent Fuel Plants	0	0	0	0	0	0	0	0	0	0	0	1	2	3
Coke Ovens (Energy)	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Blast Furnaces (Energy)	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Gas Works (Energy)	0	0	0	0	0	0	0	0	0	0	0	0	0	0
BKB (Transformation)	0	0	0	0	0	0	0	0	0	0	0	1	2	3
Petroleum refineries	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Power Plants	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Non Specified (Energy)	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Distribution Losses	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Final Consumption	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Total Transport	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Rail	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Inland Waterways	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Non Specified (Transport)	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Total Industry	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Iron and Steel	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Chemical (incl. Petro-Chemical)	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Non ferrous Metals	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Non metallic Mineral Products	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Transportation Equipment	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Machinery	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Mining and Quarrying	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Food, Beverages and Tobacco	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Pulp, Paper and Printing	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Wood and Wood Products	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Construction	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Textiles and Leather	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Non Specified (Industry)	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Total Other Sectors	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Commerce - Public Services	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Residential	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Agriculture	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Non Specified (Others)	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Total Non-Energy Use	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Table A 80: National Energy Balance 1990–2010 Bituminous Coal & Anthracite [1000 tons].

102A Bituminous Coal & Anthracite (hard coal)	1990	1995	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010
Indigenous Production	0	1	0	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	2 273	2 316	2 569	2 132	1 428
Total Exports (Balance)	0	1	0	0	0	0	0	0	21	3	0	1	2	0
International Marine Bunkers	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Stock Change (National Territory)	589	268	-97	94	176	178	-225	310	-212	-119	31	-192	28	161
Gross Inland Deliveries (Obs.)	1 822	1 484	1 555	1 305	1 848	2 040	1 942	2 411	2 426	2 151	2 346	2 376	2 158	1 588
Statistical Difference	0	0	0	0	0	0	0	0	0	0	0	4	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	1 199
Public Electricity	964	550	890	731	1 203	1 446	1 373	1 908	1 908	1 665	1 770	1 777	1 510	992
Public Combined Heat and Power	409	518	127	140	161	180	194	177	193	178	174	164	188	168
Public Heat Plants	0	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	0
Auto Producers for CHP	48	14	40	32	48	39	42	38	43	39	53	32	34	40
Auto Producer Heat Plants	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Gas Works (Transformation)	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Coke Ovens (Transformation)	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Blast Furnaces (Transformation)	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Patent Fuel Plants	0	0	0	0	0	0	0	0	0	0	0	0	0	0
BKB (Transformation)	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Non Specified (Transformation)	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Total Energy Sector	0	0	0	7	33	2	0	0	0	0	0	0	10	6
Coal Mines	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Patent Fuel Plants	0	0	0	0	0	0	0	0	0	0	0	1	2	3
Coke Ovens (Energy)	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Blast Furnaces (Energy)	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Gas Works (Energy)	0	0	0	0	0	0	0	0	0	0	0	0	0	0
BKB (Transformation)	0	0	0	0	0	0	0	0	0	0	0	1	2	3
Petroleum refineries	0	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	10	6
Non Specified (Energy)	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Distribution Losses	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Final Consumption	400	400	493	390	392	364	323	280	277	266	344	308	229	273
Total Transport	3	0	1	1	1	1	1	1	0	0	0	0	0	0
Rail	3	0	1	1	1	1	1	1	0	0	0	0	0	0
Inland Waterways	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Non Specified (Transport)	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Total Industry	208	251	383	290	313	288	254	215	217	212	296	280	220	253
Iron and Steel	0	0	0	0	0	0	0	0	0	3	5	5	1	1
Chemical (incl. Petro-Chemical)	7	45	70	88	57	68	66	67	61	35	29	22	19	18
Non ferrous Metals	0	0	0	0	0	0	0	0	0	0	0	0	0	1
Non metallic Mineral Products	199	164	199	131	170	151	98	74	72	86	140	156	140	143
Transportation Equipment	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Machinery	0	0	0	0	0	0	0	0	0	0	1	0	0	0
Mining and Quarrying	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Food, Beverages and Tobacco	0	0	0	0	0	0	0	0	0	0	0	0	1	1
Pulp, Paper and Printing	2	43	113	72	86	69	90	74	83	87	121	97	60	89
Wood and Wood Products	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Construction	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Textiles and Leather	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Non Specified (Industry)	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Total Other Sectors	189	148	109	98	78	75	69	64	60	53	48	28	9	20
Commerce - Public Services	11	10	11	18	8	7	12	14	11	9	6	3	0	0
Residential	177	137	98	80	69	67	57	50	48	44	42	25	9	20
Agriculture	1	1	1	1	0	0	0	0	0	0	0	0	0	0
Non Specified (Others)	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Total Non-Energy Use	2	1	1	1	1	1	2	2	1	1	1	85	183	110

Table A 81: National Energy Balance 1990-2010. Patent Fuel [1000 tons].

104A Patent Fuel (hard coal briquettes)	1990	1995	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010
Indigenous Production	0	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	75
Total Exports (Balance)	0	0	0	0	0	0	0	0	0	0	0	0	0	0
International Marine Bunkers	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Stock Change (National Territory)	0	0	0	0	0	0	0	0	0	0	0	0	-25	-57
Gross Inland Deliveries (Obs.)	0	0	4	4	4	1	1	2	1	1	1	9	49	18
Statistical Difference	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Total Transformation Sector	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Public Electricity	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Public Combined Heat and Power	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Public Heat Plants	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Auto Producers of Electricity	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Auto Producers for CHP	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Auto Producer Heat Plants	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Gas Works (Transformation)	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Coke Ovens (Transformation)	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Blast Furnaces (Transformation)	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Patent Fuel Plants	0	0	0	0	0	0	0	0	0	0	0	0	0	0
BKB (Transformation)	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Non Specified (Transformation)	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Total Energy Sector	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Coal Mines	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Patent Fuel Plants	0	0	0	0	0	0	0	0	0	0	0	1	2	3
Coke Ovens (Energy)	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Blast Furnaces (Energy)	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Gas Works (Energy)	0	0	0	0	0	0	0	0	0	0	0	0	0	0
BKB (Transformation)	0	0	0	0	0	0	0	0	0	0	0	1	2	3
Petroleum refineries	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Power Plants	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Non Specified (Energy)	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Distribution Losses	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Final Consumption	0	0	4	4	4	1	1	2	1	1	1	9	49	18
Total Transport	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Rail	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Inland Waterways	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Non Specified (Transport)	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Total Industry	0	0	0	0	0	0	0	0	0	0	0	0	24	3
Iron and Steel	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Chemical (incl. Petro-Chemical)	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Non ferrous Metals	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Non metallic Mineral Products	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Transportation Equipment	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Machinery	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Mining and Quarrying	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Food, Beverages and Tobacco	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Pulp, Paper and Printing	0	0	0	0	0	0	0	0	0	0	0	0	24	3
Wood and Wood Products	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Construction	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Textiles and Leather	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Non Specified (Industry)	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Total Other Sectors	0	0	4	4	4	1	1	2	1	1	1	9	25	15
Commerce - Public Services	0	0	1	1	1	0	0	0	0	0	0	0	0	0
Residential	0	0	3	3	3	0	1	2	1	1	1	9	25	15
Agriculture	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Non Specified (Others)	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Total Non-Energy Use	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Table A 82: National Energy Balance 1990-2010. Lignite and Brown Coal [1000 tons].

105A Lignite and brown coal	1990	1995	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010
Indigenous Production	0	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	75
Total Exports (Balance)	0	0	0	0	0	0	0	0	0	0	0	0	0	0
International Marine Bunkers	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Stock Change (National Territory)	0	0	0	0	0	0	0	0	0	0	0	0	-25	-57
Gross Inland Deliveries (Obs.)	0	0	4	4	4	1	1	2	1	1	1	9	49	18
Statistical Difference	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Total Transformation Sector	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Public Electricity	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Public Combined Heat and Power	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Public Heat Plants	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Auto Producers of Electricity	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Auto Producers for CHP	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Auto Producer Heat Plants	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Gas Works (Transformation)	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Coke Ovens (Transformation)	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Blast Furnaces (Transformation)	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Patent Fuel Plants	0	0	0	0	0	0	0	0	0	0	0	0	0	0
BKB (Transformation)	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Non Specified (Transformation)	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Total Energy Sector	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Coal Mines	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Patent Fuel Plants	0	0	0	0	0	0	0	0	0	0	0	1	2	3
Coke Ovens (Energy)	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Blast Furnaces (Energy)	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Gas Works (Energy)	0	0	0	0	0	0	0	0	0	0	0	0	0	0
BKB (Transformation)	0	0	0	0	0	0	0	0	0	0	0	1	2	3
Petroleum refineries	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Power Plants	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Non Specified (Energy)	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Distribution Losses	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Final Consumption	0	0	4	4	4	1	1	2	1	1	1	9	49	18
Total Transport	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Rail	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Inland Waterways	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Non Specified (Transport)	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Total Industry	0	0	0	0	0	0	0	0	0	0	0	0	24	3
Iron and Steel	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Chemical (incl. Petro-Chemical)	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Non ferrous Metals	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Non metallic Mineral Products	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Transportation Equipment	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Machinery	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Mining and Quarrying	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Food, Beverages and Tobacco	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Pulp, Paper and Printing	0	0	0	0	0	0	0	0	0	0	0	0	24	3
Wood and Wood Products	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Construction	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Textiles and Leather	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Non Specified (Industry)	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Total Other Sectors	0	0	4	4	4	1	1	2	1	1	1	9	25	15
Commerce - Public Services	0	0	1	1	1	0	0	0	0	0	0	0	0	0
Residential	0	0	3	3	3	0	1	2	1	1	1	9	25	15
Agriculture	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Non Specified (Others)	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Total Non-Energy Use	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Table A 83: National Energy Balance 1990–2010. Brown Coal Briquettes [1000 tons].

106A BKB-PB	1990	1995	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010
Indigenous Production	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Total Imports (Balance)	295	173	103	106	95	108	65	72	59	53	57	40	38	44
Total Exports (Balance)	0	1	0	0	0	0	0	0	1	2	1	1	0	2
International Marine Bunkers	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Stock Change (National Territory)	12	1	0	0	11	0	0	0	0	0	-9	-2	2	-3
Gross Inland Deliveries (Obs.)	306	172	103	106	107	108	65	72	58	51	48	38	39	39
Statistical Difference	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Total Transformation Sector	12	0	0	0	0	0	0	0	0	0	0	0	0	0
Public Electricity	7	0	0	0	0	0	0	0	0	0	0	0	0	0
Public Combined Heat and Power	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Public Heat Plants	5	0	0	0	0	0	0	0	0	0	0	0	0	0
Auto Producers of Electricity	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Auto Producers for CHP	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Auto Producer Heat Plants	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Gas Works (Transformation)	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Coke Ovens (Transformation)	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Blast Furnaces (Transformation)	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Patent Fuel Plants	0	0	0	0	0	0	0	0	0	0	0	0	0	0
BKB (Transformation)	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Non Specified (Transformation)	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Total Energy Sector	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Coal Mines	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Patent Fuel Plants	0	0	0	0	0	0	0	0	0	0	0	1	2	3
Coke Ovens (Energy)	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Blast Furnaces (Energy)	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Gas Works (Energy)	0	0	0	0	0	0	0	0	0	0	0	0	0	0
BKB (Transformation)	0	0	0	0	0	0	0	0	0	0	0	1	2	3
Petroleum refineries	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Power Plants	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Non Specified (Energy)	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Distribution Losses	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Final Consumption	295	172	103	106	107	108	65	72	58	51	48	38	39	39
Total Transport	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Rail	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Inland Waterways	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Non Specified (Transport)	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Total Industry	64	14	0	0	0	0	0	0	0	0	0	0	0	0
Iron and Steel	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Chemical (incl. Petro-Chemical)	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Non ferrous Metals	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Non metallic Mineral Products	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Transportation Equipment	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Machinery	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Mining and Quarrying	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Food, Beverages and Tobacco	1	0	0	0	0	0	0	0	0	0	0	0	0	0
Pulp, Paper and Printing	63	14	0	0	0	0	0	0	0	0	0	0	0	0
Wood and Wood Products	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Construction	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Textiles and Leather	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Non Specified (Industry)	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Total Other Sectors	230	158	103	106	107	108	65	72	58	51	48	38	39	39
Commerce - Public Services	8	6	11	11	34	41	14	30	18	13	12	10	10	10
Residential	214	146	88	91	70	65	49	40	39	36	34	27	28	28
Agriculture	8	6	4	4	3	3	2	2	2	2	2	1	1	1
Non Specified (Others)	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Total Non-Energy Use	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Table A 84: National Energy Balance 1990-2010. Coke Oven Coke [1000 tons].

107A Coke Oven Coke	1990	1995	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010
Indigenous Production	1 725	1 448	1 598	1 608	1 385	1 394	1 395	1 395	1 400	1 388	1 398	1 424	1 410	1 281
Total Imports (Balance)	815	718	642	654	981	1 091	1 073	1 173	1 266	1 402	1 282	1 438	1 420	813
Total Exports (Balance)	1	1	0	2	1	1	2	3	42	4	3	5	0	0
International Marine Bunkers	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Stock Change (National Territory)	-136	189	24	-30	71	-164	124	-77	-180	-51	108	-120	-113	53
Gross Inland Deliveries (Obs.)	2 402	2 354	2 264	2 230	2 435	2 320	2 589	2 488	2 445	2 735	2 785	2 737	2 716	2 146
Statistical Difference	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Total Transformation Sector	623	711	830	783	909	899	1 049	1 019	1 059	1 035	1 154	1 183	1 237	961
Public Electricity	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Public Combined Heat and Power	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Public Heat Plants	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Auto Producers of Electricity	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Auto Producers for CHP	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Auto Producer Heat Plants	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Gas Works (Transformation)	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Coke Ovens (Transformation)	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Blast Furnaces (Transformation)	623	711	830	783	909	899	1 049	1 019	1 059	1 035	1 154	1 183	1 237	961
Patent Fuel Plants	0	0	0	0	0	0	0	0	0	0	0	0	0	0
BKB (Transformation)	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Non Specified (Transformation)	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Total Energy Sector	107	77	68	48	53	52	58	55	50	65	62	61	57	44
Coal Mines	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Patent Fuel Plants	0	0	0	0	0	0	0	0	0	0	0	1	2	3
Coke Ovens (Energy)	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Blast Furnaces (Energy)	107	77	68	48	53	52	58	55	50	65	62	61	57	44
Gas Works (Energy)	0	0	0	0	0	0	0	0	0	0	0	0	0	0
BKB (Transformation)	0	0	0	0	0	0	0	0	0	0	0	1	2	3
Petroleum refineries	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Power Plants	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Non Specified (Energy)	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Distribution Losses	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Final Consumption	853	557	422	467	436	344	366	356	354	370	375	322	317	289
Total Transport	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Rail	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Inland Waterways	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Non Specified (Transport)	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Total Industry	290	196	200	259	247	164	219	237	241	287	298	261	256	227
Iron and Steel	235	178	164	191	207	143	193	202	216	235	273	239	232	187
Chemical (incl. Petro-Chemical)	14	6	11	17	15	12	11	14	10	9	0	0	0	0
Non ferrous Metals	7	3	6	8	6	3	6	5	6	4	4	5	5	5
Non metallic Mineral Products	23	4	13	38	10	2	5	4	5	32	16	13	16	32
Transportation Equipment	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Machinery	5	2	2	3	0	0	0	0	0	0	0	0	0	0
Mining and Quarrying	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Food, Beverages and Tobacco	5	2	4	3	7	4	5	11	4	6	4	4	3	4
Pulp, Paper and Printing	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Wood and Wood Products	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Construction	1	0	0	0	0	0	0	0	0	0	0	0	0	0
Textiles and Leather	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Non Specified (Industry)	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Total Other Sectors	563	361	222	208	190	180	147	119	113	83	77	61	62	62
Commerce - Public Services	13	9	5	6	5	7	7	5	5	4	3	2	1	1
Residential	537	345	212	198	180	169	138	112	106	78	73	58	59	59
Agriculture	12	8	5	5	4	4	3	2	2	1	1	1	1	1
Non Specified (Others)	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Total Non-Energy Use	820	1 010	944	931	1 037	1 025	1 115	1 058	982	1 265	1 195	1 171	1 104	852

Table A 85: National Energy Balance 1990-2010. Peat [1000 tons].

113A Peat	1990	1995	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010
Indigenous Production	1	1	1	1	1	1	1	1	1	1	1	1	1	1
Total Imports (Balance)	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Total Exports (Balance)	0	0	0	0	0	0	0	0	0	0	0	0	0	0
International Marine Bunkers	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Stock Change (National Territory)	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Gross Inland Deliveries (Obs.)	1	1	1	1	1	1	1	1	1	1	1	1	1	1
Statistical Difference	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Total Transformation Sector	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Public Electricity	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Public Combined Heat and Power	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Public Heat Plants	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Auto Producers of Electricity	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Auto Producers for CHP	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Auto Producer Heat Plants	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Gas Works (Transformation)	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Coke Ovens (Transformation)	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Blast Furnaces (Transformation)	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Patent Fuel Plants	0	0	0	0	0	0	0	0	0	0	0	0	0	0
BKB (Transformation)	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Non Specified (Transformation)	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Total Energy Sector	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Coal Mines	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Patent Fuel Plants	0	0	0	0	0	0	0	0	0	0	0	1	2	3
Coke Ovens (Energy)	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Blast Furnaces (Energy)	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Gas Works (Energy)	0	0	0	0	0	0	0	0	0	0	0	0	0	0
BKB (Transformation)	0	0	0	0	0	0	0	0	0	0	0	1	2	3
Petroleum refineries	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Power Plants	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Non Specified (Energy)	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Distribution Losses	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Final Consumption	1	1	1	1	1	1	1	1	1	1	1	1	1	1
Total Transport	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Rail	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Inland Waterways	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Non Specified (Transport)	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Total Industry	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Iron and Steel	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Chemical (incl. Petro-Chemical)	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Non ferrous Metals	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Non metallic Mineral Products	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Transportation Equipment	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Machinery	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Mining and Quarrying	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Food, Beverages and Tobacco	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Pulp, Paper and Printing	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Wood and Wood Products	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Construction	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Textiles and Leather	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Non Specified (Industry)	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Total Other Sectors	1	1	1	1	1	1	1	1	1	1	1	1	1	1
Commerce - Public Services	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Residential	1	1	1	1	1	1	1	1	1	1	1	1	1	1
Agriculture	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Non Specified (Others)	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Total Non-Energy Use	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Table A 86: National Energy Balance 1990-2010. Coke Oven Gas [TJ].

304A Coke Oven Gas	1990	1995	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010
Indigenous Production	13 117	10 906	12 166	12 220	10 466	9 776	9 579	722	10 911	10 9 871	9 682	9 524	9 903	8 088
Total Imports (Balance)	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Total Exports (Balance)	0	0	0	0	0	0	0	0	0	0	0	0	0	0
International Marine Bunkers	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Stock Change (National Territory)	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Gross Inland Deliveries (Obs.)	13 117	10 906	12 166	12 220	10 466	9 776	9 579	722	10 911	10 9 871	9 682	9 524	9 903	8 088
Statistical Difference	0	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	3 816	3 187	1 748	2 436	2 332	2 119	2 062	2 230	2 733
Public Electricity	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Public Combined Heat and Power	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Public Heat Plants	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Auto Producers of Electricity	0	0	2 033	2 649	3 256	3 440	2 778	1 255	2 193	2 027	1 915	1 848	1 942	2 384
Auto Producers for CHP	3 385	6 228	1 054	1 083	286	376	409	494	243	305	204	214	288	349
Auto Producer Heat Plants	0	0	0	0	50	0	0	0	0	0	0	0	0	0
Gas Works (Transformation)	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Coke Ovens (Transformation)	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Blast Furnaces (Transformation)	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Patent Fuel Plants	0	0	0	0	0	0	0	0	0	0	0	0	0	0
BKB (Transformation)	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Non Specified (Transformation)	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Total Energy Sector	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	2 436
Coal Mines	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Patent Fuel Plants	0	0	0	0	0	0	0	0	0	0	0	1	2	3
Coke Ovens (Energy)	1 072	892	995	999	856	799	783	708	595	699	645	725	605	2 436
Blast Furnaces (Energy)	3 064	2 547	2 841	2 854	2 444	2 283	2 237	3 479	3 730	3 472	3 445	3 365	3 486	0
Gas Works (Energy)	0	0	0	0	0	0	0	0	0	0	0	0	0	0
BKB (Transformation)	0	0	0	0	0	0	0	0	0	0	0	1	2	3
Petroleum refineries	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Power Plants	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Non Specified (Energy)	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Distribution Losses	0	0	0	0	0	0	1 023	1 171	1 204	845	728	673	524	194
Final Consumption	5 596	1 239	5 243	4 635	3 574	2 878	2 348	3 616	2 946	2 523	2 744	2 699	3 059	2 726
Total Transport	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Rail	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Inland Waterways	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Non Specified (Transport)	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Total Industry	5 596	1 239	5 243	4 635	3 574	2 878	2 348	3 616	2 946	2 523	2 744	2 699	3 059	2 726
Iron and Steel	5 596	1 239	5 243	4 635	3 574	2 878	2 348	3 616	2 946	2 523	2 744	2 699	3 059	2 726
Chemical (incl. Petro-Chemical)	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Non ferrous Metals	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Non metallic Mineral Products	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Transportation Equipment	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Machinery	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Mining and Quarrying	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Food, Beverages and Tobacco	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Pulp, Paper and Printing	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Wood and Wood Products	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Construction	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Textiles and Leather	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Non Specified (Industry)	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Total Other Sectors	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Commerce - Public Services	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Residential	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Agriculture	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Non Specified (Others)	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Total Non-Energy Use	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Table A 87: National Energy Balance 1990–2010. Blast Furnace Gas [TJ].

305A Blast Furnace Gas	1990	1995	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010
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	26 845
Total Imports (Balance)	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Total Exports (Balance)	0	0	0	0	0	0	0	0	0	0	0	0	0	0
International Marine Bunkers	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Stock Change (National Territory)	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Gross Inland Deliveries (Obs.)	17 094	19 503	22 528	21 873	25 385	25 098	29 309	28 463	29 577	28 902	32 217	33 031	34 556	26 845
Statistical Difference	0	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	12 431	13 751	11 941	10 294
Public Electricity	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Public Combined Heat and Power	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Public Heat Plants	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Auto Producers of Electricity	0	0	5 320	4 629	5 011	7 767	8 395	7 956	10 437	10 937	11 515	12 897	10 507	9 014
Auto Producers for CHP	4 822	6 213	2 305	2 173	1 003	612	786	1 132	690	1 157	916	854	1 435	1 280
Auto Producer Heat Plants	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Gas Works (Transformation)	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Coke Ovens (Transformation)	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Blast Furnaces (Transformation)	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Patent Fuel Plants	0	0	0	0	0	0	0	0	0	0	0	0	0	0
BKB (Transformation)	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Non Specified (Transformation)	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Total Energy Sector	9 682	11 685	13 536	13 156	15 254	15 077	17 304	17 025	16 175	16 290	18 137	18 216	20 449	16 307
Coal Mines	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Patent Fuel Plants	0	0	0	0	0	0	0	0	0	0	0	1	2	3
Coke Ovens (Energy)	2 391	2 641	3 256	3 231	3 675	3 609	3 941	3 861	4 282	3 647	5 367	4 701	10 811	16 307
Blast Furnaces (Energy)	7 291	9 044	10 280	9 924	11 579	11 468	13 363	13 164	11 894	12 643	12 770	13 515	9 638	0
Gas Works (Energy)	0	0	0	0	0	0	0	0	0	0	0	0	0	0
BKB (Transformation)	0	0	0	0	0	0	0	0	0	0	0	1	2	3
Petroleum refineries	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Power Plants	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Non Specified (Energy)	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Distribution Losses	0	0	0	0	0	0	1 111	653	967	517	1 649	1 064	2 166	244
Final Consumption	2 590	1 605	1 367	1 915	4 117	1 642	1 713	1 696	1 307	0	0	0	0	0
Total Transport	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Rail	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Inland Waterways	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Non Specified (Transport)	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Total Industry	2 590	1 605	1 367	1 915	4 117	1 642	1 713	1 696	1 307	0	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	0
Chemical (incl. Petro-Chemical)	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Non ferrous Metals	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Non metallic Mineral Products	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Transportation Equipment	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Machinery	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Mining and Quarrying	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Food, Beverages and Tobacco	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Pulp, Paper and Printing	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Wood and Wood Products	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Construction	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Textiles and Leather	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Non Specified (Industry)	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Total Other Sectors	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Commerce - Public Services	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Residential	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Agriculture	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Non Specified (Others)	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Total Non-Energy Use	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Oil

Table A 88: National Energy Balance 1990-2010. Crude Oil [1000 tons].

201A Crude Oil	1990	1995	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010
Indigenous Production	1 149	1 035	959	1 003	971	957	957	1 113	971	855	863	800	906	910
Refinery Losses	120	153	156	226	122	210	72	28	68	87	97	85	165	16
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	8 459	8 710	8 286
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	8 459	8 710	8 286
Refinery Fuel	0	0	0	0	0	0	1	0	0	0	0	38	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	7 424
Total Exports (Balance)	0	0	44	51	61	63	0	0	0	0	0	0	0	0
Stock Change (National Territory)	6	-6	6	-14	16	-36	-128	-114	-91	55	-90	105	-61	-48
Statistical Difference	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Table A 89: National Energy Balance 1990-2010. Natural Gas Liquids [1000 tons].

302A Natural Gas Liquids	1990	1995	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010
Indigenous Production	41	43	88	60	101	55	53	92	88	76	86	128	120	93
Refinery Losses	0	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	178	80	47
Refinery Intake (Observed)	41	43	226	71	107	55	53	55	51	43	47	141	80	47
Refinery Fuel	0	0	0	0	0	0	0	38	38	33	39	0	40	45
Total Imports (Balance)	0	0	135	0	6	0	0	0	0	0	0	50	0	0
Total Exports (Balance)	0	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	0
Statistical Difference	0	0	0	0	0	0	0	0	0	0	0	-38	0	0

Table A 90: National Energy Balance 1990-2010. Refinery Feedstocks [1000 tons].

217A Refinery Feedstocks	1990	1995	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010
Refinery Losses	0	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	406	467
Refinery Intake (Observed)	1 069	582	564	873	540	616	440	152	354	471	468	348	406	467
Refinery Fuel	0	0	0	2	1	14	26	5	45	65	43	53	70	186
Total Imports (Balance)	1 009	600	746	740	627	534	593	374	223	265	502	305	358	481
Total Exports (Balance)	0	39	7	64	125	80	32	72	12	18	35	28	18	11
Stock Change (National Territory)	60	-28	-182	148	-10	125	-146	-198	122	227	-20	58	68	121

Table A 91: National Energy Balance 1990-2010. Residual Fuel Oil [1000 tons].

203X; Residual Fuel Oil	1990	1995	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010
Refinery Gross Output	1 913	1 502	1 347	1 308	979	1 047	1 012	978	1 031	1 045	915	879	769	787
Refinery Fuel	81	139	63	22	37	7	7	25	7	26	6	40	36	20
Total Imports (Balance)	602	531	671	468	262	317	241	328	306	182	199	183	184	109
Total Exports (Balance)	185	38	18	37	152	228	146	55	55	72	58	37	148	296
International Marine Bunkers	0	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	89
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	775	599
Statistical Difference	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Total Transformation Sector	608	573	732	558	381	468	261	352	366	350	313	219	215	211
Public Electricity	28	88	348	236	109	112	34	106	94	79	91	73	66	40
Public Combined Heat and Power	253	316	233	241	162	191	168	203	198	179	160	99	95	106
Public Heat Plants	99	70	106	54	88	149	45	28	63	81	52	42	49	57
Auto Producers of Electricity	0	0	10	5	5	7	5	6	3	3	3	0	1	0
Auto Producers for CHP	227	97	33	20	15	9	8	8	9	9	7	5	4	8
Auto Producer Heat Plants	1	1	1	2	1	1	1	2	0	0	0	0	0	0
Gas Works (Transformation)	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Coke Ovens (Transformation)	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Blast Furnaces (Transformation)	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Petrochemical Industry	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Patent Fuel Plants	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Non Specified (Transformation)	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Total Energy Sector	116	150	191	191	231	256	154	159	203	234	227	274	224	120
Coal Mines	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Oil and Gas Extraction	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Coke Ovens (Energy)	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Blast Furnaces (Energy)	116	150	191	191	231	256	154	159	203	234	227	274	224	120
Gas Works (Energy)	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Power Plants	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Non Specified (Energy)	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Distribution Losses	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Final Consumption	1 432	1 035	976	837	686	757	668	722	607	482	550	379	335	268
Total Transport	0	0	0	0	0	0	0	0	0	0	0	0	0	0
International Civil Aviation	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Domestic Air Transport	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Road	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Rail	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Inland Waterways	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Pipeline Transport	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Non Specified (Transport)	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Total Industry	518	550	611	335	277	247	215	246	250	262	259	222	213	204
Iron and Steel	19	23	9	10	21	13	8	6	10	15	16	6	28	53
Chemical (incl. Petro-Chemical)	23	27	33	19	11	10	9	11	15	13	11	13	14	14
Non ferrous Metals	4	7	15	9	9	7	7	7	7	6	6	5	5	4
Non metallic Mineral Products	115	135	159	80	51	37	35	39	42	45	46	49	48	38
Transportation Equipment	13	17	5	4	4	5	3	4	4	5	4	4	3	2
Machinery	29	32	54	31	30	27	25	31	32	32	31	24	22	17
Mining and Quarrying	6	7	9	13	12	13	11	13	12	12	11	7	3	3
Food, Beverages and Tobacco	78	89	69	39	38	37	33	42	47	41	42	37	33	28
Pulp, Paper and Printing	126	108	114	56	41	43	36	42	30	39	36	31	23	20
Wood and Wood Products	15	21	33	19	9	4	12	13	13	13	12	9	3	3
Construction	32	22	36	17	16	11	10	14	14	16	21	16	13	12
Textiles and Leather	27	25	39	17	12	16	11	9	9	11	9	7	6	5
Non Specified (Industry)	30	36	36	22	23	24	13	15	16	15	15	12	10	7
Total Other Sectors	914	485	365	502	409	510	453	476	357	220	291	157	121	64
Commerce - Public Services	316	239	58	173	116	221	210	195	90	77	161	67	29	14
Residential	471	194	241	259	232	229	193	223	212	114	103	72	73	39
Agriculture	127	53	65	70	60	60	50	58	55	30	27	19	19	10
Non Specified (Others)	0	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	120

Table A 92: National Energy Balance 1990-2010. Heating and Other Gas Oil [1000 tons].

204A Heating and Other Gas Oil	1990	1995	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010
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	835
Refinery Fuel	0	0	2	6	0	0	0	0	0	0	0	0	0	0
Total Imports (Balance)	0	165	577	615	533	626	734	860	805	926	850	743	813	706
Total Exports (Balance)	0	0	0	0	1	3	0	0	17	20	34	10	34	33
International Marine Bunkers	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Stock Change (National Territory)	5	39	41	1	125	-93	-41	-63	75	30	-87	123	-100	-19
Gross Inland Deliveries (Obs.)	1 244	1 658	1 895	1 854	1 719	1 831	1 755	1 899	1 791	1 933	1 734	1 467	1 669	1 490
Statistical Difference	0	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	6	5	6	11
Public Electricity	0	0	0	0	0	14	0	0	0	1	1	1	1	1
Public Combined Heat and Power	0	2	0	0	0	4	0	1	0	3	1	2	2	1
Public Heat Plants	0	0	2	0	0	0	0	3	2	1	2	1	1	2
Auto Producers of Electricity	0	0	0	0	0	0	0	0	0	0	1	1	1	1
Auto Producers for CHP	0	0	0	0	0	0	0	0	0	0	0	0	0	5
Auto Producer Heat Plants	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Gas Works (Transformation)	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Coke Ovens (Transformation)	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Blast Furnaces (Transformation)	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Petrochemical Industry	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Patent Fuel Plants	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Non Specified (Transformation)	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Total Energy Sector	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Coal Mines	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Oil and Gas Extraction	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Coke Ovens (Energy)	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Blast Furnaces (Energy)	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Gas Works (Energy)	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Power Plants	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Non Specified (Energy)	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Distribution Losses	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Final Consumption	1 244	1 656	1 893	1 853	1 719	1 813	1 755	1 895	1 789	1 929	1 728	1 462	1 663	1 479
Total Transport	0	0	0	0	0	0	0	0	0	0	0	0	0	0
International Civil Aviation	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Domestic Air Transport	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Road	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Rail	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Inland Waterways	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Pipeline Transport	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Non Specified (Transport)	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Total Industry	1	5	24	24	38	111	64	93	113	114	107	86	70	68
Iron and Steel	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Chemical (incl. Petro-Chemical)	0	0	1	1	2	6	4	3	2	2	1	1	1	1
Non ferrous Metals	0	0	0	2	2	5	3	1	1	1	1	1	0	0
Non metallic Mineral Products	0	1	5	2	2	5	2	4	5	6	6	6	7	6
Transportation Equipment	0	0	0	0	0	0	0	1	1	1	1	1	1	1
Machinery	0	1	6	4	5	16	9	11	12	13	13	10	7	8
Mining and Quarrying	0	0	1	1	1	4	3	3	3	4	4	3	2	2
Food, Beverages and Tobacco	0	1	3	6	10	32	19	25	29	28	27	24	22	22
Pulp, Paper and Printing	0	0	0	0	1	2	1	1	2	2	2	1	1	1
Wood and Wood Products	0	0	1	1	1	3	2	4	6	7	7	5	1	1
Construction	0	1	6	5	10	30	17	32	44	41	34	26	23	20
Textiles and Leather	0	0	1	1	1	4	2	3	3	3	4	3	2	2
Non Specified (Industry)	0	0	2	1	2	5	3	5	5	6	7	5	3	3
Total Other Sectors	1 243	1 651	1 868	1 828	1 682	1 702	1 690	1 802	1 675	1 814	1 621	1 376	1 593	1 411
Commerce - Public Services	26	92	471	417	264	296	296	341	294	271	212	392	189	
Residential	1 216	1 558	1 396	1 410	1 416	1 405	1 393	1 382	1 333	1 519	1 349	1 163	1 200	1 220
Agriculture	1	1	1	1	1	1	1	1	1	1	1	1	1	1
Non Specified (Others)	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Total Non-Energy Use	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Table A 93: National Energy Balance 1990-2010. Diesel [1000 tons].

2050 Diesel	1990	1995	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010
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	3 164
Refinery Fuel	0	1	1	0	0	0	0	4	0	0	0	0	1	0
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	3 653
Total Exports (Balance)	3	83	467	459	415	415	520	539	563	889	584	945	1 040	805
International Marine Bunkers	0	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	-59
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	5 953
Statistical Difference	0	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	0
Public Electricity	0	6	0	0	0	0	0	0	0	0	0	0	0	0
Public Combined Heat and Power	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Public Heat Plants	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Auto Producers of Electricity	0	0	0	1	0	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	0
Auto Producer Heat Plants	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Gas Works (Transformation)	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Coke Ovens (Transformation)	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Blast Furnaces (Transformation)	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Petrochemical Industry	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Patent Fuel Plants	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Non Specified (Transformation)	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Total Energy Sector	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Coal Mines	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Oil and Gas Extraction	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Coke Ovens (Energy)	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Blast Furnaces (Energy)	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Gas Works (Energy)	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Power Plants	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Non Specified (Energy)	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Distribution Losses	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Final Consumption	2 096	2 877	3 936	3 890	4 262	4 667	5 179	5 685	5 935	6 262	6 106	6 296	6 090	5 952
Total Transport	1 766	2 507	3 522	3 484	3 830	4 245	4 760	5 174	5 317	5 662	5 506	5 690	5 470	5 333
International Civil Aviation	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Domestic Air Transport	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Road	1 705	2 456	3 475	3 436	3 782	4 196	4 713	5 124	5 267	5 590	5 438	5 624	5 405	5 268
Rail	54	45	41	42	42	42	41	44	44	52	54	54	54	54
Inland Waterways	6	6	6	6	6	6	6	5	5	21	14	12	11	11
Pipeline Transport	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Non Specified (Transport)	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Total Industry	81	113	154	147	172	162	157	248	354	335	337	343	358	358
Iron and Steel	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Chemical (incl. Petro-Chemical)	1	1	1	1	1	1	0	0	0	0	0	0	0	0
Non ferrous Metals	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Non metallic Mineral Products	0	0	1	1	1	1	1	0	1	1	1	1	1	1
Transportation Equipment	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Machinery	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Mining and Quarrying	2	2	3	3	3	3	4	4	5	4	4	4	4	4
Food, Beverages and Tobacco	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Pulp, Paper and Printing	0	0	1	1	1	1	1	1	1	1	1	1	0	0
Wood and Wood Products	0	1	1	1	1	1	1	1	1	1	1	2	1	1
Construction	77	108	147	141	165	155	151	241	346	328	329	334	350	351
Textiles and Leather	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Non Specified (Industry)	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Total Other Sectors	250	257	260	259	260	261	262	263	265	265	263	263	262	261
Commerce - Public Services	9	13	17	17	19	21	23	24	26	28	27	28	27	26
Residential	0	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	235
Non Specified (Others)	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Total Non-Energy Use	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Table A 94: National Energy Balance 1990–2010. Other Kerosene [1000 tons].

206A Other Kerosene	1990	1995	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010
Refinery Gross Output	31	8	2	1	1	1	1	1	1	1	8	1	3	3
Refinery Fuel	0	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	2
Total Exports (Balance)	21	6	2	0	0	0	0	0	0	0	0	0	0	0
International Marine Bunkers	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Stock Change (National Territory)	-7	0	1	0	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	4
Statistical Difference	0	0	0	0	0	0	0	0	0	0	7	0	0	0
Total Transformation Sector	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Public Electricity	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Public Combined Heat and Power	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Public Heat Plants	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Auto Producers of Electricity	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Auto Producers for CHP	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Auto Producer Heat Plants	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Gas Works (Transformation)	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Coke Ovens (Transformation)	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Blast Furnaces (Transformation)	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Petrochemical Industry	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Patent Fuel Plants	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Non Specified (Transformation)	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Total Energy Sector	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Coal Mines	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Oil and Gas Extraction	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Coke Ovens (Energy)	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Blast Furnaces (Energy)	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Gas Works (Energy)	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Power Plants	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Non Specified (Energy)	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Distribution Losses	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Final Consumption	18	6	17	16	6	1	4	5	4	3	4	3	5	4
Total Transport	0	0	0	0	0	0	0	0	0	0	0	0	0	0
International Civil Aviation	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Domestic Air Transport	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Road	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Rail	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Inland Waterways	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Pipeline Transport	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Non Specified (Transport)	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Total Industry	0	0	0	1	0	0	0	0	0	0	0	0	0	0
Iron and Steel	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Chemical (incl. Petro-Chemical)	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Non ferrous Metals	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Non metallic Mineral Products	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Transportation Equipment	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Machinery	0	0	0	1	0	0	0	0	0	0	0	0	0	0
Mining and Quarrying	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Food, Beverages and Tobacco	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Pulp, Paper and Printing	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Wood and Wood Products	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Construction	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Textiles and Leather	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Non Specified (Industry)	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Total Other Sectors	18	6	17	15	6	1	4	4	4	3	3	3	4	4
Commerce - Public Services	18	6	17	15	6	1	4	4	4	3	3	3	4	4
Residential	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Agriculture	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Non Specified (Others)	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Total Non-Energy Use	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Table A 95: National Energy Balance 1990-2010. Kerosene Type Jet Fuel [1000 tons].

206B Kerosene Type Jet Fuel	1990	1995	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010
Refinery Gross Output	291	420	540	508	544	513	484	446	455	592	526	604	472	313
Refinery Fuel	0	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	228
Total Exports (Balance)	5	0	6	5	5	1	1	5	4	2	1	1	2	0
International Marine Bunkers	0	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	92
Gross Inland Deliveries (Obs.)	299	447	541	525	569	553	519	491	578	653	683	724	725	633
Statistical Difference	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Total Transformation Sector	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Public Electricity	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Public Combined Heat and Power	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Public Heat Plants	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Auto Producers of Electricity	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Auto Producers for CHP	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Auto Producer Heat Plants	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Gas Works (Transformation)	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Coke Ovens (Transformation)	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Blast Furnaces (Transformation)	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Petrochemical Industry	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Patent Fuel Plants	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Non Specified (Transformation)	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Total Energy Sector	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Coal Mines	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Oil and Gas Extraction	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Coke Ovens (Energy)	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Blast Furnaces (Energy)	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Gas Works (Energy)	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Power Plants	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Non Specified (Energy)	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Distribution Losses	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Final Consumption	299	447	541	525	569	553	519	491	578	653	683	724	725	633
Total Transport	299	447	541	525	569	553	519	491	578	653	683	724	725	633
International Civil Aviation	269	425	511	489	537	447	484	414	486	549	575	552	585	517
Domestic Air Transport	30	22	30	36	32	106	34	77	92	104	108	172	140	116
Road	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Rail	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Inland Waterways	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Pipeline Transport	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Non Specified (Transport)	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Total Industry	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Iron and Steel	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Chemical (incl. Petro-Chemical)	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Non ferrous Metals	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Non metallic Mineral Products	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Transportation Equipment	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Machinery	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Mining and Quarrying	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Food, Beverages and Tobacco	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Pulp, Paper and Printing	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Wood and Wood Products	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Construction	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Textiles and Leather	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Non Specified (Industry)	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Total Other Sectors	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Commerce - Public Services	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Residential	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Agriculture	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Non Specified (Others)	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Total Non-Energy Use	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Table A 96: National Energy Balance 1990-2010. Gasoline Type Jet Fuel [1000 tons].

207A Gasoline Type Jet Fuel	1990	1995	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010
Refinery Gross Output	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Refinery Fuel	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Total Imports (Balance)	1	4	3	3	3	4	4	5	7	6	7	5	7	4
Total Exports (Balance)	0	0	0	1	1	1	2	3	3	3	3	3	4	2
International Marine Bunkers	0	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	1
Gross Inland Deliveries (Obs.)	3	3	3	3	2	2	2	3	2	3	3	3	3	3
Statistical Difference	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Total Transformation Sector	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Public Electricity	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Public Combined Heat and Power	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Public Heat Plants	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Auto Producers of Electricity	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Auto Producers for CHP	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Auto Producer Heat Plants	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Gas Works (Transformation)	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Coke Ovens (Transformation)	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Blast Furnaces (Transformation)	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Petrochemical Industry	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Patent Fuel Plants	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Non Specified (Transformation)	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Total Energy Sector	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Coal Mines	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Oil and Gas Extraction	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Coke Ovens (Energy)	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Blast Furnaces (Energy)	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Gas Works (Energy)	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Power Plants	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Non Specified (Energy)	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Distribution Losses	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Final Consumption	3	3	3	3	2	2	2	3	2	3	3	3	3	3
Total Transport	3	3	3	3	2	2	2	3	2	3	3	3	3	3
International Civil Aviation	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Domestic Air Transport	3	3	3	3	2	2	2	3	2	3	3	3	3	3
Road	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Rail	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Inland Waterways	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Pipeline Transport	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Non Specified (Transport)	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Total Industry	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Iron and Steel	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Chemical (incl. Petro-Chemical)	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Non ferrous Metals	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Non metallic Mineral Products	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Transportation Equipment	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Machinery	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Mining and Quarrying	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Food, Beverages and Tobacco	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Pulp, Paper and Printing	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Wood and Wood Products	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Construction	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Textiles and Leather	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Non Specified (Industry)	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Total Other Sectors	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Commerce - Public Services	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Residential	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Agriculture	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Non Specified (Others)	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Total Non-Energy Use	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Table A 97: National Energy Balance 1990-2010. Motor Gasoline [1000 tons].

2080 Motor Gasoline	1990	1995	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010
Refinery Gross Output	2 631	2 271	2 232	2 141	1 815	1 922	1 927	1 799	1 756	1 798	1 615	1 704	1 684	1 652
Refinery Fuel	0	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	719
Total Exports (Balance)	281	596	824	824	472	582	496	474	614	767	562	646	653	468
International Marine Bunkers	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Stock Change (National Territory)	-55	20	37	-26	-32	51	7	-9	-50	-44	-4	8	10	-87
Gross Inland Deliveries (Obs.)	2 545	2 394	2 204	2 053	1 981	1 994	2 143	2 195	2 135	2 077	2 009	1 948	1 753	1 815
Statistical Difference	9	0	0	0	0	0	0	0	0	0	0	0	0	0
Total Transformation Sector	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Public Electricity	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Public Combined Heat and Power	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Public Heat Plants	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Auto Producers of Electricity	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Auto Producers for CHP	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Auto Producer Heat Plants	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Gas Works (Transformation)	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Coke Ovens (Transformation)	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Blast Furnaces (Transformation)	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Petrochemical Industry	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Patent Fuel Plants	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Non Specified (Transformation)	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Total Energy Sector	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Coal Mines	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Oil and Gas Extraction	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Coke Ovens (Energy)	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Blast Furnaces (Energy)	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Gas Works (Energy)	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Power Plants	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Non Specified (Energy)	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Distribution Losses	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Final Consumption	2 545	2 394	2 204	2 053	1 981	1 994	2 143	2 195	2 135	2 077	2 009	1 948	1 753	1 815
Total Transport	2 545	2 394	2 204	2 053	1 981	1 994	2 143	2 195	2 135	2 077	2 009	1 948	1 753	1 815
International Civil Aviation	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Domestic Air Transport	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Road	2 545	2 394	2 204	2 053	1 981	1 994	2 143	2 195	2 135	2 077	2 009	1 948	1 753	1 815
Rail	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Inland Waterways	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Pipeline Transport	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Non Specified (Transport)	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Total Industry	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Iron and Steel	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Chemical (incl. Petro-Chemical)	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Non ferrous Metals	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Non metallic Mineral Products	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Transportation Equipment	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Machinery	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Mining and Quarrying	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Food, Beverages and Tobacco	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Pulp, Paper and Printing	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Wood and Wood Products	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Construction	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Textiles and Leather	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Non Specified (Industry)	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Total Other Sectors	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Commerce - Public Services	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Residential	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Agriculture	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Non Specified (Others)	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Total Non-Energy Use	0	0	4	0	0	0	0	0	0	0	0	0	0	0

Table A 98: National Energy Balance 1990-2010. Lubricants [1000 tons].

219A Lubricants	1990	1995	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010
Refinery Gross Output	31	73	107	105	111	117	100	123	108	111	120	122	135	103
Refinery Fuel	0	1	0	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	45
Total Exports (Balance)	32	41	53	51	58	65	62	80	70	85	91	102	117	91
International Marine Bunkers	0	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	2
Gross Inland Deliveries (Obs.)	174	86	106	103	108	108	86	92	75	80	79	75	73	59
Statistical Difference	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Total Transformation Sector	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Public Electricity	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Public Combined Heat and Power	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Public Heat Plants	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Auto Producers of Electricity	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Auto Producers for CHP	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Auto Producer Heat Plants	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Gas Works (Transformation)	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Coke Ovens (Transformation)	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Blast Furnaces (Transformation)	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Petrochemical Industry	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Patent Fuel Plants	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Non Specified (Transformation)	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Total Energy Sector	19	9	12	11	12	12	9	10	8	9	9	8	8	6
Coal Mines	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Oil and Gas Extraction	1	0	1	1	1	1	0	1	0	0	0	0	0	0
Coke Ovens (Energy)	6	3	3	3	4	4	3	3	2	3	3	2	2	2
Blast Furnaces (Energy)	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Gas Works (Energy)	1	0	0	0	0	0	0	0	0	0	0	0	0	0
Power Plants	2	1	1	1	1	1	1	1	1	1	1	1	1	1
Non Specified (Energy)	11	5	6	6	6	6	5	6	4	5	5	4	4	4
Distribution Losses	0	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	53
Total Transport	71	35	43	42	44	44	36	38	31	32	32	30	29	24
International Civil Aviation	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Domestic Air Transport	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Road	70	34	42	41	43	43	35	37	30	32	31	30	29	24
Rail	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Inland Waterways	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Pipeline Transport	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Non Specified (Transport)	1	1	1	0	1	1	1	1	0	0	0	0	0	0
Total Industry	81	40	49	48	50	50	40	42	35	38	37	35	34	28
Iron and Steel	15	7	9	9	9	9	7	7	7	7	7	7	6	5
Chemical (incl. Petro-Chemical)	7	3	4	4	4	4	3	4	3	3	3	3	3	2
Non ferrous Metals	2	1	1	1	2	2	1	1	1	1	1	1	1	1
Non metallic Mineral Products	11	5	6	6	7	7	5	6	5	5	5	5	4	4
Transportation Equipment	2	1	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	2
Mining and Quarrying	3	2	2	2	2	2	2	2	1	1	1	1	1	1
Food, Beverages and Tobacco	11	5	7	7	7	7	5	6	5	5	5	5	5	4
Pulp, Paper and Printing	9	4	5	5	5	5	4	5	4	4	4	4	4	3
Wood and Wood Products	3	1	2	2	2	2	1	1	1	1	1	1	1	1
Construction	2	1	1	1	1	1	1	1	1	1	1	1	1	1
Textiles and Leather	5	2	3	3	3	3	2	2	2	2	2	2	2	2
Non Specified (Industry)	9	4	6	5	6	4	3	3	2	3	3	2	2	2
Total Other Sectors	3	2	2	2	2	2	2	2	1	2	2	1	1	1
Commerce - Public Services	3	2	2	2	2	2	1	1	1	1	1	1	1	1
Residential	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Agriculture	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Non Specified (Others)	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Total Non-Energy Use	174	86	106	103	108	108	86	92	75	80	79	75	73	59

Table A 99: National Energy Balance 1990-2010. White Spirit [1000 tons].

220A White Spirit	1990	1995	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010
Refinery Gross Output	31	73	107	105	111	117	100	123	108	111	120	122	135	103
Refinery Fuel	0	1	0	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	45
Total Exports (Balance)	32	41	53	51	58	65	62	80	70	85	91	102	117	91
International Marine Bunkers	0	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	2
Gross Inland Deliveries (Obs.)	174	86	106	103	108	108	86	92	75	80	79	75	73	59
Statistical Difference	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Total Transformation Sector	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Public Electricity	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Public Combined Heat and Power	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Public Heat Plants	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Auto Producers of Electricity	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Auto Producers for CHP	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Auto Producer Heat Plants	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Gas Works (Transformation)	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Coke Ovens (Transformation)	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Blast Furnaces (Transformation)	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Petrochemical Industry	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Patent Fuel Plants	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Non Specified (Transformation)	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Total Energy Sector	19	9	12	11	12	12	9	10	8	9	9	8	8	6
Coal Mines	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Oil and Gas Extraction	1	0	1	1	1	1	0	1	0	0	0	0	0	0
Coke Ovens (Energy)	6	3	3	3	4	4	3	3	2	3	3	2	2	2
Blast Furnaces (Energy)	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Gas Works (Energy)	1	0	0	0	0	0	0	0	0	0	0	0	0	0
Power Plants	2	1	1	1	1	1	1	1	1	1	1	1	1	1
Non Specified (Energy)	11	5	6	6	6	6	5	6	4	5	5	4	4	4
Distribution Losses	0	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	53
Total Transport	71	35	43	42	44	44	36	38	31	32	32	30	29	24
International Civil Aviation	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Domestic Air Transport	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Road	70	34	42	41	43	43	35	37	30	32	31	30	29	24
Rail	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Inland Waterways	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Pipeline Transport	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Non Specified (Transport)	1	1	1	0	1	1	1	1	0	0	0	0	0	0
Total Industry	81	40	49	48	50	50	40	42	35	38	37	35	34	28
Iron and Steel	15	7	9	9	9	9	7	7	7	7	7	7	6	5
Chemical (incl. Petro-Chemical)	7	3	4	4	4	4	3	4	3	3	3	3	3	2
Non ferrous Metals	2	1	1	1	2	2	1	1	1	1	1	1	1	1
Non metallic Mineral Products	11	5	6	6	7	7	5	6	5	5	5	5	4	4
Transportation Equipment	2	1	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	2
Mining and Quarrying	3	2	2	2	2	2	2	2	1	1	1	1	1	1
Food, Beverages and Tobacco	11	5	7	7	7	7	5	6	5	5	5	5	5	4
Pulp, Paper and Printing	9	4	5	5	5	5	4	5	4	4	4	4	4	3
Wood and Wood Products	3	1	2	2	2	2	1	1	1	1	1	1	1	1
Construction	2	1	1	1	1	1	1	1	1	1	1	1	1	1
Textiles and Leather	5	2	3	3	3	3	2	2	2	2	2	2	2	2
Non Specified (Industry)	9	4	6	5	6	4	3	3	2	3	3	2	2	2
Total Other Sectors	3	2	2	2	2	2	2	2	1	2	2	1	1	1
Commerce - Public Services	3	2	2	2	2	2	1	1	1	1	1	1	1	1
Residential	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Agriculture	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Non Specified (Others)	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Total Non-Energy Use	174	86	106	103	108	108	86	92	75	80	79	75	73	59

Table A 100: National Energy Balance 1990-2010. Bitumen [1000 tons].

222A Bitumen	1990	1995	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010
Refinery Gross Output	269	254	300	326	343	402	416	398	433	466	392	411	444	420
Refinery Fuel	0	0	4	0	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	281
Total Exports (Balance)	1	5	1	1	45	78	62	82	81	147	122	151	215	198
International Marine Bunkers	0	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	-1
Gross Inland Deliveries (Obs.)	538	440	572	560	587	618	601	613	646	651	685	526	505	502
Statistical Difference	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Total Transformation Sector	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Public Electricity	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Public Combined Heat and Power	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Public Heat Plants	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Auto Producers of Electricity	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Auto Producers for CHP	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Auto Producer Heat Plants	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Gas Works (Transformation)	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Coke Ovens (Transformation)	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Blast Furnaces (Transformation)	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Petrochemical Industry	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Patent Fuel Plants	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Non Specified (Transformation)	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Total Energy Sector	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Coal Mines	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Oil and Gas Extraction	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Coke Ovens (Energy)	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Blast Furnaces (Energy)	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Gas Works (Energy)	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Power Plants	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Non Specified (Energy)	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Distribution Losses	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Final Consumption	538	440	572	560	587	618	601	613	646	651	685	526	505	502
Total Transport	0	0	0	0	0	0	0	0	0	0	0	0	0	0
International Civil Aviation	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Domestic Air Transport	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Road	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Rail	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Inland Waterways	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Pipeline Transport	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Non Specified (Transport)	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Total Industry	538	440	572	560	587	618	601	613	646	651	685	526	505	502
Iron and Steel	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Chemical (incl. Petro-Chemical)	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Non ferrous Metals	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Non metallic Mineral Products	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Transportation Equipment	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Machinery	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Mining and Quarrying	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Food, Beverages and Tobacco	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Pulp, Paper and Printing	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Wood and Wood Products	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Construction	538	440	572	560	587	618	601	613	646	651	685	526	505	502
Textiles and Leather	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Non Specified (Industry)	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Total Other Sectors	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Commerce - Public Services	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Residential	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Agriculture	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Non Specified (Others)	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Total Non-Energy Use	538	440	572	560	587	618	601	613	646	651	685	526	505	502

Table A 101: National Energy Balance 1990-2010. Other Oil Products [1000 tons].

224A Other Oil Products	1990	1995	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010
Refinery Gross Output	499	761	960	927	859	988	1 030	1 048	1 044	851	1 186	1 217	1 082	1 049
Refinery Fuel	164	212	264	213	223	226	254	278	344	229	282	241	202	81
Total Imports (Balance)	126	13	77	70	111	42	43	43	95	45	78	51	54	50
Total Exports (Balance)	3	39	137	131	139	162	168	149	163	93	180	157	161	260
International Marine Bunkers	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Stock Change (National Territory)	-41	-3	6	-2	-6	17	1	-13	104	-8	2	-13	11	20
Gross Inland Deliveries (Obs.)	472	518	641	651	601	659	652	651	734	566	803	858	785	777
Statistical Difference	-56	0	0	0	0	0	0	0	0	0	0	0	0	0
Total Transformation Sector	23	0	0	0	0	0	0	0	0	0	0	0	0	0
Public Electricity	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Public Combined Heat and Power	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Public Heat Plants	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Auto Producers of Electricity	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Auto Producers for CHP	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Auto Producer Heat Plants	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Gas Works (Transformation)	23	0	0	0	0	0	0	0	0	0	0	0	0	0
Coke Ovens (Transformation)	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Blast Furnaces (Transformation)	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Petrochemical Industry	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Patent Fuel Plants	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Non Specified (Transformation)	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Total Energy Sector	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Coal Mines	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Oil and Gas Extraction	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Coke Ovens (Energy)	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Blast Furnaces (Energy)	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Gas Works (Energy)	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Power Plants	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Non Specified (Energy)	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Distribution Losses	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Final Consumption	449	518	641	651	601	659	652	651	734	566	803	858	785	777
Total Transport	0	0	0	0	0	0	0	0	0	0	0	0	0	0
International Civil Aviation	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Domestic Air Transport	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Road	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Rail	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Inland Waterways	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Pipeline Transport	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Non Specified (Transport)	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Total Industry	449	518	641	651	601	659	652	651	734	566	803	858	785	777
Iron and Steel	0	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	858	785	777
Non ferrous Metals	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Non metallic Mineral Products	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Transportation Equipment	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Machinery	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Mining and Quarrying	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Food, Beverages and Tobacco	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Pulp, Paper and Printing	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Wood and Wood Products	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Construction	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Textiles and Leather	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Non Specified (Industry)	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Total Other Sectors	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Commerce - Public Services	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Residential	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Agriculture	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Non Specified (Others)	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Total Non-Energy Use	449	518	641	651	601	659	652	651	734	566	803	858	785	777

Table A 102: National Energy Balance 1990-2010. LPG [1000 tons].

303A LPG	1990	1995	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010
Refinery Gross Output	47	60	30	19	34	0	23	50	57	107	50	70	98	92
Refinery Fuel	8	19	1	4	20	0	2	1	3	49	3	22	21	40
Total Imports (Balance)	97	149	132	152	159	140	155	137	132	133	155	129	112	99
Total Exports (Balance)	14	42	19	20	17	4	7	9	17	20	21	21	37	8
International Marine Bunkers	0	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	0
Gross Inland Deliveries (Obs.)	125	166	144	147	150	143	168	176	174	172	179	158	152	143
Statistical Difference	0	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	0
Public Electricity	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Public Combined Heat and Power	0	0	0	0	0	0	1	0	0	0	0	0	0	0
Public Heat Plants	1	3	1	1	0	0	0	0	0	0	0	0	0	0
Auto Producers of Electricity	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Auto Producers for CHP	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Auto Producer Heat Plants	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Gas Works (Transformation)	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Coke Ovens (Transformation)	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Blast Furnaces (Transformation)	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Petrochemical Industry	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Patent Fuel Plants	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Non Specified (Transformation)	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Total Energy Sector	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Coal Mines	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Oil and Gas Extraction	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Coke Ovens (Energy)	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Blast Furnaces (Energy)	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Gas Works (Energy)	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Power Plants	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Non Specified (Energy)	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Distribution Losses	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Final Consumption	124	163	143	147	150	143	168	176	174	171	179	158	151	143
Total Transport	9	11	13	13	16	18	24	25	21	21	22	21	22	21
International Civil Aviation	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Domestic Air Transport	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Road	9	11	13	13	16	18	24	25	21	21	22	21	22	21
Rail	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Inland Waterways	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Pipeline Transport	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Non Specified (Transport)	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Total Industry	65	62	66	49	55	48	41	40	29	33	42	36	36	38
Iron and Steel	4	3	13	0	1	0	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	0
Non ferrous Metals	8	6	5	4	4	4	4	5	4	4	4	4	2	3
Non metallic Mineral Products	12	23	14	15	15	14	10	11	2	3	5	6	8	8
Transportation Equipment	1	3	11	0	1	1	1	1	3	2	2	3	2	1
Machinery	11	13	11	11	14	13	13	11	9	10	12	10	9	9
Mining and Quarrying	1	1	1	1	1	1	1	1	1	1	1	1	1	1
Food, Beverages and Tobacco	3	3	2	5	4	5	3	3	4	5	6	4	3	5
Pulp, Paper and Printing	1	1	1	2	2	1	2	1	1	1	1	0	0	0
Wood and Wood Products	0	0	0	1	1	1	1	1	0	0	0	0	0	0
Construction	23	9	7	9	13	6	5	5	5	6	9	7	10	10
Textiles and Leather	0	0	0	0	0	0	0	0	0	0	1	0	0	0
Non Specified (Industry)	0	1	1	1	0	1	1	1	0	0	0	0	0	0
Total Other Sectors	50	90	64	84	79	77	102	112	124	117	116	101	93	83
Commerce - Public Services	32	61	21	36	23	30	59	74	87	72	72	44	35	25
Residential	16	26	39	43	51	44	40	35	35	42	41	52	54	54
Agriculture	2	3	4	4	5	4	3	3	3	3	3	4	4	4
Non Specified (Others)	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Total Non-Energy Use	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Table A 103: National Energy Balance 1990-2010. Refinery Gas [1000 tons].

308A Refinery Gas	1990	1995	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010
Refinery Gross Output	373	305	348	341	312	328	306	235	255	309	390	417	383	369
Refinery Fuel	373	305	348	338	310	327	308	273	293	343	429	454	423	415
Total Imports (Balance)	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Total Exports (Balance)	-	-	-	-	-	-	-	-	-	-	-	-	-	-
International Marine Bunkers	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Stock Change (National Territory)	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Gross Inland Deliveries (Obs.)	0	0	0	2	2	1	0	0	0	0	0	0	0	0
Statistical Difference	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Total Transformation Sector	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Public Electricity	0	0	0	2	2	1	0	0	0	0	0	0	0	0
Public Combined Heat and Power	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Public Heat Plants	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Auto Producers of Electricity	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Auto Producers for CHP	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Auto Producer Heat Plants	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Gas Works (Transformation)	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Coke Ovens (Transformation)	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Blast Furnaces (Transformation)	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Petrochemical Industry	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Patent Fuel Plants	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Non Specified (Transformation)	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Total Energy Sector	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Coal Mines	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Oil and Gas Extraction	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Coke Ovens (Energy)	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Blast Furnaces (Energy)	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Gas Works (Energy)	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Power Plants	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Non Specified (Energy)	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Distribution Losses	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Final Consumption	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Total Transport	0	0	0	0	0	0	0	0	0	0	0	0	0	0
International Civil Aviation	0	0	0	2	2	1	0	0	0	0	0	0	0	0
Domestic Air Transport	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Road	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Rail	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Inland Waterways	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Pipeline Transport	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Non Specified (Transport)	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Total Industry	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Iron and Steel	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Chemical (incl. Petro-Chemical)	0	0	0	2	2	1	0	0	0	0	0	0	0	0
Non ferrous Metals	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Non metallic Mineral Products	0	0	0	2	2	1	0	0	0	0	0	0	0	0
Transportation Equipment	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Machinery	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Mining and Quarrying	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Food, Beverages and Tobacco	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Pulp, Paper and Printing	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Wood and Wood Products	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Construction	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Textiles and Leather	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Non Specified (Industry)	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Total Other Sectors	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Commerce - Public Services	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Residential	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Agriculture	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Non Specified (Others)	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Total Non-Energy Use	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Natural Gas

Table A 104: National Energy Balance 1990-2010. Natural Gas [PJ NCV].

	1990	1995	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010
Indigenous Production	46.4	53.3	56.4	62.5	64.8	62.2	67.5	75.1	70.5	59.3	66.1	67.2	55.7	60.6
Total Imports (Balance)	187.9	229.1	224.0	219.5	222.8	225.6	234.8	288.4	301.2	339.6	372.5	345.1	351.3	402.0
Total Exports (Balance)	0.0	0.6	0.7	0.0	0.6	14.7	19.1	36.9	53.7	35.0	87.3	95.7	68.8	130.9
Stock Change (National Territory)	-15.1	-12.3	4.2	6.9	-11.3	19.1	12.3	-7.2	-2.4	-18.1	-27.4	-11.0	-15.3	-15.6
Gross Inland Deliveries (Obs.)	219.2	269.6	283.9	288.9	275.7	292.2	295.5	319.5	315.7	345.9	324.0	305.5	322.9	314.6
Statistical Difference	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.5
Total Transformation Sector	74.7	95.8	100.6	102.7	83.3	80.6	86.9	99.3	96.9	115.3	97.5	92.1	101.0	105.6
Public Electricity	28.1	21.7	35.4	37.7	25.4	23.8	22.1	27.6	24.4	36.9	20.0	16.8	26.6	26.6
Public Combined Heat and Power	23.8	30.8	29.4	30.7	27.7	33.5	37.1	45.2	46.5	49.0	50.2	46.4	43.8	49.0
Public Heat Plants	7.6	9.6	8.8	7.4	9.3	5.8	9.5	7.7	6.2	9.1	8.9	9.1	11.6	12.5
Auto Producers of Electricity	9.6	21.2	19.2	16.8	12.0	5.3	5.6	5.3	5.8	5.8	3.3	4.0	4.3	3.5
Auto Producers for CHP	5.7	12.5	7.9	9.6	8.6	12.0	12.5	12.9	13.6	13.8	14.8	15.2	13.9	13.2
Auto Producer Heat Plants	0.0	0.0	0.0	0.6	0.4	0.2	0.0	0.5	0.4	0.6	0.3	0.5	0.9	0.8
Gas Works (Transformation)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Coke Ovens (Transformation)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Blast Furnaces (Transformation)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Conversion to Liquids	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Non Specified (Transformation)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Energy Sector	15.8	18.4	13.0	13.7	11.6	12.4	15.6	13.0	14.9	16.0	17.0	14.8	15.5	10.3
Coal Mines	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Oil and Gas Extraction	6.6	10.8	5.7	6.4	5.3	5.6	9.0	6.9	9.9	9.1	11.3	9.6	9.1	8.8
Inputs to Oil Refineries	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	1.4
Coke Ovens (Energy)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Gas Works (Energy)	2.4	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Power Plants	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Non Specified (Energy)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Distribution Losses	0.3	0.2	0.0	0.0	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1
Final Consumption	113.5	144.6	159.8	161.7	170.2	189.1	182.6	195.9	193.6	203.8	197.9	188.4	195.0	188.3
Total Transport	4.1	4.1	6.3	7.8	9.7	8.3	5.0	6.7	6.6	6.6	8.6	8.2	10.5	7.9
Road	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.1	0.2
Pipeline Transport	4.1	4.1	6.3	7.8	9.7	8.3	5.0	6.7	6.6	6.6	8.6	8.1	10.4	7.7
Non Specified (Transport)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Industry	69.0	73.5	80.3	79.2	88.7	91.7	95.9	96.8	92.6	104.3	100.3	99.4	102.8	100.6
Iron and Steel	10.5	11.2	14.2	13.8	13.6	14.0	13.9	14.1	13.8	17.2	16.8	15.8	14.8	16.3
Chemical (incl. Petro-Chemical)	7.7	8.3	9.8	12.6	14.4	13.8	13.6	13.7	12.6	16.7	13.6	13.9	16.1	14.6
Non ferrous Metals	1.4	2.2	2.3	2.2	2.3	2.6	2.7	2.9	3.0	3.2	3.3	3.8	4.0	4.2
Non metallic Mineral Products	10.1	11.1	12.9	11.0	11.7	12.0	13.6	14.0	14.6	15.8	13.8	14.0	13.8	13.3
Transportation Equipment	1.5	2.6	1.1	1.0	1.3	1.5	1.2	1.7	2.2	2.3	2.3	2.1	1.8	1.4
Machinery	4.3	6.1	5.4	4.4	4.8	5.1	4.8	5.3	5.7	6.6	7.0	6.9	7.0	7.4
Mining and Quarrying	2.6	2.5	2.5	1.7	2.3	2.6	2.8	2.6	2.6	1.6	2.9	2.9	3.0	1.6
Food, Beverages and Tobacco	8.9	9.4	9.4	9.7	11.5	11.1	15.1	11.6	10.8	11.6	11.5	11.1	11.4	11.4
Pulp, Paper and Printing	12.9	9.8	16.4	16.1	19.5	21.0	20.5	23.5	20.5	20.7	20.4	20.3	21.9	22.0
Wood and Wood Products	1.7	2.0	1.6	1.8	1.7	1.9	1.9	2.1	1.8	3.4	2.9	2.9	3.5	2.8
Construction	0.7	1.5	0.5	1.6	1.4	1.8	1.8	1.6	1.4	1.7	2.0	1.7	1.6	1.7
Textiles and Leather	3.5	3.4	2.3	2.2	2.9	3.0	2.6	2.2	1.9	2.1	2.0	2.1	2.1	1.9
Non Specified (Industry)	3.1	3.4	1.9	1.1	1.2	1.3	1.4	1.5	1.7	1.7	1.7	1.8	1.8	1.8
Total Other Sectors	40.4	67.0	73.2	74.7	71.8	89.1	81.7	92.4	94.4	92.8	89.0	80.8	81.7	79.9
Commerce - Public Services	7.7	23.4	18.6	23.2	23.8	38.1	30.9	40.8	44.4	38.8	37.2	32.3	32.4	29.7
Residential	32.3	43.2	54.0	50.9	47.5	50.4	50.2	51.1	49.5	53.5	51.3	48.0	48.8	49.6
Agriculture	0.4	0.5	0.6	0.6	0.5	0.6	0.6	0.6	0.6	0.6	0.6	0.5	0.6	0.6
Non Specified (Others)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Non-Energy Use	14.9	10.5	10.6	10.6	10.5	9.9	10.3	11.3	10.3	10.8	11.5	10.1	11.2	10.3

Renewable Fuels

Table A 105: National Energy Balance 1990-2010. Fuel Wood [PJ].

111A Fuel Wood	1990	1995	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010
Indigenous Production	61.40	65.76	63.42	64.59	58.63	61.99	58.22	57.08	54.76	61.74	57.36	56.52	58.28	56.69
Total Imports (Balance)	2.30	1.62	1.60	1.49	1.80	1.80	2.10	2.53	3.31	3.51	4.19	3.36	3.44	7.21
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	0.99
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	0.00
Gross Inland Deliveries (Obs.)	63.12	67.35	64.88	66.04	60.25	63.62	59.94	58.68	56.76	64.40	60.87	59.31	61.22	62.92
Statistical Difference	0.00	0.00	0.21	0.06	0.08	0.08	0.07	0.09	0.10	0.09	0.10	0.09	0.10	0.11
Total Transformation Sector	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.05	0.05	0.02	0.02	0.03	0.04
Public Electricity	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Public Combined Heat and Power	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Public Heat Plants	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.05	0.05	0.02	0.02	0.03	0.04
Auto Producers of Electricity	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Auto Producers for CHP	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Auto Producer Heat Plants	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Total Energy Sector	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Coal Mines	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Patent Fuel Plants	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Coke Ovens (Energy)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Blast Furnaces (Energy)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Gas Works (Energy)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
BKB (Transformation)	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Petroleum refineries	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Power Plants	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Non Specified (Energy)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Distribution Losses	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Final Consumption	63.12	67.35	64.67	65.97	60.17	63.54	59.87	58.58	56.61	64.26	60.75	59.20	61.09	62.77
Total Transport	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Rail	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Inland Waterways	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Non Specified (Transport)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Total Industry	0.66	1.08	0.15	1.87	0.95	1.15	1.42	1.42	1.56	1.13	1.04	1.72	1.75	3.40
Iron and Steel	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Chemical (incl. Petro-Chemical)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.01	0.07
Non ferrous Metals	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Non metallic Mineral Products	0.05	0.06	0.00	0.00	0.00	0.00	0.00	0.01	0.01	0.02	0.02	0.01	0.00	0.00
Transportation Equipment	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Machinery	0.05	0.06	0.01	0.03	0.03	0.03	0.03	0.05	0.07	0.06	0.06	0.04	0.02	0.07
Mining and Quarrying	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Food, Beverages and Tobacco	0.12	0.09	0.01	0.02	0.02	0.02	0.02	0.05	0.07	0.05	0.04	0.03	0.03	0.03
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	0.00	0.67
Wood and Wood Products	0.23	0.30	0.04	1.62	0.71	0.86	1.15	0.86	0.78	0.36	0.32	1.16	1.35	2.24
Construction	0.00	0.29	0.05	0.12	0.11	0.13	0.13	0.20	0.25	0.27	0.29	0.28	0.27	0.27
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	0.00
Non Specified (Industry)	0.19	0.25	0.05	0.08	0.08	0.10	0.09	0.24	0.37	0.35	0.31	0.18	0.06	0.06
Total Other Sectors	62.45	66.28	64.52	64.10	59.22	62.39	58.45	57.17	55.05	63.13	59.71	57.48	59.35	59.37
Commerce - Public Services	1.33	1.17	0.49	0.48	0.34	0.49	0.48	0.48	0.53	0.59	0.64	0.70	0.75	0.74
Residential	57.50	61.25	60.24	59.85	55.38	58.23	54.53	53.33	51.29	58.84	55.57	53.42	55.12	55.15
Agriculture	3.63	3.86	3.80	3.77	3.49	3.67	3.44	3.36	3.23	3.71	3.50	3.37	3.47	3.48
Non Specified (Others)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

Table A 106: National Energy Balance 1990-2010. Wood Waste [PJ].

116A Wood waste; Other	1990	1995	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010
Indigenous Production	13.69	18.77	23.25	38.25	36.30	41.97	38.43	47.73	52.08	65.24	56.60	76.54	88.06	82.35
Total Imports (Balance)	2.14	2.49	3.20	2.90	3.14	4.09	4.47	4.24	7.48	7.36	17.51	14.98	11.79	11.76
Total Exports (Balance)	2.08	2.62	5.05	6.14	6.51	7.98	6.86	10.41	16.91	13.84	12.41	13.17	13.32	9.55
Stock Change (National Territory)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Gross Inland Deliveries (Obs.)	13.75	18.63	21.40	35.01	32.93	38.08	36.05	41.56	42.64	58.77	61.70	78.34	86.53	84.56
Statistical Difference	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Total Transformation Sector	2.27	8.64	9.18	11.86	12.37	14.15	15.36	16.52	18.15	23.95	28.84	39.46	45.99	46.90
Public Electricity	0.00	0.00	0.01	0.06	0.01	1.35	1.15	1.31	1.82	2.70	5.48	7.70	7.57	9.17
Public Combined Heat and Power	0.00	0.00	0.10	0.38	0.35	0.75	1.07	1.50	3.08	7.50	8.66	12.71	17.64	17.12
Public Heat Plants	1.63	3.98	6.69	5.80	7.46	8.69	10.75	10.90	9.94	9.80	10.38	12.13	13.71	14.34
Auto Producers of Electricity	0.00	0.19	0.27	2.65	1.51	1.03	1.00	0.85	1.21	1.24	1.05	2.59	2.71	2.61
Auto Producers for CHP	0.64	4.46	2.10	2.87	2.96	2.12	1.26	1.77	2.02	2.67	3.28	4.33	4.37	3.66
Auto Producer Heat Plants	0.00	0.00	0.00	0.09	0.08	0.21	0.13	0.19	0.09	0.02	0.00	0.00	0.00	0.00
Total Energy Sector	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Coal Mines	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Patent Fuel Plants	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Coke Ovens (Energy)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Blast Furnaces (Energy)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Gas Works (Energy)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
BKB (Transformation)	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Petroleum refineries	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Power Plants	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Non Specified (Energy)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Distribution Losses	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Final Consumption	11.48	10.00	12.22	23.16	20.56	23.94	20.69	25.04	24.50	34.82	32.85	38.88	40.53	37.66
Total Transport	0.08	0.23	0.29	0.56	0.61	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Rail	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Inland Waterways	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Non Specified (Transport)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Total Industry	9.43	6.89	7.30	15.29	11.62	14.02	10.72	13.18	12.02	20.51	19.40	23.14	24.60	21.86
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	0.01	0.01
Chemical (incl.Petro-Chemical)	2.90	1.72	1.58	3.60	2.52	1.07	0.97	1.35	1.13	1.46	1.37	1.91	1.72	1.30
Non ferrous Metals	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Non metallic Mineral Products	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.07	0.07	2.12	2.49	2.66	3.67	2.99
Transportation Equipment	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.02	0.02	0.03	0.01
Machinery	0.00	0.00	0.02	0.04	0.05	0.14	0.15	0.24	0.32	0.24	0.22	0.33	0.50	0.55
Mining and Quarrying	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.00	0.01	0.00	0.00	0.00
Food, Beverages and Tobacco	0.01	0.01	0.00	0.19	0.21	0.24	0.23	0.16	0.08	0.07	0.40	0.43	0.22	0.25
Pulp, Paper and Printing	3.66	3.90	3.75	4.73	1.95	5.91	3.11	4.08	3.05	7.52	5.41	5.65	5.17	2.88
Wood and Wood Products	2.76	1.16	1.75	5.93	6.00	5.52	5.24	6.00	5.78	8.15	8.10	9.64	11.36	11.71
Construction	0.04	0.03	0.05	0.31	0.36	0.41	0.40	0.55	0.80	0.47	0.45	1.50	0.76	0.77
Textiles and Leather	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.00	0.01	0.01	0.00	0.01
Non Specified (Industry)	0.07	0.07	0.15	0.49	0.52	0.73	0.62	0.73	0.78	0.47	0.92	0.99	1.15	1.38
Total Other Sectors	1.98	2.87	4.63	7.31	8.33	9.91	9.97	11.86	12.47	14.30	13.45	15.74	15.94	15.80
Commerce - Public Services	0.64	0.60	1.06	1.83	2.27	2.23	2.20	2.66	3.02	2.74	2.43	2.33	1.95	1.86
Residential	0.77	1.40	2.50	4.06	4.50	5.74	5.80	6.82	6.58	8.05	7.67	9.37	9.77	9.74
Agriculture	0.57	0.87	1.07	1.42	1.57	1.95	1.97	2.38	2.88	3.52	3.36	4.04	4.21	4.20
Non Specified (Others)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

Table A 107: National Energy Balance 1990-2010. Black Liquor [PJ].

215A Black Liquor	1990	1995	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010
Indigenous Production	17.80	21.39	22.92	23.56	24.06	23.24	22.72	22.92	24.24	24.38	24.68	25.07	25.78	24.93
Total Imports (Balance)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Total Exports (Balance)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Stock Change (National Territory)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Gross Inland Deliveries (Obs.)	17.80	21.39	22.92	23.56	24.06	23.24	22.72	22.92	24.24	24.38	24.68	25.07	25.78	24.93
Statistical Difference	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Total Transformation Sector	5.26	9.27	11.35	10.18	7.62	7.46	8.10	7.81	7.83	8.78	7.30	6.32	7.24	7.41
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	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	0.00
Public Heat Plants	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Auto Producers of Electricity	2.62	5.27	8.87	6.16	2.00	1.23	2.34	2.36	1.99	2.42	0.79	0.35	0.66	0.40
Auto Producers for CHP	2.64	4.00	2.49	4.02	5.62	6.21	5.76	5.45	5.84	6.36	6.51	5.96	6.58	7.01
Auto Producer Heat Plants	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Total Energy Sector	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Coal Mines	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Patent Fuel Plants	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Coke Ovens (Energy)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Blast Furnaces (Energy)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Gas Works (Energy)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
BKB (Transformation)	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Petroleum refineries	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Power Plants	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Non Specified (Energy)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Distribution Losses	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Final Consumption	12.54	12.12	11.56	13.38	16.44	15.78	14.62	15.11	16.41	15.61	17.38	18.75	18.54	17.52
Total Transport	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Rail	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Inland Waterways	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Non Specified (Transport)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Total Industry	12.54	12.12	11.56	13.38	16.44	15.78	14.62	15.11	16.41	15.61	17.38	18.75	18.54	17.52
Iron and Steel	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Chemical (incl.Petro-Chemical)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Non ferrous Metals	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Non metallic Mineral Products	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Transportation Equipment	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Machinery	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Mining and Quarrying	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Food, Beverages and Tobacco	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Pulp, Paper and Printing	12.54	12.12	11.56	13.38	16.44	15.78	14.62	15.11	16.41	15.61	17.38	18.75	18.54	17.52
Wood and Wood Products	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Construction	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Textiles and Leather	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Non Specified (Industry)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Total Other Sectors	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Commerce - Public Services	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Residential	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Agriculture	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Non Specified (Others)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

Table A 108: National Energy Balance 1990-2010. Biogas [TJ].

309A Biogas	1990	1995	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010
Indigenous Production	0.00	0.04	0.03	0.22	0.36	0.29	0.35	0.51	0.48	4.33	5.85	5.35	6.19	5.91
Total Imports (Balance)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Total Exports (Balance)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Stock Change (National Territory)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Gross Inland Deliveries (Obs.)	0.00	0.04	0.03	0.22	0.36	0.29	0.35	0.51	0.48	4.33	5.85	5.35	6.19	5.91
Statistical Difference	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.02
Total Transformation Sector	0.00	0.04	0.03	0.12	0.22	0.20	0.19	0.38	0.28	3.83	5.54	4.97	5.69	5.51
Public Electricity	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.17	0.08	3.31	4.69	4.26	4.92	4.73
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	0.28
Public Heat Plants	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.10	0.14	0.25	0.31
Auto Producers of Electricity	0.00	0.00	0.00	0.03	0.12	0.07	0.11	0.11	0.01	0.10	0.34	0.11	0.09	0.09
Auto Producers for CHP	0.00	0.04	0.03	0.09	0.10	0.12	0.09	0.09	0.11	0.22	0.12	0.14	0.14	0.11
Auto Producer Heat Plants	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Total Energy Sector	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Coal Mines	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Patent Fuel Plants	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Coke Ovens (Energy)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Blast Furnaces (Energy)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Gas Works (Energy)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
BKB (Transformation)	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Petroleum refineries	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Power Plants	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Non Specified (Energy)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Distribution Losses	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Final Consumption	0.00	0.00	0.00	0.11	0.15	0.10	0.16	0.13	0.21	0.50	0.31	0.38	0.49	0.38
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	0.02	0.00
Rail	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Inland Waterways	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Non Specified (Transport)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.02	0.00
Total Industry	0.00	0.00	0.00	0.10	0.15	0.10	0.16	0.13	0.21	0.50	0.31	0.38	0.40	0.38
Iron and Steel	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Chemical (incl. Petro-Chemical)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.00
Non ferrous Metals	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Non metallic Mineral Products	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01	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	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	0.01	0.00
Mining and Quarrying	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Food, Beverages and Tobacco	0.00	0.00	0.00	0.00	0.00	0.00	0.02	0.03	0.08	0.10	0.13	0.17	0.17	0.24
Pulp, Paper and Printing	0.00	0.00	0.00	0.10	0.12	0.10	0.14	0.11	0.12	0.25	0.10	0.08	0.08	0.10
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	0.00
Construction	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.15	0.09	0.13	0.10	0.00
Textiles and Leather	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Non Specified (Industry)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.03
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	0.08	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	0.03	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	0.05	0.00
Agriculture	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Non Specified (Others)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

Table A 109: National Energy Balance 1990-2010. Sewage Sludge Gas [PJ].

309B Sewage sludge gas	1990	1995	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010
Indigenous Production	0.00	0.62	0.71	0.37	0.47	0.36	0.21	0.25	0.23	0.39	0.63	0.90	0.92	0.79
Total Imports (Balance)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Total Exports (Balance)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Stock Change (National Territory)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Gross Inland Deliveries (Obs.)	0.00	0.62	0.71	0.37	0.47	0.36	0.21	0.25	0.23	0.39	0.63	0.90	0.92	0.79
Statistical Difference	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Total Transformation Sector	0.00	0.62	0.71	0.02	0.11	0.07	0.04	0.07	0.08	0.10	0.36	0.58	0.68	0.53
Public Electricity	0.00	0.01	0.05	0.00	0.08	0.04	0.04	0.03	0.04	0.00	0.25	0.47	0.56	0.45
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	0.04
Public Heat Plants	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Auto Producers of Electricity	0.00	0.00	0.00	0.02	0.03	0.03	0.00	0.01	0.01	0.01	0.03	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	0.05	0.05	0.05	0.06	0.03
Auto Producer Heat Plants	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Total Energy Sector	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Coal Mines	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Patent Fuel Plants	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Coke Ovens (Energy)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Blast Furnaces (Energy)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Gas Works (Energy)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
BKB (Transformation)	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Petroleum refineries	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Power Plants	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Non Specified (Energy)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Distribution Losses	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Final Consumption	0.00	0.00	0.00	0.35	0.36	0.30	0.17	0.19	0.15	0.29	0.27	0.33	0.24	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	0.00
Rail	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Inland Waterways	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Non Specified (Transport)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Total Industry	0.00	0.00	0.00	0.35	0.36	0.30	0.17	0.19	0.15	0.29	0.27	0.33	0.24	0.26
Iron and Steel	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Chemical (incl. Petro-Chemical)	0.00	0.00	0.00	0.35	0.36	0.30	0.17	0.19	0.15	0.29	0.27	0.33	0.24	0.26
Non ferrous Metals	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Non metallic Mineral Products	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Transportation Equipment	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Machinery	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Mining and Quarrying	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Food, Beverages and Tobacco	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Pulp, Paper and Printing	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Wood and Wood Products	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Construction	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Textiles and Leather	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Non Specified (Industry)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Total Other Sectors	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Commerce - Public Services	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Residential	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Agriculture	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Non Specified (Others)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

Table A 110: National Energy Balance 1990-2010. Landfill Gas [PJ].

310A Landfill Gas	1990	1995	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010
Indigenous Production	0.00	0.20	0.53	0.50	0.44	0.48	0.36	0.33	0.49	0.23	0.20	0.20	0.20	0.21
Total Imports (Balance)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Total Exports (Balance)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Stock Change (National Territory)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Gross Inland Deliveries (Obs.)	0.00	0.20	0.53	0.50	0.44	0.48	0.36	0.33	0.49	0.23	0.20	0.20	0.20	0.21
Statistical Difference	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Total Transformation Sector	0.00	0.15	0.52	0.50	0.44	0.48	0.36	0.33	0.49	0.23	0.20	0.20	0.20	0.21
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	0.08
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	0.00
Public Heat Plants	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Auto Producers of Electricity	0.00	0.12	0.49	0.48	0.43	0.41	0.30	0.27	0.43	0.19	0.17	0.15	0.15	0.12
Auto Producers for CHP	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	0.00
Auto Producer Heat Plants	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Total Energy Sector	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Coal Mines	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Patent Fuel Plants	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Coke Ovens (Energy)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Blast Furnaces (Energy)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Gas Works (Energy)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
BKB (Transformation)	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Petroleum refineries	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Power Plants	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Non Specified (Energy)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Distribution Losses	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Final Consumption	0.00	0.05	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Total Transport	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Rail	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Inland Waterways	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Non Specified (Transport)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Total Industry	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Iron and Steel	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Chemical (incl. Petro-Chemical)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Non ferrous Metals	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Non metallic Mineral Products	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Transportation Equipment	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Machinery	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Mining and Quarrying	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Food, Beverages and Tobacco	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Pulp, Paper and Printing	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Wood and Wood Products	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Construction	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Textiles and Leather	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Non Specified (Industry)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Total Other Sectors	0.00	0.05	0.01	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	0.05	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Residential	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Agriculture	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Non Specified (Others)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

Table A 111: National Energy Balance 1990-2010. Municipal Solid Waste [PJ].

114B Municipal Solid Waste	1990	1995	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010
Indigenous Production	2.41	3.91	4.78	4.74	4.51	4.65	5.03	5.88	8.39	8.84	11.39	10.88	11.21	12.91
Total Imports (Balance)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Total Exports (Balance)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Stock Change (National Territory)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Gross Inland Deliveries (Obs.)	2.41	3.91	4.78	4.74	4.51	4.65	5.03	5.88	8.39	8.84	11.39	10.88	11.21	12.91
Statistical Difference	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Total Transformation Sector	2.41	3.91	4.78	4.74	4.51	4.65	5.03	5.88	8.39	8.84	11.39	10.88	11.21	12.91
Public Electricity	0.00	0.00	0.00	0.73	0.58	0.67	0.69	1.58	2.91	2.19	2.39	2.60	2.24	2.93
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	3.52	4.46
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	1.86
Auto Producers of Electricity	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.07	1.46	3.90	3.33	3.33	3.57
Auto Producers for CHP	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.14	0.07	0.06	0.06	0.06	0.09
Auto Producer Heat Plants	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Total Energy Sector	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Coal Mines	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Patent Fuel Plants	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Coke Ovens (Energy)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Blast Furnaces (Energy)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Gas Works (Energy)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
BKB (Transformation)	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Petroleum refineries	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Power Plants	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Non Specified (Energy)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Distribution Losses	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Final Consumption	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Total Transport	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Rail	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Inland Waterways	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Non Specified (Transport)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Total Industry	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Iron and Steel	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Chemical (incl. Petro-Chemical)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Non ferrous Metals	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Non metallic Mineral Products	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Transportation Equipment	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Machinery	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Mining and Quarrying	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Food, Beverages and Tobacco	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Pulp, Paper and Printing	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Wood and Wood Products	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Construction	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Textiles and Leather	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Non Specified (Industry)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Total Other Sectors	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Commerce - Public Services	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Residential	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Agriculture	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Non Specified (Others)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

Table A 112: National Energy Balance 1990-2010. Industrial Waste [PJ].

115A Industrial Waste	1990	1995	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010
Indigenous Production	6.58	7.00	7.50	6.85	7.76	9.84	11.74	13.52	16.17	14.09	14.87	15.47	20.70	17.24
Total Imports (Balance)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Total Exports (Balance)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Stock Change (National Territory)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Gross Inland Deliveries (Obs.)	6.58	7.00	7.50	6.85	7.76	9.84	11.74	13.52	16.17	14.09	14.87	15.47	20.70	17.24
Statistical Difference	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Total Transformation Sector	2.54	1.93	2.15	2.32	1.59	1.58	2.67	2.82	3.06	2.50	2.74	3.13	3.37	3.22
Public Electricity	0.00	0.00	0.00	0.01	0.13	0.06	1.04	1.16	0.95	0.62	0.69	0.51	0.42	0.51
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	0.74
Public Heat Plants	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Auto Producers of Electricity	0.00	0.00	0.54	1.12	0.44	0.10	0.14	0.14	0.18	0.17	0.15	0.59	0.58	0.58
Auto Producers for CHP	2.54	1.93	1.61	1.20	1.02	0.54	0.79	0.70	1.18	0.99	1.11	1.11	1.54	1.38
Auto Producer Heat Plants	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Total Energy Sector	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Coal Mines	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Patent Fuel Plants	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Coke Ovens (Energy)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Blast Furnaces (Energy)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Gas Works (Energy)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
BKB (Transformation)	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Petroleum refineries	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Power Plants	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Non Specified (Energy)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Distribution Losses	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Final Consumption	4.03	5.08	5.35	4.54	6.17	8.26	9.07	10.71	13.11	11.59	12.12	12.35	17.33	14.02
Total Transport	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Rail	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Inland Waterways	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Non Specified (Transport)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Total Industry	2.92	4.56	4.74	3.93	5.61	7.64	8.45	10.06	12.59	11.19	11.85	12.20	17.31	14.00
Iron and Steel	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.22	0.82	1.64	3.64	0.60
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	3.71	5.78	4.83
Non ferrous Metals	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Non metallic Mineral Products	1.31	1.98	2.66	2.88	3.56	4.55	4.56	4.15	5.34	3.47	4.14	5.76	6.60	7.51
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	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	0.06	0.04	0.01
Mining and Quarrying	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Food, Beverages and Tobacco	0.00	0.00	0.01	0.00	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	0.07	0.14	0.00	0.11	0.09	0.16	0.17	0.04	0.04	0.13	0.04	0.17
Wood and Wood Products	0.04	0.55	0.79	0.78	0.37	0.69	0.46	0.58	0.94	0.36	0.34	0.63	1.05	0.83
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	0.07	0.02
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	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	0.23	0.08	0.04
Total Other Sectors	1.11	0.52	0.61	0.61	0.56	0.63	0.62	0.65	0.52	0.40	0.27	0.15	0.02	0.02
Commerce - Public Services	1.11	0.52	0.61	0.61	0.56	0.63	0.62	0.65	0.52	0.40	0.27	0.15	0.02	0.02
Residential	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Agriculture	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Non Specified (Others)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

Net Calorific Values

The selected net calorific values of each fuel are presented below.

Table A 113 presents the net calorific values (IEA JQ 2010) used for unit conversion.

Table A 113: Net calorific values for 1990-2010 in [MJ/kg], [MJ/m³] taken from (IEA JQ 2010).

Fuel Code	Fuel Name		1990	1995	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010
101A	Coking Coal	T	29.07	29.07	29.07	29.07	29.07	29.07	29.07	29.07	29.07	29.07	29.07	29.07	29.07	29.07
102A	Hard Coal	FC	28.00	28.00	28.00	27.66	27.99	27.99	27.50	27.50	28.41	28.15	28.07	27.99	28.46	28.10
		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	27.99
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	31.00
105A	Brown Coal	FC	10.90	10.90	9.90	9.77	9.82	9.79	9.82	9.82	9.97	15.97	20.61	21.93	20.78	21.06
		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	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	19.31
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	29.00
113A	Peat	FC	8.80	8.80	8.80	8.80	8.80	8.80	8.80	8.80	8.80	8.80	8.80	8.80	8.80	8.80
304A	Coke Oven Gas	P	17.90	17.90	17.90	17.90	17.90	17.90	17.60	17.90	17.90	17.90	17.59	17.36	18.43	16.09
305A	Blast Furnace Gas	P	3.10	3.10	3.10	4.10	4.10	4.10	4.27	3.73	3.70	3.52	3.76	4.05	4.12	4.32
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	31.37	31.67	31.69
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	42.77
203X	Residual Fuel Oil	A	41.00	40.50	40.30	41.50	41.49	42.12	41.45	41.42	41.41	41.73	41.17	41.63	41.56	40.93
204A	Gasoil	A	42.60	42.70	42.80	42.80	42.80	42.82	42.80	42.80	42.80	42.80	42.91	42.70	42.80	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	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	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	43.30
207A	Aviation Gasoline	A	42.50	42.50	42.50	42.50	42.50	42.51	42.49	42.49	42.48	42.49	43.21	43.18	43.16	43.18
2080	Motor Gasoline	A	42.50	42.50	42.50	42.50	42.50	42.51	42.49	42.49	42.48	42.49	43.21	43.18	43.16	43.18
217A	Refinery Feedstocks	A	40.36	42.56	42.25	42.27	42.56	42.65	42.77	42.05	42.72	42.28	42.57	42.41	42.91	42.33
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	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	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	44.38
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	31.37	31.67	31.69
		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	44.38
302A	NGL	A	42.50	42.50	42.50	42.52	42.52	42.50	42.52	42.52	42.52	42.69	42.72	42.71	42.72	42.77
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	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	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	36.30

Legend: A...Average; T...Transformation; FC...Final Consumption; P...Production; NE...Non Energy use;

NGL...Natural Gas Liquids; LPG...Liquified Petroleum Gas

Table A 114 presents the net calorific values from STATISTIK AUSTRIA, which are used for default unit conversion.

Table A 114: 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 115 presents the IPCC default values of net calorific values of gaseous biofuels which are used for default unit conversion.

Table A 115: 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 CO₂, CH₄, N₂O and FCs and the recalculation differences of national total emissions by gas.

Table A 116: 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 CO₂ Emissions by Categories

Explanations are provided in Chapter 9 Recalculations and Improvements and in the sector specific chapters of this report.

Table A 117: Recalculation Difference of CO₂ Emissions 1990-1999.

IPCC Cat.	CO ₂ [Gg]									
	Differences with respect to Submission 2011									
	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999
Total	-8.48	-12.11	-73.23	-11.81	-15.15	-7.20	-9.82	-7.77	-8.86	-4.53
1	-5.94	-6.04	-6.38	-6.49	-6.62	-7.09	-9.71	-7.61	-8.64	-7.03
1 A 1	0.02	0.01	0.02	-0.02	-0.02	0.01	0.03	-10.70	0.01	-127.23
1 A 2	3.20	3.57	3.73	4.00	4.11	4.35	5.33	15.89	5.95	1.06
1 A 3	17.58	17.86	18.49	18.64	19.05	20.43	28.24	21.46	23.63	25.37
1 A 4	-26.73	-27.48	-28.62	-29.11	-29.75	-31.87	-43.31	-34.26	-38.22	93.77
1 B	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2	-2.54	-6.07	-66.85	-5.33	-8.53	-0.11	-0.11	-0.15	-0.22	2.50
2 A 3	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

2 A 4	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2 A 7 c	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
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	3 715.43	3 874.13	3 586.05	6 988.34	6 896.20	4 851.25	3 117.57	3 252.36	3 153.00	4 637.99
6	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

Table A 118: Recalculation Difference of CO₂ Emissions 2000-2009.

IPCC Cat.	CO ₂ [Gg] Differences with respect to Submission 2011									
	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009
Total	-12.09	-4.49	-170.31	-15.15	528.06	4.61	-51.72	-14.58	-7.66	-310.13
1	-14.52	-6.94	-172.75	-17.43	466.78	9.09	-43.28	-4.46	0.86	-461.44
1 A 1	-17.71	12.09	-173.43	198.84	211.22	178.81	-1.48	-13.38	-20.68	103.17
1 A 2	144.10	-2.48	6.05	9.67	269.95	157.46	119.36	133.37	118.01	268.17
1 A 3	-170.30	72.91	49.05	50.59	46.92	42.84	43.49	46.37	59.36	154.14
1 A 4	29.39	-89.46	-54.42	-276.54	-61.31	-370.02	-204.65	-170.81	-155.83	-986.92
1 B	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2	2.43	2.45	2.44	2.50	61.53	-4.22	-6.25	-5.54	-2.40	159.10
2 A 3	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2 A 4	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	-2.91
2 A 7 c	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.05
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	-0.22	-0.25	-0.26	-0.07	-0.44	0.07	0.41
3 A	0.00	0.00	0.00	-0.03	-0.04	-0.04	-0.01	-0.07	0.01	0.06
3 B	0.00	0.00	0.00	-0.03	-0.04	-0.04	-0.01	-0.07	0.01	0.06
3 C	0.00	0.00	0.00	-0.02	-0.02	-0.02	0.00	-0.03	0.00	0.03
3 D 5	0.00	0.00	0.00	-0.11	-0.12	-0.12	-0.03	-0.21	0.03	0.19
4	NA=	NA=	NA=	NA=	NA=	NA=	NA=	NA=	NA=	NA=
5	2 437.24	3 189.75	5 380.17	16 857.66	11 755.74	10 284.67	16 085.84	17 095.71	17 972.24	13 880.55
6	0.00	0.00	0.00	0.00	0.00	0.00	-2.11	-4.14	-6.17	-8.20

Recalculation of CH₄ Emissions by Categories

Explanations are provided in Chapter 9 Recalculations and Improvements and in the sector specific chapters of this report.

Table A 119: Recalculation Difference of CH₄ Emissions 1990-1999.

IPCC Cat.	CH ₄ [Gg] Differences with respect to Submission 2011									
	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999
Total	0.02	0.03	0.03	0.04	0.09	0.10	0.12	0.14	0.17	0.24
1	0.01	0.01	0.01	0.01	0.01	0.01	0.02	0.01	0.01	0.01
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	0.01	0.00	0.00	0.00
1 A 3	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01
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	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
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	0.01	0.02	0.02	0.03	0.08	0.09	0.10	0.13	0.16	0.23
4 A	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
4 B	0.01	0.02	0.02	0.03	0.08	0.09	0.10	0.13	0.16	0.23
4 D	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
5	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
6	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
6 A	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
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 120: Recalculation Difference of CH₄ Emissions 2000-2009.

IPCC Cat.	CH ₄ [Gg] Differences with respect to Submission 2011									
	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009
Total	0.29	0.27	0.25	0.21	0.26	-0.32	0.29	0.26	0.29	-0.13
1	0.01	-0.06	-0.13	-0.22	-0.21	-0.82	-0.25	-0.30	-0.25	-0.62
1 A 1	0.00	0.00	0.00	0.01	0.01	0.00	0.00	0.00	0.00	0.01
1 A 2	0.01	0.00	0.00	0.00	0.01	0.01	0.01	0.01	0.00	0.01
1 A 3	0.00	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01
1 A 4	0.00	-0.07	-0.15	-0.24	-0.23	-0.84	-0.26	-0.31	-0.26	-0.65
1 B	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
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	0.27	0.33	0.38	0.43	0.47	0.50	0.54	0.56	0.58	0.57
4 A	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
4 B	0.27	0.33	0.38	0.43	0.47	0.50	0.54	0.56	0.58	0.57
4 D	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
5	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
6	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	-0.04	-0.08
6 A	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
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	-0.04	-0.08

Recalculation of N₂O Emissions by Categories

Explanations are provided in Chapter 9 Recalculations and in the sector specific chapters of this report.

Table A 121: Recalculation Difference of N₂O Emissions 1990-1999.

IPCC Cat.	N ₂ O [Gg]									
	Differences with respect to Submission 2011									
	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999
Total	0.00	0.00	0.00	0.00	0.00	0.00	0.00	-0.01	-0.01	0.00
1	0.00	0.00	0.00	0.00	0.00	0.00	0.00	-0.01	-0.01	0.00
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	0.01	0.01	0.01	0.01	0.01	0.00	0.00	0.00
1 A 3	0.00	0.00	0.00	0.00	0.00	-0.01	-0.01	-0.01	-0.01	-0.01
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	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
4 B	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
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	-0.01	-0.01	-0.01	-0.01	-0.01	-0.01	-0.01	-0.01	-0.01
6	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
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 122: Recalculation Difference of N₂O Emissions 2000-2009.

IPCC Cat.	N ₂ O[Gg]									
	Differences with respect to Submission 2011									
	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009
Total	0.00	0.00	0.00	0.00	-0.01	-0.01	0.01	0.00	-0.01	-0.02
1	-0.01	-0.01	-0.01	-0.01	-0.02	-0.02	0.00	-0.01	-0.02	-0.03
1 A 1	0.00	0.00	0.00	0.00	0.00	-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	-0.01	0.00
1 A 3	-0.01	-0.01	-0.01	0.00	-0.01	0.01	0.00	0.00	0.00	0.01
1 A 4	0.00	0.00	0.00	-0.01	-0.01	-0.01	-0.01	-0.01	-0.01	-0.04
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	0.00	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.02
4 B	0.00	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.02
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	-0.01	-0.01	-0.01	0.00	0.00	0.00	0.00	0.00	0.00
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	0.00	0.00
6 D	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	-0.01	-0.01

Recalculation of National Total GHG Emissions

Table A 123 compares the national total GHG emissions of UNFCCC submission 2012 with UNFCCC submission 2011. Explanations are provided in Chapter 9 Recalculations and in the sector specific chapters of this report.

Table A 123: Recalculation Difference of National Total GHG Emissions.

Year	National Total GHG emissions without LUCF		
	Submission 2011 [Gg CO ₂ e]	Submission 2012 [Gg CO ₂ e]	Recalculation Difference [%]
1990*	78 170.69	78 162.33	-0.01%
1991	82 213.93	82 203.00	-0.01%
1992	75 513.79	75 442.31	-0.09%
1993	75 497.86	75 488.13	-0.01%
1994	76 385.72	76 373.04	-0.02%
1995	79 811.08	79 806.18	-0.01%
1996	82 894.86	82 888.33	-0.01%
1997	82 475.88	82 469.57	-0.01%
1998	81 869.40	81 862.56	-0.01%
1999	80 253.75	80 254.13	0.00%
2000	80 476.16	80 469.58	-0.01%
2001	84 343.44	84 343.58	0.00%
2002	86 158.61	85 992.07	-0.19%
2003	91 893.78	91 882.00	-0.01%
2004	90 926.69	91 458.44	0.58%
2005	92 883.84	92 879.51	0.00%
2006	90 102.71	90 059.07	-0.05%
2007	87 373.41	87 365.67	-0.01%
2008	86 960.71	86 955.53	-0.01%
2009	80 058.86	79 739.35	-0.40%

*Base year is 1990 for all gases

Table A 124 and A 125 present recalculation differences per gas.

Table A 124: Recalculation Difference of National CO₂ and CH₄ Emissions.

Year	CO ₂ [Gg CO ₂ e]			CH ₄ [Gg CO ₂ e]		
	Submission 2011	Submission 2012	Recalc. Difference [%]	Submission 2011	Submission 2012	Recalc. Difference [%]
1990*	62 068.06	62 059.59	-0.01%	8 304.14	8 304.66	0.01%
1991	65 655.95	65 643.84	-0.02%	8 267.49	8 268.14	0.01%
1992	60 211.55	60 138.33	-0.12%	7 985.34	7 986.05	0.01%
1993	60 527.94	60 516.13	-0.02%	7 933.73	7 934.59	0.01%
1994	60 914.90	60 899.75	-0.02%	7 706.60	7 708.51	0.02%
1995	63 951.17	63 943.97	-0.01%	7 616.01	7 618.18	0.03%
1996	67 393.56	67 383.73	-0.01%	7 396.04	7 398.53	0.03%
1997	67 187.79	67 180.02	-0.01%	7 090.95	7 093.97	0.04%
1998	66 771.86	66 763.01	-0.01%	6 939.77	6 943.43	0.05%
1999	65 349.39	65 344.86	-0.01%	6 769.21	6 774.34	0.08%
2000	65 984.31	65 972.21	-0.02%	6 619.72	6 625.71	0.09%
2001	70 009.35	70 004.86	-0.01%	6 484.58	6 490.28	0.09%
2002	71 890.39	71 720.08	-0.24%	6 388.35	6 393.61	0.08%
2003	77 773.39	77 758.24	-0.02%	6 386.89	6 391.35	0.07%
2004	77 687.84	78 215.90	0.68%	6 246.16	6 251.63	0.09%
2005	79 719.28	79 723.89	0.01%	6 101.23	6 094.53	-0.11%
2006	77 084.24	77 032.53	-0.07%	5 972.13	5 978.19	0.10%
2007	74 377.30	74 362.72	-0.02%	5 866.79	5 872.33	0.09%
2008	73 929.19	73 921.54	-0.01%	5 725.33	5 731.45	0.11%
2009	67 535.83	67 225.70	-0.46%	5 666.12	5 663.35	-0.05%

*Base year is 1990 for all gases

Table A 125: Recalculation Difference of National N₂O and HFC, PFC, SF₆ Emissions.

Year	N ₂ O [Gg CO ₂ e]			HFC, PFC, SF ₆ [Gg CO ₂ e]		
	Submission 2011	Submission 2012	Recalc. Difference [%]	Submission 2011	Submission 2012	Recalc. Difference [%]
1990*	6 198.65	6 198.25	-0.01%	1 599.84	1 599.84	0.00%
1991	6 529.10	6 529.63	0.01%	1 761.39	1 761.39	0.00%
1992	6 133.35	6 134.39	0.02%	1 183.54	1 183.54	0.00%
1993	5 959.17	5 960.40	0.02%	1 077.01	1 077.01	0.00%
1994	6 441.01	6 441.57	0.01%	1 323.21	1 323.21	0.00%
1995	6 606.69	6 606.82	0.00%	1 637.21	1 637.21	0.00%
1996	6 267.49	6 268.29	0.01%	1 837.77	1 837.77	0.00%
1997	6 301.04	6 299.48	-0.02%	1 896.09	1 896.09	0.00%
1998	6 419.30	6 417.65	-0.03%	1 738.46	1 738.46	0.00%
1999	6 392.72	6 392.50	0.00%	1 742.43	1 742.43	0.00%
2000	6 289.96	6 289.48	-0.01%	1 582.18	1 582.18	0.00%
2001	6 176.43	6 175.35	-0.02%	1 673.09	1 673.09	0.00%
2002	6 178.17	6 176.67	-0.02%	1 701.70	1 701.70	0.00%
2003	6 100.92	6 099.84	-0.02%	1 632.58	1 632.58	0.00%
2004	5 403.60	5 401.82	-0.03%	1 589.09	1 589.09	0.00%

2005	5 435.82	5 433.59	-0.04%	1 627.51	1 627.51	0.00%
2006	5 472.89	5 474.91	0.04%	1 573.44	1 573.44	0.00%
2007	5 502.74	5 504.04	0.02%	1 626.57	1 626.57	0.00%
2008	5 691.84	5 688.19	-0.06%	1 614.35	1 614.35	0.00%
2009	5 417.11	5 409.51	-0.14%	1 439.81	1 440.80	0.07%

**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, NO_x, NMVOCs, NH₃, CO, TSP, PM₁₀, and PM_{2.5} 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 Law¹ concerning the reporting of national emission data on SO₂, NO_x, NMVOC, CO, heavy metals (Pb, Cd, Hg), benzene and particulate matter.

¹ AUSTRIAN AMBIENT AIR QUALITY LAW (1997): Immissionsschutzgesetz-Luft. Federal Law Gazette I 115/1997.

- Austria's obligation according to Article 15 of the European IPPC Directive 1996/61/EC is to implement a European Pollutant Emission Register (EPER). EPER was displaced and upgraded by regulation (EC) No 166/2006 concerning the establishment of a European Pollutant Release and Transfer Register (E-PRTR Regulation). EPER and E-PRTR are associated with Article 6 of the Aarhus Convention (United Nations: Aarhus, 1998) which refers to the right of the public to access environmental information and to participate in the decision-making process of environmental issues.

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 SO₂ 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: SO_x as SO₂, NO_x as NO₂, NMVOC, CH₄, CO, CO₂, N₂O and NH₃.
- 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.

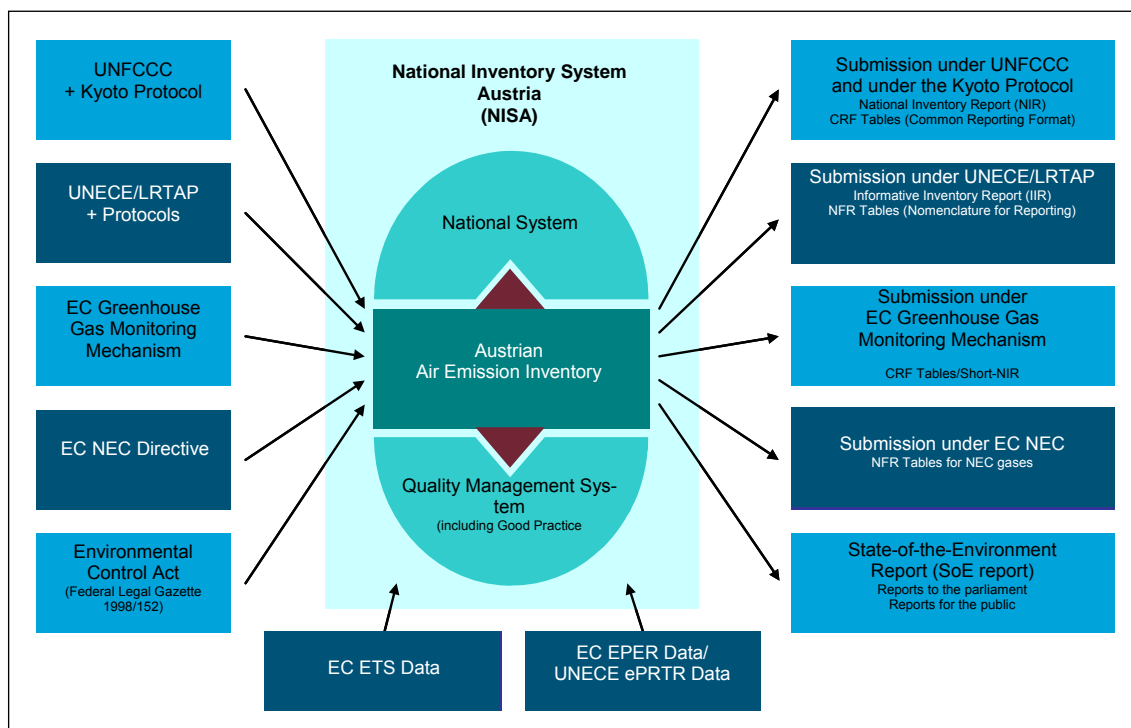


Figure 1: Structure of the emission inventory system in Austria (NISA).

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 subchapter 1.2.4)
- The responsibilities for inventory planning, preparation and management are specified and allocated within the Umweltbundesamt. Following internal Umweltbundesamt quality management regulation, a yearly plan is implemented to ensure capacity for timely performance of the functions defined in the guidelines for national systems. The technical competence of the staff involved in the inventory preparation process is ensured by arrangements according to the internal Umweltbundesamt training plan.
- The inventory preparation, including identification of key categories, uncertainty estimates and QC procedures, is performed according to the 2000 Intergovernmental Panel on Climate Change (IPCC) Good Practice Guidance (GPG) and Uncertainty Management of Greenhouse Gas Inventories and to the 2003 IPCC GPG for Land Use, Land-Use Change and Forestry.
- A Quality Management System (QMS) has been developed and implemented.
- The national greenhouse gas inventory is prepared by the inspection body for GHG inventories within the Umweltbundesamt which is accredited as inspection body according to the International Standard ISO/IEC 17020 General Criteria for the operation of various types of bodies performing inspections. The accreditation audit of the Umweltbundesamt as inspection body took place in September 2005. The accreditation was completed officially in December 2005.
- The QMS also includes the necessary procedures to ensure quality improvement of the emission inventory. They comprise documentation of allocated responsibilities, of any discrepancies and of the findings by UNFCCC review experts in particular.
- The inventory management as part of the QMS includes a control system for data and calculations, for records and their archiving as well as documentation of QA/QC activities. This ensures the necessary documentation and archiving for future reconstruction of the inventory and for the timely response to requests during the review process.
- Part of the legal and institutional arrangements in place to provide a basis for the national system pertains to data availability for the annual compilation of the GHG inventory. The main data source for the Austrian inventory preparation is the Austrian statistical office (Statistik Austria). The compilation of several statistics is regulated by law; the compilation of the national energy balance is regulated by contracts. Other data sources include reporting obligations under national and European regulations and reports of companies and associations.
- A process for official consideration and approval of the inventory prior to its submission is established. The inventory information is provided by the Umweltbundesamt to the Federal Ministry of Agriculture, Forestry, Environment and Water Management, where the National Focal Point for the UNFCCC is established. The inventory is then submitted by the Ministry to the UNFCCC secretariat.

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

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 (Environment Agency Austria) as *Inspection Body for Emission inventories (IBE)* place in autumn 2005, accreditation was then awarded in December 2005 and renewed in 2011.

Table A 126: presents the timetable for the implementation of the quality management system.

Table A 126: 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	September 2005
Accreditation as Inspection Body for Greenhouse Gas Inventories	December 2005
Re-Accreditation Audit	January 2011

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 17020². 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 17020:2012 *Requirements for the operation of various types of bodies performing*

² The International Standard ISO/IEC 17020 superseded the European Standard EN 45004.

inspections. This standard has been drawn up with the objective of promoting confidence in those bodies performing inspections which conform to it.

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

Accreditation Act

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

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

Accreditation is granted after 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.

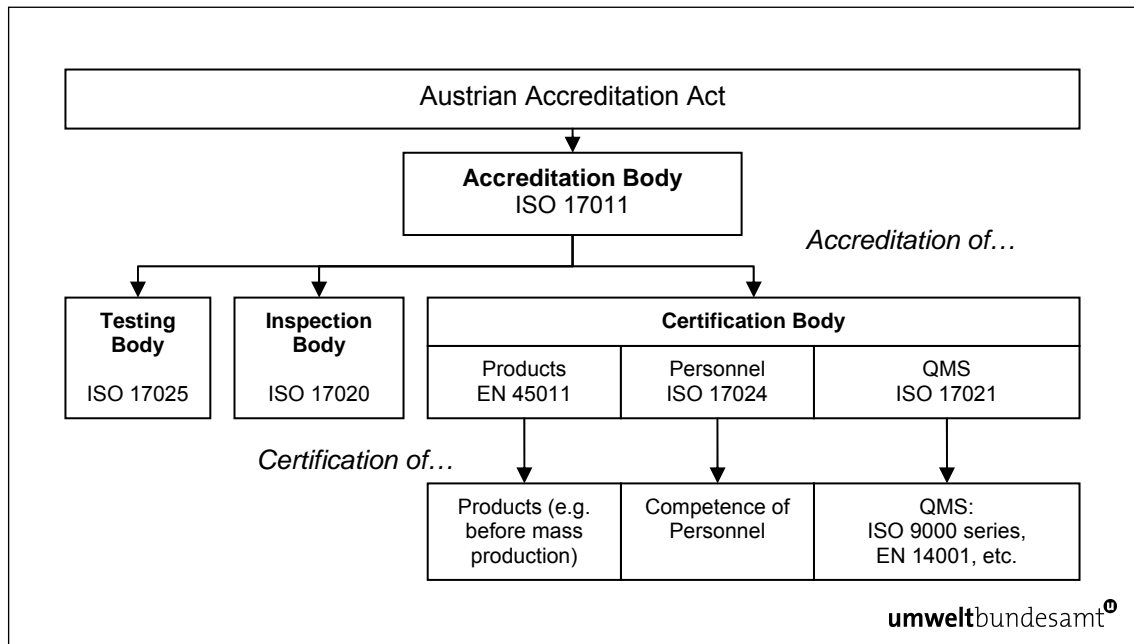


Figure 2: Inter-relationship between the Austrian Accreditation Act, the EN 45000/ISO 17000 and the ISO 9000 series.

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

Independence

The impartiality and independence of the Environment Agency Austria can be deduced from the principles laid down in the UKG (especially sections 5, 6 and 11):

- The Environment Agency Austria GmbH is an independent company which has been assigned public governance functions and specific tasks of public administration.
- In addition to these, the Environment Agency Austria performs only tasks which are in the public interest of protecting the environment.
- Basic annual funds are provided to the Environment Agency Austria as stipulated in the UKG. The responsibility for managing these funds lies with the managing director of the Environment Agency Austria.

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 Emission Inventories* (IBE) at the Umweltbundesamt follows a *process based approach*. It is illustrated in Figure 3.

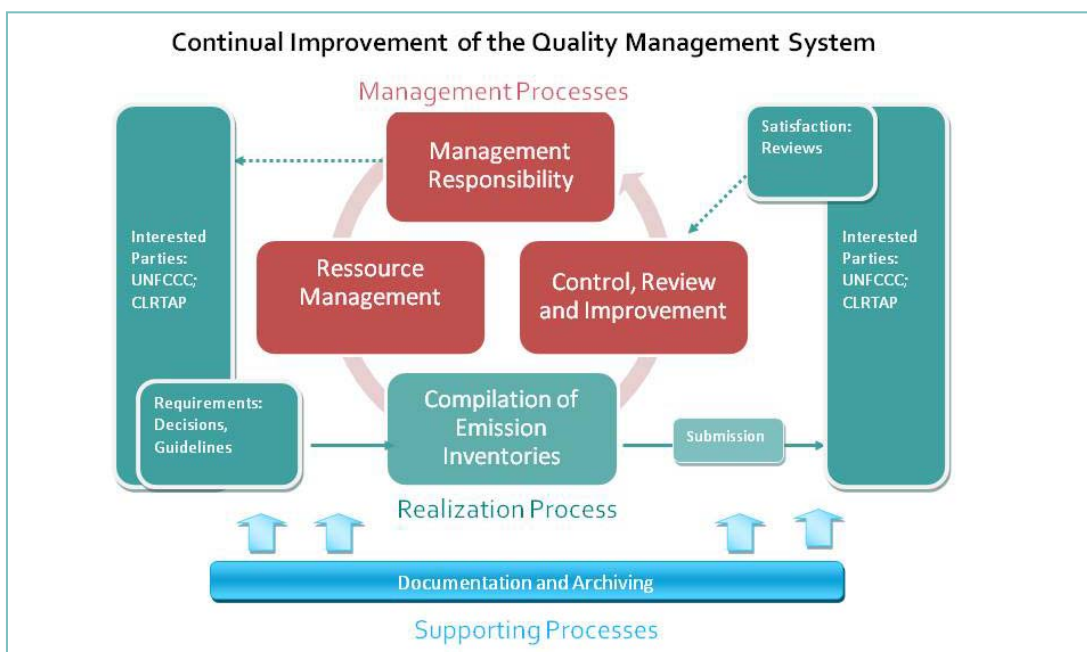


Figure 3: Process-based QMS of the IBE

In the following the processes are explained:

1) Realisation process

The realisation process is the *Inspection Body's for Emission Inventories* (IBE) core competence as they concern the compilation of emission inventories. 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 itself. Any subcontractor performing part of the inspection is required to work in compliance with ISO/IEC 17020.

2) Management processes

Management Processes comprise all activities necessary for management and control of an organisation: resources and responsibilities, quality system, internal audits, management review, corrective actions and prevention, 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.

A management review is held every year; the report is presented to the managing director who is responsible for resources. The management review report includes an evaluation of the QMS based on information obtained mainly from internal audits, as well as results from the UNFCCC review process, 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).

3) Supporting processes

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.

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R-2 List of discrepant transactions

There have been no discrepant transactions.

R-3 List of CDM notifications

There have been no CDM notifications.

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 a 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 uncertainties 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 (CO₂): The emission factor of CO₂ 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 (CH₄): 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 CH₄ 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 CH₄ 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 (N₂O): 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 N₂O factors back to GEMIS. In line with an earlier assessment done in an Austrian N₂O balance (ORTHOFFER 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 N₂O 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 SF₆) 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 127: Tier 1 Uncertainty Analysis (Table 6.1 GPG) – excluding LULUCF

A	B	C	D	E	F	G	H	I	J	K	L	M
IPCC Key category	Gas	Base year emissions 1990	Year 2010 emissions	Activity data uncertainty	Emission factor uncertainty	Combined uncertainty	Combined uncertainty as % of total national emissions in year t	Type A sensitivity	Type B sensitivity	Uncertainty in trend in national emissions introduced by emission factor uncertainty	Uncertainty in trend in national emissions introduced by activity data uncertainty	Uncertainty introduced into the trend in total national emissions
		Input data	Input data	Input data	Input data	$\sqrt{E^2 + F^2}$	$G * D / \sum D$	Note B	$D / \sum C$	$I * F$ Note C	$J * E * \sqrt{2}$ Note D	$\sqrt{K^2 + L^2}$
		Gg CO2 equivalent	Gg CO2 equivalent	%	%	%	%	%	%	%	%	%
1 A 1 a gaseous: Public Electricity and Heat Production	CO2	3 294	5 307	2.0	0.5	2.1	0.13	0.02	0.07	0.01	0.20	0.20
1 A 1 a liquid: Public Electricity and Heat Production	CO2	1 229	728	0.5	0.5	0.7	0.01	0.01	0.01	0.00	0.01	0.01
1 A 1 a other: Public Electricity and Heat Production	CO2	118	825	10.0	20.0	22.4	0.23	0.01	0.01	0.19	0.16	0.24
1 A 1 a solid: Public Electricity and Heat Production	CO2	6 247	3 870	0.5	0.5	0.7	0.03	0.04	0.05	0.02	0.04	0.04
1 A 1 b gaseous: Petroleum refining	CO2	437	530	2.0	0.5	2.1	0.01	0.00	0.01	0.00	0.02	0.02
1 A 1 b liquid: Petroleum refining	CO2	1 958	2 195	0.5	0.5	0.7	0.02	0.00	0.03	0.00	0.02	0.02
1 A 1 c gaseous: Manufacture of Solid fuels and Other Energy Industries	CO2	506	719	2.0	0.5	2.1	0.02	0.00	0.01	0.00	0.03	0.03
1 A 2 gaseous: Manufacturing Industries and Construction	CO2	4 265	6 848	5.0	0.5	5.0	0.42	0.03	0.09	0.01	0.64	0.64
1 A 2 mobile-liquid: Manufacturing Industries and Construction	CO2	256	1 069	3.0	0.5	3.0	0.04	0.01	0.01	0.01	0.06	0.06
1 A 2 other: Manufacturing Industries and Construction	CO2	264	783	10.0	20.0	22.4	0.21	0.01	0.01	0.13	0.15	0.20
1 A 2 solid: Manufacturing Industries and Construction	CO2	5 016	4 944	1.0	0.5	1.1	0.07	0.01	0.07	0.00	0.09	0.09
1 A 2 stat-liquid: Manufacturing Industries and Construction	CO2	2 884	1 811	3.0	0.5	3.0	0.07	0.02	0.02	0.01	0.10	0.10
1 A 3 b diesel oil: Road Transportation	CO2	5 362	16 280	3.0	3.0	4.2	0.85	0.14	0.22	0.42	0.92	1.01
1 A 3 b gasoline: Road Transportation	CO2	7 936	5 270	3.0	3.0	4.2	0.27	0.04	0.07	0.13	0.30	0.33
1 A 3 e gaseous: Other	CO2	224	320	2.0	0.5	2.1	0.01	0.00	0.00	0.00	0.01	0.01
1 A 4 biomass: Other Sectors	CH4	316	203	10.0	50.0	51.0	0.13	0.00	0.00	0.09	0.04	0.10
1 A 4 gaseous: Other Sectors	CO2	2 574	4 666	5.0	0.5	5.0	0.29	0.02	0.06	0.01	0.44	0.44
1 A 4 mobile-diesel: Other Sectors	CO2	737	704	3.0	0.5	3.0	0.03	0.00	0.01	0.00	0.04	0.04
1 A 4 other: Other Sectors	CO2	350	2	10.0	20.0	22.4	0.00	0.01	0.00	0.10	0.00	0.10
1 A 4 solid: Other Sectors	CO2	2 654	245	1.0	0.5	1.1	0.00	0.03	0.00	0.02	0.00	0.02
1 A 4 stat-liquid: Other Sectors	CO2	7 293	5 196	3.0	0.5	3.0	0.19	0.04	0.07	0.02	0.29	0.29
2 A 1: Cement Production	CO2	2 033	1 622	1.1	2.0	2.3	0.05	0.01	0.02	0.02	0.03	0.04
2 A 2: Lime Production	CO2	396	574	1.6	5.0	5.2	0.04	0.00	0.01	0.01	0.02	0.02
2 A 3: Limestone and Dolomite Use	CO2	203	294	19.6	2.0	19.7	0.07	0.00	0.00	0.00	0.11	0.11
2 A 7 b: Sinter Production	CO2	481	314	2.0	5.0	5.4	0.02	0.00	0.00	0.01	0.01	0.02
2 B 1: Ammonia Production	CO2	514	538	2.0	4.6	5.0	0.03	0.00	0.01	0.00	0.02	0.02
2 B 2: Nitric Acid Production	N2O	912	63	2.0	5.0	5.4	0.00	0.01	0.00	0.06	0.00	0.06
2 C 1: Iron and Steel Production	CO2	3 546	5 460	0.5	0.5	0.7	0.05	0.02	0.07	0.01	0.05	0.05
2 C 3: Aluminium production	PFC	1 050	0	2.0	50.0	50.0	0.00	0.02	0.00	0.76	-	0.76
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	0.02	-	0.02
2 F 1/2/3/4/5: ODS Substitutes	HFC/PFC	24	1 165	20.0	50.0	53.9	0.77	0.02	0.02	0.76	0.44	0.87
2 F 9: Other Sources of SF6	PFC/SF6	127	245	25.0	50.0	55.9	0.17	0.00	0.00	0.07	0.11	0.14
3: SOLVENT AND OTHER PRODUCT USE	CO2	279	177	5.0	10.0	11.2	0.02	0.00	0.00	0.02	0.02	0.02
3: SOLVENT AND OTHER PRODUCT USE	N2O	233	150	20.0	0.0	20.0	0.04	0.00	0.00	-	0.06	0.06
4 A 1: Cattle	CH4	3 551	3 045	10.0	20.0	22.4	0.83	0.01	0.04	0.21	0.57	0.61
4 B 1: Cattle	CH4	283	229	10.0	50.0	51.0	0.14	0.00	0.00	0.05	0.04	0.07
4 B 1: Cattle	N2O	759	744	10.0	100.0	100.5	0.92	0.00	0.01	0.10	0.14	0.17
4 D 1: Direct Soil Emissions	N2O	1 909	1 738	5.0	150.0	150.1	3.20	0.00	0.02	0.66	0.16	0.68
4 D 3: Indirect Emissions	N2O	1 352	1 096	5.0	150.0	150.1	2.02	0.00	0.01	0.74	0.10	0.75
6 A: SOLID WASTE DISPOSAL ON LAND	CH4	3 314	1 350	12.0	25.0	27.7	0.46	0.03	0.02	0.75	0.30	0.80
6 B: WASTEWATER HANDLING	N2O	109	265	20.0	50.0	53.9	0.17	0.00	0.00	0.10	0.10	0.14
Total Key Categories including LULUCF	Gg CO2 e	75 247	81 585				4.24					2.34

Table A 128: Tier 1 Uncertainty Analysis (Table 6.1 GPG) – including LULUCF

A	B	C	D	E	F	G	H	I	J	K	L	M
IPCC Key category	Gas	Base year emissions 1990	Year 2010 emissions	Activity data uncertainty	Emission factor uncertainty	Combined uncertainty	Combined uncertainty as % of total national emissions in year t	Type A sensitivity	Type B sensitivity	Uncertainty in trend in national emissions introduced by emission factor uncertainty	Uncertainty in trend in national emissions introduced by activity data uncertainty	Uncertainty introduced into the trend in total national emissions
		Input data	Input data	Input data	Input data	$\sqrt{E^2 + F^2}$	$G * D / \sum D$	Note B	$D / \sum C$	$I * F$ Note C	$J * E * \sqrt{2}$ Note D	$\sqrt{K^2 + L^2}$
		Gg CO2 equivalent	Gg CO2 equivalent	%	%	%	%	%	%	%	%	%
1 A 1 a gaseous: Public Electricity and Heat Production	CO2	3 294	5 307	2.0	0.5	2.1	0.14	0.02	0.08	0.01	0.23	0.23
1 A 1 a liquid: Public Electricity and Heat Production	CO2	1 229	728	0.5	0.5	0.7	0.01	0.01	0.01	0.01	0.01	0.01
1 A 1 a other: Public Electricity and Heat Production	CO2	118	825	10.0	20.0	22.4	0.24	0.01	0.01	0.21	0.18	0.28
1 A 1 a solid: Public Electricity and Heat Production	CO2	6 247	3 870	0.5	0.5	0.7	0.04	0.06	0.06	0.03	0.04	0.05
1 A 1 b gaseous: Petroleum refining	CO2	437	530	2.0	0.5	2.1	0.01	0.00	0.01	0.00	0.02	0.02
1 A 1 b liquid: Petroleum refining	CO2	1 958	2 195	0.5	0.5	0.7	0.02	0.00	0.03	0.00	0.02	0.02
1 A 1 c gaseous: Manufacture of Solid fuels and Other Energy Industries	CO2	506	719	2.0	0.5	2.1	0.02	0.00	0.01	0.00	0.03	0.03
1 A 2 gaseous: Manufacturing Industries and Construction	CO2	4 265	6 848	0.0	0.5	0.5	0.04	0.03	0.10	0.01	-	0.01
1 A 2 mobile-liquid: Manufacturing Industries and Construction	CO2	256	1 069	3.0	0.5	3.0	0.04	0.01	0.02	0.01	0.07	0.07
1 A 2 other: Manufacturing Industries and Construction	CO2	264	783	10.0	20.0	22.4	0.22	0.01	0.01	0.14	0.17	0.22
1 A 2 solid: Manufacturing Industries and Construction	CO2	5 016	4 944	1.0	0.5	1.1	0.07	0.02	0.08	0.01	0.11	0.11
1 A 2 stat-liquid: Manufacturing Industries and Construction	CO2	2 884	1 811	3.0	0.5	3.0	0.07	0.03	0.03	0.01	0.12	0.12
1 A 3 b diesel oil: Road Transportation	CO2	5 362	16 280	3.0	3.0	4.2	0.89	0.15	0.25	0.45	1.06	1.15
1 A 3 b gasoline: Road Transportation	CO2	7 936	5 270	3.0	3.0	4.2	0.29	0.06	0.08	0.19	0.34	0.39
1 A 3 e gaseous: Other	CO2	224	320	2.0	0.5	2.1	0.01	0.00	0.00	0.00	0.01	0.01
1 A 4 biomass: Other Sectors	CH4	316	203	10.0	50.0	51.0	0.13	0.00	0.00	0.13	0.04	0.14
1 A 4 gaseous: Other Sectors	CO2	2 574	4 666	0.0	0.5	0.5	0.03	0.02	0.07	0.01	-	0.01
1 A 4 mobile-diesel: Other Sectors	CO2	737	704	3.0	0.5	3.0	0.03	0.00	0.01	0.00	0.05	0.05
1 A 4 other: Other Sectors	CO2	350	2	10.0	20.0	22.4	0.00	0.01	0.00	0.13	0.00	0.13
1 A 4 solid: Other Sectors	CO2	2 654	245	1.0	0.5	1.1	0.00	0.04	0.00	0.02	0.01	0.02
1 A 4 stat-liquid: Other Sectors	CO2	7 293	5 196	3.0	0.5	3.0	0.20	0.05	0.08	0.03	0.34	0.34
1 B 2 a: Oil	CO2	43	145	0.5	0.5	0.7	0.00	0.00	0.00	0.00	0.00	0.00
2 A 1: Cement Production	CO2	2 033	1 622	1.1	2.0	2.3	0.05	0.01	0.02	0.02	0.04	0.05
2 A 2: Lime Production	CO2	396	574	1.6	5.0	5.2	0.04	0.00	0.01	0.01	0.02	0.02
2 A 3: Limestone and Dolomite Use	CO2	203	294	20.0	2.0	20.1	0.08	0.00	0.00	0.00	0.13	0.13
2 A 7 b: Sinter Production	CO2	481	314	2.0	5.0	5.4	0.02	0.00	0.00	0.02	0.01	0.02
2 B 1: Ammonia Production	CO2	514	538	2.0	4.6	5.0	0.03	0.00	0.01	0.01	0.02	0.02
2 B 2: Nitric Acid Production	N2O	912	63	2.0	5.0	5.4	0.00	0.02	0.00	0.08	0.00	0.08
2 C 1: Iron and Steel Production	CO2	3 546	5 460	0.5	0.5	0.7	0.05	0.02	0.08	0.01	0.06	0.06
2 C 3: Aluminium production	PFC	1 050	0	2.0	50.0	50.0	0.00	0.02	0.00	0.96	-	0.96
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	0.02	-	0.02
2 F 1/2/3/4/5: ODS Substitutes	HFC/PFC	24	1 165	20.0	50.0	53.9	0.80	0.02	0.02	0.87	0.51	1.01
2 F 9: Other Sources of SF6	PFC/SF6	127	245	25.0	50.0	55.9	0.18	0.00	0.00	0.07	0.13	0.15
3: SOLVENT AND OTHER PRODUCT USE	CO2	279	177	5.0	10.0	11.2	0.03	0.00	0.00	0.02	0.02	0.03
4 A 1: Cattle	CH4	3 551	3 045	10.0	20.0	22.4	0.87	0.02	0.05	0.37	0.66	0.76
4 B 1: Cattle	CH4	283	229	10.0	50.0	51.0	0.15	0.00	0.00	0.08	0.05	0.10
4 B 1: Cattle	N2O	759	744	10.0	100.0	100.5	0.96	0.00	0.01	0.25	0.16	0.30
4 D 1: Direct Soil Emissions	N2O	1 909	1 738	5.0	150.0	150.1	3.35	0.01	0.03	1.25	0.19	1.26
4 D 3: Indirect Emissions	N2O	1 352	1 096	5.0	150.0	150.1	2.11	0.01	0.02	1.19	0.12	1.20
5 A 1: Forest land remaining forest land	CO2	-7 617	-2 968			547.0	-20.83	0.09	-0.05	-	-	0.00
5 A 2: Land converted to forest land	CO2	-4 246	-2 443			94.0	-2.95	0.04	-0.04	-	-	0.00
5 B 2: Land converted to cropland	CO2	356	454			225.0	1.31	0.00	0.01	-	-	0.00
5 C 2: Land converted to grassland	CO2	353	367			572.0	2.69	0.00	0.01	-	-	0.00
5 D 2: Land converted to Wetlands	CO2	191	356			184.0	0.84	0.00	0.01	-	-	0.00
5 E 2: Land converted to Settlements	CO2	281	248			346.0	1.10	0.00	0.00	-	-	0.00
5 F 2: Land converted to Other land	CO2	866	347			905.0	4.03	0.01	0.01	-	-	0.00
6 A: SOLID WASTE DISPOSAL ON LAND	CH4	3 314	1 350	12.0	25.0	27.7	0.48	0.04	0.02	1.00	0.35	1.06
6 B: WASTEWATER HANDLING	N2O	109	265	20.0	50.0	53.9	0.18	0.00	0.00	0.10	0.11	0.15
Total Key Categories including LULUCF	Gg CO2 e	65 241	77 941				22.1					2.95

Table A 129: Tier 2 Uncertainty Analysis (Table 6.2 GPG)

A	B	C	D	E	F	G	H	I	J
IPCC Source category	Gas	Base year emissions 1990	Year 2010 emissions	Uncertainty in year t emissions as % of emissions in the category		Uncertainty introduced on national total in year 2010	% change in emissions between 2010 and base year	Range of likely % change between 2010 and base year	
		Gg CO2 equivalent	Gg CO2 equivalent	% below (2.5 percentile)	% above (97.5 percentile)	%	%	Lower % (2.5 percentile)	Upper % (97.5 percentile)
1 A 1 a gaseous: Public Electricity and Heat Production	CO2	3 294	5 307	2	2	0.1	61	53	69
1 A 1 a liquid: Public Electricity and Heat Production	CO2	1 229	728	0.7	0.7	0.0	-41	-42	-40
1 A 1 a other: Public Electricity and Heat Production	CO2	118	825	21.3	22.5	0.2	599	345	907
1 A 1 a solid: Public Electricity and Heat Production	CO2	6 247	3 870	0.7	0.7	0.0	-38	-39	-37
1 A 1 b gaseous: Petroleum refining	CO2	437	530	2.0	2.0	0.0	21	14	27
1 A 1 b liquid: Petroleum refining	CO2	1 958	2 195	0.6	0.6	0.0	12	11	14
1 A 1 c gaseous: Manufacture of Solid fuels and Other Energy Ind	CO2	506	719	2.0	2.0	0.0	42	34	49
1 A 2 gaseous: Manufacturing Industries and Construction	CO2	4 266	6 848	4.9	4.9	0.4	61	39	81
1 A 2 mobile-liquid: Manufacturing Industries and Construction	CO2	256	1 069	3.0	2.9	0.0	318	292	349
1 A 2 other: Manufacturing Industries and Construction	CO2	264	783	21.3	22.6	0.2	196	108	313
1 A 2 solid: Manufacturing Industries and Construction	CO2	5 016	4 944	1.1	1.1	0.1	-1	-5	2
1 A 2 stat-liquid: Manufacturing Industries and Construction	CO2	2 883	1 811	2.5	2.5	0.1	-37	-44	-31
1 A 3 b diesel oil: Road Transportation	CO2	5 362	16 280	4.1	4.2	0.8	204	181	225
1 A 3 b gasoline: Road Transportation	CO2	7 936	5 270	4.1	4.2	0.3	-34	-41	-26
1 A 3 e gaseous: Other	CO2	224	320	2.0	2.0	0.0	43	35	50
1 A 4 biomass: Other Sectors	CH4	317	203	49.8	50.3	0.1	-36	-91	1
1 A 4 gaseous: Other Sectors	CO2	2 574	4 666	4.9	4.9	0.3	81	58	103
1 A 4 mobile-diesel: Other Sectors	CO2	737	704	3.0	2.9	0.0	-5	-14	5
1 A 4 other: Other Sectors	CO2	350	2	21.3	22.6	0.0	-99	-147	-59
1 A 4 solid: Other Sectors	CO2	2 654	245	1.1	1.1	0.0	-91	-93	-88
1 A 4 stat-liquid: Other Sectors	CO2	7 292	5 197	2.9	2.8	0.2	-29	-37	-21
2 A 1: Cement Production	CO2	2 034	1 622	2.3	2.2	0.0	-20	-31	-9
2 A 2: Lime Production	CO2	396	574	5.1	5.2	0.0	45	2	88
2 A 3: Limestone and Dolomite Use	CO2	203	294	19.2	19.2	0.1	45	-23	119
2 A 7 b: Sinter Production	CO2	481	314	5.3	5.3	0.0	-35	-41	-29
2 B 1: Ammonia Production	CO2	514	538	4.9	5.0	0.0	5	-1	12
2 B 2: Nitric Acid Production	N2O	912	63	5.3	5.3	0.0	-93	-104	-83
2 C 1: Iron and Steel Production	CO2	3 546	5 460	0.7	0.7	0.0	54	52	56
2 C 3: Aluminium production	F-Gases	1 050	0	-	-	0.0	-100	-206	1
2 C 4: SF6 used in Al and Mg Foundries	F-Gases	253	0	4.9	4.9	0.0	-100	-110	-89
2 F 1/2/3/4/5: ODS Substitutes	F-Gases	24	1 165	53.5	53.0	0.7	4 662	-773	10 079
2 F 9: Other Sources of SF6	F-Gases	126	245	54.6	54.6	0.2	94	-179	377
3: SOLVENT AND OTHER PRODUCT USE	CO2	279	177	7.6	7.9	0.0	-37	-47	-27
3: SOLVENT AND OTHER PRODUCT USE	N2O	232	150	19.6	19.6	0.0	-35	-88	13
4 A 1: Cattle	CH4	3 548	3 043	20.5	21.0	0.8	-14	-39	7
4 B 1: Cattle	CH4	283	229	68.9	69.4	0.2	-19	-71	7
4 B 1: Cattle	N2O	760	745	50.2	101.1	0.7	-2	-56	36
4 D 1: Direct Soil Emissions	N2O	1 906	1 736	70.1	200.7	3.1	-9	-173	19
4 D 3: Indirect Emissions	N2O	1 350	1 094	70.1	200.7	2.0	-19	-325	-2
6 A: SOLID WASTE DISPOSAL ON LAND	CH4	3 314	1 350	26.3	28.0	0.4	-59	-104	-26
6 B: WASTEWATER HANDLING	N2O	109	264	50.7	55.6	0.2	142	-28	425

Conclusions

The comparison of Tier 1 and Tier 2 (see Table A-120 and A-121) results shows that, basically, both approaches yield very similar results in terms of contribution to level or trend uncertainty for an individual source category. Differences become visible where distributions are not symmetric (in the case of Austria, lognormal distributions have been applied to N₂O emissions only, most visible for N₂O from soils). This is also seen in the difference between the “lower range” vs. “upper range” uncertainties, and those determined by standard deviations (2s).

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

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

Figure 4 shows the resulting probability density distribution for Austria. The distribution is most strongly influenced by the lognormal distribution of the uncertainty in soil N₂O emissions. If the previous (WINIWARTER & RYPDAL 2001) assumption on “random” N₂O emission factor uncertainty is taken (triangular distribution between 50% and 200% of the given emission factor), the total level uncertainty of the Austrian inventory decreases considerably. This is again proof of the importance on assumptions taken on N₂O emissions on the overall uncertainty of a national GHG inventory.

Compared to the previous Monte-Carlo uncertainty analysis of the Austrian GHG inventory (WINIWARTER & ORTHOFER 2000, WINIWARTER & RYPDAL 2001), results (without LULUCF, and without considering systematic uncertainties) are somewhat higher. As has been discussed above, virtually all of that increase is due to different and new assumptions on the uncertainty of the emission factor of N₂O.

As is also shown in Figure 5, studying the sensitivity of the output to the input parameters yields a result virtually fully determined by soil N₂O emission factor. While, compared to previously, other components have improved, it is now virtually N₂O alone that determines the uncertainty. It should be noted that even at quite low uncertainty, transport has taken over a considerable role due to its large overall contribution to emissions, albeit not at all challenging the leading role of N₂O.

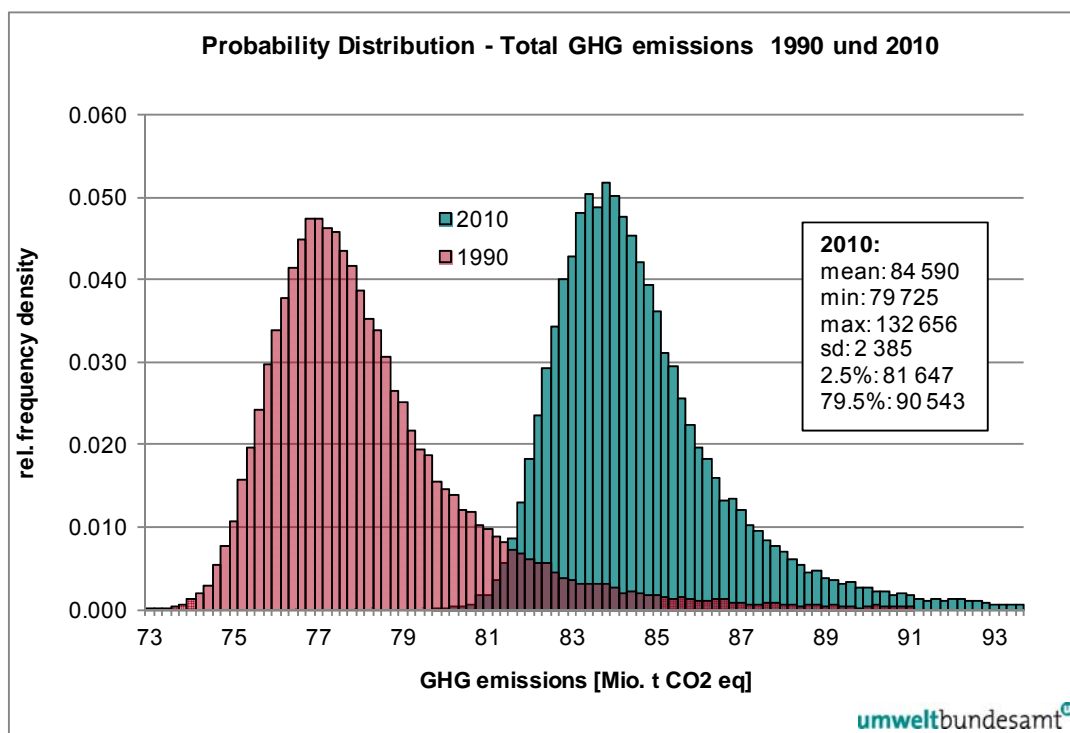


Figure 4: Austria's greenhouse gas emissions 1990 und 2010 without LULUCF – probability bins according to uncertainty analysis.

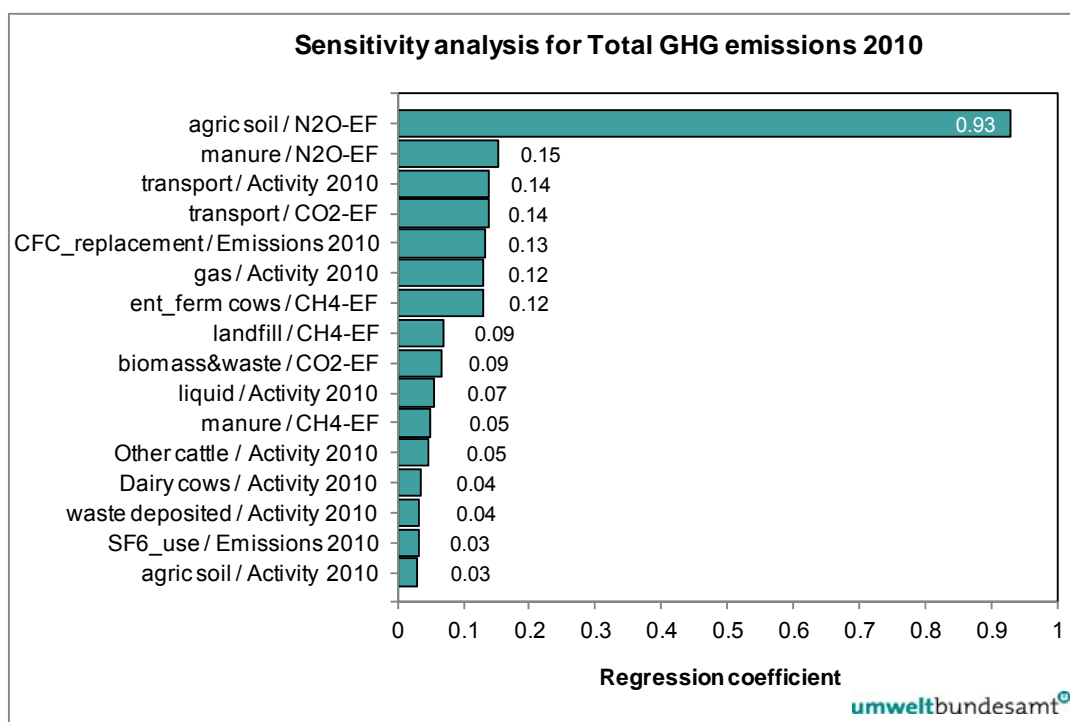


Figure 5: Sensitivity analysis: regression coefficients between total GHG emissions 2010 (without LULUCF) and input parameters.

Table A 130 and A 131 present a comparison to the previous study on uncertainties of the Austrian GHG inventory (WINIWARTER & RYPDAL 2001). As is evident from the 1990 emission figures

(mean value), methodical problems of the underlying inventory as of the late 1990s only allow for a limited evaluation (differences to the state-of-the-art compilation methods, then not implemented in the national inventory, were regarded as systematic error and are not included in this analysis). The low uncertainty for CO₂, the dominating greenhouse gas, could be sustained. Improved analysis leads to better understanding of CH₄ emissions, thus reducing uncertainty. For N₂O, as discussed above, some of the uncertainty considered systematic and method-relevant had to be included into the random uncertainty after adaptation of the method. This is also the main reason for the change in total uncertainty, which is mostly determined by the N₂O uncertainty and hardly influenced by uncertainties from the additionally evaluated F-gases.

Differences also become obvious when comparing between years (1990 vs. 2010). This is not due to the method, but only due to shifts in activities. Abolishing Al-production in Austria stops the highly uncertain emissions and decreases PFC uncertainty. The increase in uncertainty on CO₂ is due to a shift of the activity into transport, which is considered more uncertain than most other parts of fossil fuel consumption. The increase in uncertainty for individual gas emissions still allows for a decrease of the overall inventory, as the weight of CO₂ emissions becomes larger, and N₂O emissions actually have been reduced in that period.

Table A 130: Key results of the first comprehensive study on the Austrian GHG inventory uncertainty (WINIWARTER & RYPDAL 2001).

Random uncertainty		CO ₂	CH ₄	N ₂ O	PFC	HFC	SF ₆	Total GHG emissions
1990	Mean value [Tg]	63.54	11.41	1.99	–	–	–	76.94
	Standard deviation	0.30	1.64	0.26	–	–	–	1.73
	2σ	1.0%	28.7%	25.6%	–	–	–	4.5%
1997	Mean value [Tg]	68.05	10.02	2.27	–	–	–	80.34
	Standard deviation	0.34	1.43	0.27	–	–	–	1.53
	2σ	1.0%	28.5%	23.9%	–	–	–	3.8%

Table A 131: Key results of the Austrian GHG inventory uncertainty analysis 2012.

Random uncertainty		CO ₂	CH ₄	N ₂ O	PFC*	HFC	SF ₆ *	Total GHG emissions
1990	Mean value [Tg]	62.06	8.30	6.19	1.08	0.03	0.49	78.16
	Standard deviation	0.42	0.63	2.62	0.26	0.01	0.04	2.74
	2s	1.3%	15.1%	84.5%	48.6%	49.8%	16.2%	7.0%
2010	Mean value [Tg]	72.29	5.57	5.15	0.07	1.16	0.35	84.59
	Standard deviation	0.61	0.40	2.25	0.00	0.31	0.08	2.38
	2s	1.7%	14.5%	87.3%	11.2%	53.9%	44.6%	5.6%

*Due to the definition of key category FC emissions from 2.F.7, PFC emissions are partly considered in SF₆ emissions.

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

ANNEX 8: CRF FOR 2010

The full set of tables is submitted electronically together with this report.

TABLE 1 SECTORAL REPORT FOR ENERGY
(Sheet 1 of 2)

Inventory 2010
Submission 2012 v1.3
AUSTRIA

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	CO ₂	CH ₄	N ₂ O	NO _x	CO	NMVOC	SO ₂
	(Gg)						
Total Energy	63 088.31	25.12	2.30	180.22	607.90	51.86	17.44
A. Fuel Combustion Activities (Sectoral Approach)	62 851.15	11.84	2.30	180.22	607.90	49.88	17.21
1. Energy Industries	14 173.77	0.37	0.36	13.83	5.23	0.80	3.24
a. Public Electricity and Heat Production	10 729.98	0.35	0.34	10.83	4.79	0.79	2.62
b. Petroleum Refining	2 724.48	IE,NO	0.02	1.05	0.31	IE	0.62
c. Manufacture of Solid Fuels and Other Energy Industries	719.31	0.02	0.00	1.95	0.13	0.01	NA
2. Manufacturing Industries and Construction	15 455.70	0.68	0.48	31.81	138.30	2.40	10.85
a. Iron and Steel	5 834.92	0.08	0.06	4.42	107.83	0.25	4.92
b. Non-Ferrous Metals	242.71	0.01	0.00	0.22	0.04	0.00	0.10
c. Chemicals	1 360.45	0.09	0.02	1.37	1.25	0.20	0.56
d. Pulp, Paper and Print	2 228.59	0.15	0.08	5.22	2.12	0.25	1.17
e. Food Processing, Beverages and Tobacco	1 020.81	0.02	0.01	0.94	0.15	0.02	0.35
f. Other (as specified in table 1.A(a) sheet 2)	4 768.22	0.33	0.31	19.64	26.92	1.69	3.75
Other non-specified	4 768.22	0.33	0.31	19.64	26.92	1.69	3.75
3. Transport	22 205.42	0.72	0.75	111.62	161.96	13.10	0.21
a. Civil Aviation	63.53	0.00	0.00	0.24	2.44	0.11	0.02
b. Road Transportation	21 661.69	0.69	0.69	108.77	156.08	12.44	0.13
c. Railways	148.60	0.01	0.05	1.69	1.48	0.25	0.06
d. Navigation	11.13	0.00	0.00	0.05	1.90	0.29	0.00
e. Other Transportation (as specified in table 1.A(a) sheet 3)	320.47	0.01	0.00	0.87	0.06	0.00	NA
Pipeline transport	320.47	0.01	0.00	0.87	0.06	0.00	NA

TABLE 1 SECTORAL REPORT FOR ENERGY

(Sheet 2 of 2)

Inventory 2010

Submission 2012 v1.3

AUSTRIA

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	CO ₂	CH ₄	N ₂ O	NO _x	CO	NM VOC	SO ₂
	(Gg)						
4. Other Sectors	10 969.98	10.07	0.71	22.89	302.12	33.57	2.90
a. Commercial/Institutional	2 302.94	0.21	0.05	1.86	6.56	0.53	0.41
b. Residential	7 813.29	9.19	0.40	12.26	264.75	28.10	2.29
c. Agriculture/Forestry/Fisheries	853.75	0.67	0.26	8.77	30.81	4.94	0.20
5. Other (as specified in table 1.A(a) sheet 4)	46.27	0.00	0.00	0.08	0.28	0.02	0.01
a. Stationary	NA	NA	NA	NA	NA	NA	NA
b. Mobile	46.27	0.00	0.00	0.08	0.28	0.02	0.01
Military use	46.27	0.00	0.00	0.08	0.28	0.02	0.01
B. Fugitive Emissions from Fuels	237.17	13.29	IE,NA	IE,NA	IE,NA	1.98	0.23
1. Solid Fuels	IE,NA,NO	IE,NA,NO	IE,NA	IE,NA	IE,NA	IE,NA	IE,NA
a. Coal Mining and Handling	IE,NA,NO	IE,NO	NA	NA	NA	NA	
b. Solid Fuel Transformation	IE	IE	IE	IE	IE	IE	IE
c. Other (as specified in table 1.B.1)	NA	NA	NA	NA	NA	NA	NA
2. Oil and Natural Gas	237.17	13.29	IE,NA	IE,NA	IE,NA	1.98	0.23
a. Oil	145.00	6.68	IE,NA	NA	NA	1.96	NA
b. Natural Gas	92.17	6.61				0.02	0.23
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	2 080.68	0.04	0.08	9.08	2.78	0.86	0.67
Aviation	2 049.55	0.04	0.07	8.50	2.27	0.86	0.65
Marine	31.13	0.00	0.01	0.58	0.51	NA	0.02
Multilateral Operations	NO	NO	NO	NO	NO	NO	NO
CO₂ Emissions from Biomass	22 600.50						

⁽¹⁾ Countries are asked to report emissions from international aviation and marine bunkers and multilateral operations, as well as CO₂ 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 CO₂ 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 CO₂ 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.

1.AA Fuel Combustion - Sectoral Approach: Usage of "NO" notation keys in table 1.A(a)s1 to s4 : Energy statistics does not inquire all consumers but is limited to statistical samples. In the case that a statistical inquiry results in zero consumption of a specific sector and fuel group it is not always possible to decide if there occurs a consumption of a specific fuel category in a specific sector and year. However, as the energy statistics is based on a top down/bottom up approach it is assured that total national fuel consumption is equivalent to category 1A fuel consumption. Thus "NO" may be sometimes interpreted as "included elsewhere".

1.B.2 Oil and Natural Gas: Usage of "NO" notation keys in table 1.A(a)s1 to s4 : Energy statistics does not inquire all consumers but is limited to statistical samples. In the case that a statistical inquiry results in zero consumption of a specific sector and fuel group it is not always possible to decide if there occurs a consumption of a specific fuel category in a specific sector and year. However, as the energy statistics is based on a top down/bottom up approach it is assured that total national fuel consumption is equivalent to category 1A fuel consumption. Thus "NO" may be sometimes interpreted as "included elsewhere".

TABLE 1.A(a) SECTORAL BACKGROUND DATA FOR ENERGY

Fuel Combustion Activities - Sectoral Approach

(Sheet 1 of 4)

Inventory 2010

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GREENHOUSE GAS SOURCE AND SINK CATEGORIES	AGGREGATE ACTIVITY DATA		IMPLIED EMISSION FACTORS ⁽²⁾			EMISSIONS		
	Consumption		CO ₂	CH ₄	N ₂ O	CO ₂	CH ₄	N ₂ O
	(TJ)	NCV/GCV ⁽¹⁾	(t/TJ)	(kg/TJ)		(Gg)		
I.A. Fuel Combustion	1 136 908.32	NCV				62 851.15	11.84	2.30
Liquid Fuels	457 519.81	NCV	73.83	1.91	2.82	33 779.35	0.88	1.29
Solid Fuels	93 017.20	NCV	97.39	3.62	1.43	9 058.90	0.34	0.13
Gaseous Fuels	332 240.81	NCV	55.39	0.96	0.44	18 402.44	0.32	0.15
Biomass	219 794.95	NCV	102.83	45.01	3.08 ⁽³⁾		9.89	0.68
Other Fuels	34 335.55	NCV	46.90	12.00	1.40	1 610.45	0.41	0.05
I.A.1. Energy Industries	268 499.37	NCV				14 173.77	0.37	0.36
Liquid Fuels	40 160.44	NCV	72.78	0.23	0.71	2 922.91	0.01	0.03
Solid Fuels	41 470.71	NCV	93.31	0.10	1.62	3 869.81	0.00	0.07
Gaseous Fuels	118 344.50	NCV	55.40	0.54	0.41	6 556.29	0.06	0.05
Biomass	53 268.28	NCV	110.21	2.10	3.63 ⁽³⁾	5 870.92	0.11	0.19
Other Fuels	15 255.43	NCV	54.06	12.00	1.40	824.76	0.18	0.02
a. Public Electricity and Heat Production	215 088.40	NCV				10 729.98	0.35	0.34
Liquid Fuels	9 292.46	NCV	78.34	1.00	1.38	728.01	0.01	0.01
Solid Fuels	41 470.71	NCV	93.31	0.10	1.62	3 869.81	0.00	0.07
Gaseous Fuels	95 801.51	NCV	55.40	0.46	0.48	5 307.40	0.04	0.05
Biomass	53 268.28	NCV	110.21	2.10	3.63 ⁽³⁾	5 870.92	0.11	0.19
Other Fuels	15 255.43	NCV	54.06	12.00	1.40	824.76	0.18	0.02
b. Petroleum Refining	40 427.07	NCV				2 724.48	IE,NO	0.02
Liquid Fuels	30 867.99	NCV	71.11	IE	0.51	2 194.91	IE	0.02
Solid Fuels	NO	NCV	NO	NO	NO	NO	NO	NO
Gaseous Fuels	9 559.09	NCV	55.40	IE	0.10	529.57	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	12 983.90	NCV				719.31	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	12 983.90	NCV	55.40	1.50	0.10	719.31	0.02	0.00
Biomass	NO	NCV	NO	NO	NO ⁽³⁾	NO	NO	NO
Other Fuels	NO	NCV	NO	NO	NO	NO	NO	NO

Note: All footnotes for this table are given at the end of the table on sheet 4.

Note: For the coverage of fuel categories, refer to the IPCC Guidelines (Volume 1. Reporting Instructions - Common Reporting Framework, section 1.2, p. 1.19). If some derived gases (e.g. gas works, gas, coke oven gas, blast furnace gas) are considered, Parties should provide information on the allocation of these derived gases under the above fuel categories (liquid, solid, gaseous, biomass and other fuels) in the NIR (see also documentation box at the end of sheet 4 of this table).

TABLE 1.A(a) SECTORAL BACKGROUND DATA FOR ENERGY

Fuel Combustion Activities - Sectoral Approach

(Sheet 2 of 4)

Inventory 2010

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GREENHOUSE GAS SOURCE AND SINK CATEGORIES	AGGREGATE ACTIVITY DATA		IMPLIED EMISSION FACTORS ⁽²⁾			EMISSIONS		
	Consumption		CO ₂	CH ₄	N ₂ O	CO ₂	CH ₄	N ₂ O
	(TJ)	NCV/GCV ⁽¹⁾	(t/TJ)	(kg/TJ)		(Gg)		
1.A.2 Manufacturing Industries and Construction	290 611.13	NCV				15 455.70	0.68	0.48
Liquid Fuels	38 021.11	NCV	75.76	1.47	5.77	2 880.35	0.06	0.22
Solid Fuels	48 939.24	NCV	101.02	1.85	1.22	4 944.08	0.09	0.06
Gaseous Fuels	123 678.09	NCV	55.37	1.45	0.10	6 848.06	0.18	0.01
Biomass	60 916.40	NCV	108.69	2.04	2.64 ⁽³⁾	6 620.95	0.12	0.16
Other Fuels	19 056.30	NCV	41.10	12.00	1.40	783.21	0.23	0.03
a. Iron and Steel	67 378.81	NCV				5 834.92	0.08	0.06
Liquid Fuels	8 665.89	NCV	77.98	1.41	1.00	675.75	0.01	0.01
Solid Fuels	40 537.08	NCV	102.52	1.17	1.18	4 156.04	0.05	0.05
Gaseous Fuels	18 173.85	NCV	55.20	1.14	0.10	1 003.13	0.02	0.00
Biomass	2.00	NCV	110.00	2.00	4.00 ⁽³⁾	0.22	0.00	0.00
Other Fuels	NO	NCV	NO	NO	NO	NO	NO	NO
b. Non-Ferrous Metals	4 183.98	NCV				242.71	0.01	0.00
Liquid Fuels	253.45	NCV	76.45	0.87	0.76	19.38	0.00	0.00
Solid Fuels	114.87	NCV	104.00	2.00	1.40	11.95	0.00	0.00
Gaseous Fuels	3 815.66	NCV	55.40	1.50	0.10	211.39	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	24 959.16	NCV				1 360.45	0.09	0.02
Liquid Fuels	1 054.41	NCV	78.64	0.64	0.70	82.91	0.00	0.00
Solid Fuels	809.64	NCV	94.12	5.00	1.40	76.20	0.00	0.00
Gaseous Fuels	16 073.76	NCV	55.40	1.50	0.10	890.49	0.02	0.00
Biomass	2 671.04	NCV	110.33	1.92	3.50 ⁽³⁾	294.70	0.01	0.01
Other Fuels	4 350.31	NCV	71.45	12.00	1.40	310.85	0.05	0.01
d. Pulp, Paper and Print	74 791.78	NCV				2 228.59	0.15	0.08
Liquid Fuels	895.22	NCV	78.10	1.77	0.96	69.92	0.00	0.00
Solid Fuels	3 547.58	NCV	91.75	5.00	1.40	325.50	0.02	0.00
Gaseous Fuels	32 946.46	NCV	55.40	1.50	0.10	1 825.23	0.05	0.00
Biomass	37 260.80	NCV	109.87	2.09	1.96 ⁽³⁾	4 093.83	0.08	0.07
Other Fuels	141.71	NCV	55.94	12.00	1.40	7.93	0.00	0.00
e. Food Processing, Beverages and Tobacco	17 375.30	NCV				1 020.81	0.02	0.01
Liquid Fuels	3 621.77	NCV	72.26	1.16	0.90	261.71	0.00	0.00
Solid Fuels	144.65	NCV	103.67	2.18	1.40	15.00	0.00	0.00
Gaseous Fuels	13 426.30	NCV	55.40	1.50	0.10	743.82	0.02	0.00
Biomass	179.87	NCV	108.43	1.65	1.90 ⁽³⁾	19.50	0.00	0.00
Other Fuels	2.72	NCV	104.17	12.00	1.40	0.28	0.00	0.00
f. Other (please specify) ⁽⁴⁾	101 922.09	NCV				4 768.22	0.33	0.31
Other non-specified								
Liquid Fuels	23 530.36	NCV	75.25	1.57	8.74	1 770.67	0.04	0.21
Solid Fuels	3 785.42	NCV	94.94	5.42	1.40	359.38	0.02	0.01
Gaseous Fuels	39 242.07	NCV	55.40	1.50	0.10	2 174.01	0.06	0.00
Biomass	20 802.69	NCV	106.37	1.97	3.75 ⁽³⁾	2 212.70	0.04	0.08
Other Fuels	14 561.55	NCV	31.88	12.00	1.40	464.15	0.17	0.02

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)

Inventory 2010

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GREENHOUSE GAS SOURCE AND SINK CATEGORIES	AGGREGATE ACTIVITY DATA		IMPLIED EMISSION FACTORS ⁽²⁾			EMISSIONS		
	Consumption		CO ₂	CH ₄	N ₂ O	CO ₂	CH ₄	N ₂ O
	(TJ)	NCV/GCV ⁽¹⁾	(t/TJ)	(kg/TJ)		(Gg)		
1.A.3 Transport	325 092.58	NCV				22 205.42	0.72	0.75
Liquid Fuels	297 455.45	NCV	73.53	2.38	2.51	21 872.72	0.71	0.75
Solid Fuels	4.42	NCV	95.00	6.83	6.83	0.42	0.00	0.00
Gaseous Fuels	5 997.89	NCV	55.40	1.45	0.10	332.28	0.01	0.00
Biomass	21 634.82	NCV	70.80	IE,NO	IE,NO	1 531.74	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	872.65	NCV				63.53	0.00	0.00
Aviation Gasoline	126.44	NCV	72.75	0.50	2.00	9.20	0.00	0.00
Jet Kerosene	746.21	NCV	72.82	6.48	4.24	54.34	0.00	0.00
b. Road Transportation	316 267.46	NCV				21 661.69	0.69	0.69
Gasoline	71 869.84	NCV	73.33	7.81	3.76	5 270.12	0.56	0.27
Diesel Oil	220 990.60	NCV	73.67	0.60	1.89	16 279.98	0.13	0.42
Liquefied Petroleum Gases (LPG)	1 558.89	NCV	64.00	IE	IE	99.77	IE	IE
Other Liquid Fuels (please specify)	NA	NCV				NA	NA	NA
Gaseous Fuels	213.32	NCV	55.40	IE	IE	11.82	IE	IE
Biomass	21 634.82	NCV	70.80	IE	IE ⁽³⁾	1 531.74	IE	IE
Other Fuels (please specify)	NA	NCV				NA	NA	NA
c. Railways	2 015.92	NCV				148.60	0.01	0.05
Liquid Fuels	2 011.50	NCV	73.67	3.08	25.99	148.18	0.01	0.05
Solid Fuels	4.42	NCV	95.00	6.83	6.83	0.42	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	151.98	NCV				11.13	0.00	0.00
Residual Oil (Residual Fuel Oil)	NO	NCV	NO	NO	NO	NO	NO	NO
Gas/Diesel Oil	34.78	NCV	73.67	3.38	28.49	2.56	0.00	0.00
Gasoline	117.21	NCV	73.08	36.52	2.73	8.57	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⁾	5 784.57	NCV				320.47	0.01	0.00
Pipeline transport	5 784.57	NCV				320.47	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	5 784.57	NCV	55.40	1.50	0.10	320.47	0.01	0.00
Biomass	NO	NCV	NO	NO	NO ⁽³⁾	NO	NO	NO
Other Fuels	NO	NCV	NO	NO	NO	NO	NO	NO

Note: All footnotes for this table are given at the end of the table on sheet 4.

TABLE 1.A(a) SECTORAL BACKGROUND DATA FOR ENERGY

Fuel Combustion Activities - Sectoral Approach

(Sheet 4 of 4)

Inventory 2010

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GREENHOUSE GAS SOURCE AND SINK CATEGORIES	AGGREGATE ACTIVITY DATA		IMPLIED EMISSION FACTORS ⁽²⁾			EMISSIONS		
	Consumption		CO ₂	CH ₄	N ₂ O	CO ₂	CH ₄	N ₂ O
	(TJ)	NCV/GCV ⁽¹⁾	(t/TJ)	(kg/TJ)			(Gg)	
1.A.4 Other Sectors	252 067.45	NCV				10 969.98	10.07	0.71
Liquid Fuels	81 247.05	NCV	74.55	1.24	3.62	6 057.09	0.10	0.29
Solid Fuels	2 602.83	NCV	93.97	93.16	2.46	244.60	0.24	0.01
Gaseous Fuels	84 220.33	NCV	55.40	0.80	1.00	4 665.81	0.07	0.08
Biomass	83 973.43	NCV	102.14	115.01	3.85 ⁽³⁾	8 576.74	9.66	0.32
Other Fuels	23.82	NCV	104.17	12.00	1.40	2.48	0.00	0.00
a. Commercial/Institutional	41 486.79	NCV				2 302.94	0.21	0.05
Liquid Fuels	10 607.82	NCV	74.62	0.32	0.89	791.57	0.00	0.01
Solid Fuels	198.82	NCV	96.13	90.00	3.52	19.11	0.02	0.00
Gaseous Fuels	26 891.35	NCV	55.40	0.80	1.00	1 489.78	0.02	0.03
Biomass	3 764.98	NCV	108.02	44.00	2.76 ⁽³⁾	406.69	0.17	0.01
Other Fuels	23.82	NCV	104.17	12.00	1.40	2.48	0.00	0.00
b. Residential	189 164.35	NCV				7 813.29	9.19	0.40
Liquid Fuels	59 609.68	NCV	74.69	0.75	1.18	4 452.09	0.04	0.07
Solid Fuels	2 353.73	NCV	93.79	93.49	2.37	220.77	0.22	0.01
Gaseous Fuels	56 686.48	NCV	55.40	0.80	1.00	3 140.43	0.05	0.06
Biomass	70 514.45	NCV	101.70	125.95	3.77 ⁽³⁾	7 171.11	8.88	0.27
Other Fuels	NO	NCV	NO	NO	NO	NO	NO	NO
c. Agriculture/Forestry/Fisheries	21 416.32	NCV				853.75	0.67	0.26
Liquid Fuels	11 029.54	NCV	73.75	4.77	19.44	813.44	0.05	0.21
Solid Fuels	50.28	NCV	93.83	90.00	2.72	4.72	0.00	0.00
Gaseous Fuels	642.50	NCV	55.40	0.80	1.00	35.59	0.00	0.00
Biomass	9 693.99	NCV	103.05	63.05	4.92 ⁽³⁾	998.94	0.61	0.05
Other Fuels	NO	NCV	NO	NO	NO	NO	NO	NO
1.A.5 Other (Not specified elsewhere) ⁽⁶⁾	637.79	NCV				46.27	0.00	0.00
a. Stationary (please specify) ⁽⁷⁾	NA	NCV				NA	NA	NA
b. Mobile (please specify) ⁽⁸⁾	637.79	NCV				46.27	0.00	0.00
Military use								
Liquid Fuels	635.76	NCV	72.78	2.35	5.13	46.27	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	2.02	NCV	70.80	IE	IE ⁽³⁾	0.14	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 CH₄ and N₂O 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 CO₂ emissions from fuel combustion. The value for total CO₂ 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
- 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, solid, gaseous, biomass and

1.AA Fuel Combustion - Sectoral Approach: Usage of "NO" notation keys in table 1.A(a)s1 to s4 : Energy statistics does not inquire all consumers but is limited to statistical samples. In the case that a statistical inquiry results in zero consumption of a specific sector and fuel group it is not always possible to decide if there occurs a consumption of a specific fuel category in a specific sector and year. However, as the energy statistics is based on a top down/bottom up approach it is assured that total national fuel consumption is equivalent to category 1A fuel consumption. Thus "NO" may be sometimes interpreted as "included elsewhere".

TABLE 1.A(b) SECTORAL BACKGROUND DATA FOR ENERGY
CO₂ from Fuel Combustion Activities - Reference Approach (IPCC Worksheet 1-1)
(Sheet 1 of 1)

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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	933.23	6 764.81	NO		-20.47	7 718.51	42.79	NCV	330 237.18	20.00	6 604.74	NO	6 604.74	0.99	23 975.22
		Orimulsion	Gg	NO	NO	NO		NO	NO	NA	NCV	NA,NO	NA	NA,NO	NA	NA,NO	NA	NA,NO
		Natural Gas Liquids	Gg	134.37	NO	NO		NO	134.37	42.79	NCV	5 749.12	17.20	98.88	NO	98.88	0.99	358.95
	Secondary Fuels	Gasoline	Gg		800.02	561.15	NO	-46.66	285.53	43.14	NCV	12 319.22	18.90	232.83	NO	232.83	0.99	845.18
		Jet Kerosene	Gg		193.14	0.08	650.03	-11.84	-445.13	43.30	NCV	-19 274.36	19.50	-375.85	NO	-375.85	0.99	-1 364.34
		Other Kerosene	Gg		1.32	0.10	NO	0.06	1.16	43.30	NCV	50.20	19.60	0.98	NO	0.98	0.99	3.57
		Shale Oil	Gg		NO	NO		NO	NO	NA	NCV	NA,NO	NA	NA,NO	NA	NA,NO	NA	NA,NO
		Gas / Diesel Oil	Gg		4 989.33	872.65	10.76	-57.55	4 163.48	42.80	NCV	178 196.93	20.20	3 599.58	NO	3 599.58	0.99	13 066.47
		Residual Fuel Oil	Gg		173.38	244.18	NO	-206.55	135.75	40.94	NCV	5 557.23	21.10	117.26	NO	117.26	0.99	425.65
		Liquefied Petroleum Gas (LPG)	Gg		113.86	10.52		1.25	102.09	46.00	NCV	4 696.00	17.20	80.77	NO	80.77	0.99	293.20
		Ethane	Gg		IE	IE		IE	IE	NA	NCV	IE,NA	NA	IE,NA	NO	IE,NA,NO	NA	IE,NA,NO
		Naphtha	Gg		27.00	28.00		2.00	-3.00	45.01	NCV	-135.03	20.00	-2.70	527.97	-530.67	0.99	-1 926.32
		Bitumen	Gg		345.53	182.41		4.42	158.70	43.83	NCV	6 955.32	22.00	153.02	434.87	-281.85	0.99	-1 023.13
		Lubricants	Gg		45.39	70.82	NO	4.81	-30.24	41.80	NCV	-1 264.19	20.00	-25.28	27.48	-52.77	0.99	-191.54
		Petroleum Coke	Gg		103.95	0.05		0.49	103.41	32.21	NCV	3 331.30	27.50	91.61	76.11	15.51	0.99	56.28
		Refinery Feedstocks	Gg		360.06	11.17		3.03	345.86	42.59	NCV	14 729.15	20.00	294.58	NO	294.58	0.99	1 069.34
		Other Oil	Gg		41.16	207.66		-30.11	-136.39	43.83	NCV	-5 977.54	20.00	-119.55	17.27	-136.82	0.99	-496.64
Other Liquid Fossil												NA		NA	NA	NA		NA
Liquid Fossil Totals												535 170.53		10 750.88	1 083.69	9 667.19		35 091.89
Solid Fossil	Primary Fuels	Anthracite ⁽²⁾	Gg	NO	4.00	NO		2.00	2.00	28.00	NCV	56.00	26.80	1.50	0.38	1.13	0.98	4.04
		Coking Coal	Gg	NO	1 326.63	NO		-511.77	1 838.40	29.08	NCV	53 452.70	25.40	1 357.71	69.02	1 288.69	0.98	4 630.69
		Other Bituminous Coal	Gg	NO	1 723.00	1.00	NO	-171.00	1 893.00	27.00	NCV	51 116.30	25.91	1 324.62	NO	1 324.62	0.98	4 759.81
		Sub-bituminous Coal	Gg	NO	69.00	NO	NO	NO	69.00	22.20	NCV	1 531.80	26.20	40.13	NO	40.13	0.98	144.21
		Lignite	Gg	NO	16.00	8.00		-4.00	12.00	19.67	NCV	236.10	26.89	6.35	NO	6.35	0.98	22.81
		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		49.67	0.38		6.80	42.49	19.30	NCV	820.04	25.80	21.16	NO	21.16	0.98	76.02
		Coke Oven/Gas Coke	Gg		1 252.06	2.81		73.41	1 175.85	29.00	NCV	34 099.55	29.64	1 010.87	6.29	1 004.58	0.98	3 609.78
Other Solid Fossil												NA		NA	NA	NA		NA
Solid Fossil Totals												141 316.89		3 762.46	75.68	3 686.78		13 247.83
Gaseous Fossil		Natural Gas (Dry)	TJ	62 843.53	#####	#####		-25 964.71	347 395.22	1.00	NCV	347 395.22	15.19	5 275.20	NO	5 275.20	1.00	19 245.70
Other Gaseous Fossil												NA		NA	NA	NA		NA
Gaseous Fossil Totals												347 395.22		5 275.20	NA,NO	5 275.20		19 245.70
Total												1 023 882.64		19 788.54	1 159.37	18 629.17		67 585.42
Biomass total												195 534.66		5 846.49	NA,NO	5 846.49		18 951.25
		Solid Biomass	TJ	181 697.35	20 617.23	13 959.66		NO	188 354.92	1.00	NCV	188 354.92	29.90	5 631.81	NO	5 631.81	0.88	18 171.98
		Liquid Biomass	TJ	IE	IE	IE		IE	IE	NA	NCV	IE,NA	NA	IE,NA	NA	IE,NA	NA	IE,NA
		Gas Biomass	TJ	7 179.73	NO	NO		NO	7 179.73	1.00	NCV	7 179.73	29.90	214.67	NO	214.67	0.99	779.27

⁽¹⁾ To convert quantities in previous columns to energy units, use net calorific values (NCV) and write NCV in this column. If gross calorific values (GCV) are used, write GCV in this column.

⁽²⁾ If data for Anthracite are not available separately, include with Other Bituminous Coal.

⁽³⁾ BKB: Brown coal/peat briquettes.

Documentation Box:

Parties should provide detailed explanations on the fuel combustion sub-sector, including information relating to CO₂ from the Reference approach, in the corresponding part of Chapter 3: Energy (CRF sub-sector 1.A) of the NIR. Use this documentation box to provide references to relevant sections of the NIR if any additional information and/or further details are needed to understand the content of this table.

TABLE 1.A(c) COMPARISON OF CO₂ EMISSIONS FROM FUEL COMBUSTION

(Sheet 1 of 1)

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FUEL TYPES	REFERENCE APPROACH			SECTORAL APPROACH ⁽¹⁾		DIFFERENCE ⁽²⁾	
	Apparent energy consumption ⁽³⁾ (PJ)	Apparent energy consumption (excluding non-energy use and feedstocks) ⁽⁴⁾ (PJ)	CO ₂ emissions (Gg)	Energy consumption (PJ)	CO ₂ emissions (Gg)	Energy consumption (%)	CO ₂ emissions (%)
Liquid Fuels (excluding international bunkers)	535.17	465.19	35 091.89	457.52	33 779.35	1.68	3.89
Solid Fuels (excluding international bunkers) ⁽⁵⁾	141.32	107.05	13 247.83	93.02	9 058.90	15.09	46.24
Gaseous Fuels	347.40	331.37	19 245.70	332.24	18 402.44	-0.26	4.58
Other ⁽⁵⁾	NA	NA	NA	34.34	1 610.45	-100.00	-100.00
Total ⁽⁵⁾	1 023.88	903.61	67 585.42	917.11	62 851.15	-1.47	7.53

⁽¹⁾ "Sectoral approach" is used to indicate the approach (if different from the Reference approach) used by the Party to estimate CO₂ emissions from fuel combustion as reported in table 1.A(a), sheets 1-4.

⁽²⁾ Difference in CO₂ 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 CO₂ 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 CO₂ 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 CO₂ emission estimates from the two approaches differ by more than 2 per cent, Parties should briefly explain the cause of this difference in this documentation box and provide a reference to relevant section of the NIR where this difference is explained in more detail.

1.AA Fuel Combustion - Sectoral Approach: Usage of "NO" notation keys in table 1.A(a)s1 to s4 : Energy statistics does not inquire all consumers but is limited to statistical samples. In the case that a stat

TABLE 1.A(d) SECTORAL BACKGROUND DATA FOR ENERGY
Feedstocks and Non-Energy Use of Fuels
 (Sheet 1 of 1)

Inventory 2010

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FUEL TYPE	ACTIVITY DATA AND RELATED INFORMATION		IMPLIED EMISSION FACTOR	ESTIMATE
	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⁾	35 197.82	0.75	20.00	527.97
Lubricants	2 748.25	0.50	20.00	27.48
Bitumen	19 766.80	1.00	22.00	434.87
Coal Oils and Tars (from Coking Coal)	2 045.97	0.75	44.98	69.02
Natural Gas ⁽¹⁾	15 938.00	NO	NO	NO
Gas/Diesel Oil ⁽¹⁾	NO	0.50	NO	NO
LPG ⁽¹⁾	NO	1.00	NO	NO
Ethane ⁽¹⁾	NO	NO	NO	NO
Other (<i>please specify</i>)				23.92
Butane	NO	0.75	NO	NO
Coal	28.00	0.50	26.80	0.38
Coke	30 304.71	0.01	29.64	6.29
Gasoline	NO	0.50	NO	NO
Other petroleum products	1 151.04	0.75	20.00	17.27

Total	1 083.27
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	1 124.69

(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)).

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

Additional information ^(a)

CO ₂ not emitted (Gg CO ₂)	Subtracted from energy sector (specify source category)
1 935.88	N
100.77	N
1 594.52	N
253.06	N
NO	N
NO	N
NO	N
NO	N
NO	N
1.38	N
23.06	N
NO	N
63.31	N

3 971.97
4 123.86

(a) The fuel lines continue from the table to the left.

[illegible]

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.

TABLE 1.B.1 SECTORAL BACKGROUND DATA FOR ENERGY
Fugitive Emissions from Solid Fuels

(Sheet 1 of 1)

Inventory 2010

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GREENHOUSE GAS SOURCE AND SINK CATEGORIES	ACTIVITY DATA	IMPLIED EMISSION FACTORS		EMISSIONS		
	Amount of fuel produced	CH ₄ ⁽¹⁾	CO ₂	CH ₄		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	1.39	IE	IE	NO	IE	IE
1. B. 1. c. Other (please specify) ⁽⁵⁾				NA	NA	NA

⁽¹⁾ The IEFs for CH₄ are estimated on the basis of gross emissions as follows: (CH₄ emissions + amounts of CH₄ 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 provide information on the fugitive emissions from solid fuels.
- 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 CH₄ 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 2010

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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 ₂ O	CO ₂	CH ₄	N ₂ O
				(kg/unit) ⁽²⁾			(Gg)		
1. B. 2. a. Oil ⁽³⁾							145.00	6.68	IE,NA
i. Exploration	<i>number of wells drilled</i>	number	689.00	IE	IE	IE	IE	IE	IE
ii. Production ⁽⁴⁾	<i>Oil throughput</i>	Mt	0.93	155 374 888.82	6 892 215.76		145.00	6.43	
iii. Transport	<i>oil loaded in tankers</i>	number	NA	IE	IE		IE	IE	
iv. Refining / Storage	<i>Oil refined (SNAP 0401)</i>	Mt	7.76	NA	31 662.50	NA	NA	0.25	NA
v. Distribution of Oil Products	<i>Gasoline Consumption (SNAP)</i>	Mt	1.82	NA	NA		NA	NA	
vi. Other	<i>NO</i>	Mt	NO	NO	NO		NO	NO	
1. B. 2. b. Natural Gas							92.17	6.61	
i. Exploration	<i>Gas produced</i>	10 ⁶ m ³	1 816.00	NA	IE		NA	IE	
ii. Production ⁽⁴⁾ / Processing	<i>gas produced</i>	10 ⁶ m ³	1 816.00	50 660.79	IE		92.00	IE	
iii. Transmission	<i>Pipelines length (km)</i>	km	6 798.00	24.50	494.56		0.17	3.36	
iv. Distribution	<i>Distribution network length</i>	km	28 732.62	NA	113.02		NA	3.25	
v. Other Leakage	<i>Gas consumed</i>	PJ	NO	NO	NO		NO	NO	
<i>at industrial plants and power stations</i>	<i>Gas consumed</i>	PJ	NO	NO	NO		NO	NO	
<i>in residential and commercial sectors</i>	<i>Gas consumed</i>	PJ	NO	NO	NO		NO	NO	
1. B. 2. c. Venting ⁽⁵⁾							IE	IE	
i. Oil	<i>oil produced</i>	Mt	NA	NA	NA		NA	NA	
ii. Gas	<i>gas produced</i>	PJ	NA	NA	NA		NA	NA	
iii. Combined	<i>Oil Produced</i>	Mt	NA	NA	NA		NA	NA	
Flaring							IE	IE	IE
i. Oil	<i>Oil consumed</i>	Mtoe	NA	NA	NA	NA	NA	NA	NA
ii. Gas	<i>gas consumed</i>	PJ	NA	NA	NA	NA	NA	NA	NA
iii. Combined	<i>oil consumed</i>	Mt	NA	NA	NA	NA	NA	NA	NA
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, 10⁶ m³, 10⁶ 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 CO₂ 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)

Inventory 2010

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GREENHOUSE GAS SOURCE AND SINK CATEGORIES	ACTIVITY DATA	IMPLIED EMISSION FACTORS			EMISSIONS		
		CO ₂	CH ₄	N ₂ O	CO ₂	CH ₄	N ₂ O
	Consumption (TJ)	(t/TJ)			(Gg)		
Aviation Bunkers	28 146.67				2 049.55	0.04	0.07
Jet Kerosene	28 146.67	72.82	0.00	0.00	2 049.55	0.04	0.07
Gasoline	NO	NO	NO	NO	NO	NO	NO
Marine Bunkers	460.40				31.13	0.00	0.01
Gasoline	NO	NO	NO	NO	NO	NO	NO
Gas/Diesel Oil	460.40	67.61	0.00	0.03	31.13	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 <i>(please specify)</i>	NA				NA	NA	NA
Multilateral Operations ⁽¹⁾	NO	NO	NO	NO	NO	NO	NO

⁽¹⁾ Parties may choose to report or not report the activity data and implied emission factors for multilateral operations consistent with the principle of confidentiality stated in the Guidelines. 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.

Additional information

Fuel consumption	Distribution ^(a) (per cent)	
	Domestic	International
Aviation	3.01	96.99
Marine	24.82	75.18

^(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.

TABLE 2(I) SECTORAL REPORT FOR INDUSTRIAL PROCESSES

(Sheet 1 of 2)

Inventory 2010

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GREENHOUSE GAS SOURCE AND SINK CATEGORIES	CO ₂	CH ₄	N ₂ O	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	9 023.24	0.87	0.20	1 837.57	1 160.63	349.38	69.85	0.03	0.01	1.50	23.86	4.73	1.21
A. Mineral Products	2 935.52	NA	NA							NA	9.78	IE,NA	NA
1. Cement Production	1 622.13												NA
2. Lime Production	574.43												
3. Limestone and Dolomite Use	293.92												
4. Soda Ash Production and Use	9.68												
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)	435.37	NA	NA							NA	NA	NA	NA
Glass Production	40.10	NA	NA							NA	NA	NA	NA
Bricks and Tiles (decarbonizing)	81.43	NA	NA							NA	NA	NA	NA
Sinter Production	313.85	NA	NA							NA	NA	NA	NA
B. Chemical Industry	607.80	0.87	0.20	NO	NO	NO	NO	NO	NO	0.42	11.12	1.32	0.77
1. Ammonia Production	538.07	0.07	NA							0.20	0.06	IE	NA
2. Nitric Acid Production			0.20							0.14			
3. Adipic Acid Production	NO		NO							NO	NO	NO	
4. Carbide Production	42.81	NA,NO								NA	NA	NA	NA
5. Other (as specified in table 2(I).A-G)	26.92	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											
CO ₂ from nitric acid production	0.40	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
Other Chemical Industry	26.52	0.30	NA	NO	NO	NO	NO	NO	NO	0.08	11.07	1.32	0.77
C. Metal Production	5 479.91	0.00	NA	NO	NO	NO	NO	NA,NO	0.00	0.10	2.24	0.43	0.45
1. Iron and Steel Production	5 460.19	0.00								0.08	1.92	0.24	0.05
2. Ferroalloys Production	19.72	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	0.19	0.40
Non-ferrous metals	NA	NA	NA	NO	NO	NO	NO	NO	NO	0.02	0.32	0.19	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 CO₂ equivalent emissions. Data on disaggregated emissions of HFCs and PFCs are to be provided in Table 2(II).

TABLE 2(I) SECTORAL REPORT FOR INDUSTRIAL PROCESSES

(Sheet 2 of 2)

Inventory 2010

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GREENHOUSE GAS SOURCE AND SINK CATEGORIES	CO ₂	CH ₄	N ₂ O	HFCs ⁽¹⁾		PFCs ⁽¹⁾		SF ₆		NO _x	CO	NM VOC	SO ₂
				P	A	P	A	P	A				
	(Gg)			CO ₂ equivalent (Gg)				(Gg)					
D. Other Production	NA									0.97	0.71	2.98	NA
1. Pulp and Paper										0.97	0.71	0.71	NA
2. Food and Drink ⁽²⁾	NA											2.27	
E. Production of Halocarbons and SF₆					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 SF₆				1 837.57	1 160.63	349.38	69.85	0.03	0.01				
1. Refrigeration and Air Conditioning Equipment				NA	1 098.09	NA	5.91	NA	NA				
2. Foam Blowing				NA	31.00	NA	NO	NA	NA				
3. Fire Extinguishers				NA	10.10	NA	NO	NA	NA				
4. Aerosols/ Metered Dose Inhalers				NA	19.82	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	1.62	NA	63.93	NA	0.00				
8. Electrical Equipment				NA	NO	NA	NO	NA	0.00				
9. Other (as specified in table 2(II))				NA	NA,NO	NA	NA,NO	NA	0.01				
Double glaze windows				NA	NA,NO	NA	NO	NA	0.01				
Research and other use				NA	NA,NO	NA	NA,NO	NA	0.00				
G. Other (as specified in tables 2(I).A-G and 2(II))	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA

Note: P = Potential emissions based on Tier 1 approach of the IPCC Guidelines. A = Actual emissions based on Tier 2 approach of the IPCC Guidelines. This applies only to source categories where methods exist for both tiers.

⁽¹⁾ The emissions of HFCs and PFCs are to be expressed as CO₂ equivalent emissions. Data on disaggregated emissions of HFCs and PFCs are to be provided in Table 2(II).

⁽²⁾ CO₂ from Food and Drink Production (e.g. gasification of water) can be of biogenic or non-biogenic origin. Only information on CO₂ 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 CO₂, CH₄ and N₂O

(Sheet 1 of 2)

Inventory 2010

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GREENHOUSE GAS SOURCE AND SINK CATEGORIES	ACTIVITY DATA		IMPLIED EMISSION FACTORS ⁽²⁾			EMISSIONS					
	Production/Consumption quantity		CO ₂	CH ₄	N ₂ O	CO ₂		CH ₄		N ₂ O	
						Emissions ⁽³⁾	Recovery ⁽⁴⁾	Emissions ⁽³⁾	Recovery ⁽⁴⁾	Emissions ⁽³⁾	Recovery ⁽⁴⁾
	Description ⁽¹⁾	(kt)	(t/t)			(Gg)					
A. Mineral Products						2 935.52	IE,NO	NA	NO	NA	NO
1. Cement Production	Clinker Production [kt]	3 097.04	0.52			1 622.13	NO				
2. Lime Production	Lime Produced [kt]	765.23	0.75			574.43	NO				
3. Limestone and Dolomite Use	Limestone and Dolomite used [kt]	676.21	0.43			293.92	NO				
4. Soda Ash						9.68	IE,NO				
Soda Ash Production	Soda Ash Production	NA	IE			IE	IE				
Soda Ash Use	Soda Ash Used [kt]	23.33	0.42			9.68	NO				
5. Asphalt Roofing	Roofing Material Production [Mio m2]	27.95	IE			IE	NO				
6. Road Paving with Asphalt	Asphalt Production [kt]	1 414.09	IE			IE	NO				
7. Other <i>(please specify)</i>						435.37	NO	NA	NO	NA	NO
Glass Production	(specify)	498.16	0.08	NA	NA	40.10	NO	NA	NO	NA	NO
Bricks and Tiles (decarbonizing)	Bricks Production [kt]	1 789.88	0.05	NA	NA	81.43	NO	NA	NO	NA	NO
Sinter Production	MgCO3 sintered [kt]	627.61	0.50	NA	NA	313.85	NO	NA	NO	NA	NO
B. Chemical Industry						607.80	NO	0.87	NO	0.20	NO
1. Ammonia Production ⁽⁵⁾	Ammonia Production [kt]	495.35	1.09	0.00	NA	538.07	NO	0.07	NO	NA	NO
2. Nitric Acid Production	Nitric Acid Production [kt]	547.70			0.00					0.20	NO
3. Adipic Acid Production	Adipic Acid Production	NO	NO		NO	NO	NO			NO	NO
4. Carbide Production	Carbide Production	33.04	1.30	NA,NO		42.81	NO	NA,NO	NO		
Silicon Carbide	Silicon Carbide Production	NO	NO	NO		NO	NO	NO	NO		
Calcium Carbide	Calcium Carbide Production	33.04	1.30	NA		42.81	NO	NA	NO		
5. Other <i>(please specify)</i>						26.92	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	26.52	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 CO₂, CH₄ and N₂O

(Sheet 2 of 2)

Inventory 2010

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GREENHOUSE GAS SOURCE AND SINK CATEGORIES	ACTIVITY DATA		IMPLIED EMISSION FACTORS ⁽²⁾			EMISSIONS					
	Production/Consumption quantity		CO ₂	CH ₄	N ₂ O	CO ₂		CH ₄		N ₂ O	
						Emissions ⁽³⁾	Recovery ⁽⁴⁾	Emissions ⁽³⁾	Recovery ⁽⁴⁾	Emissions ⁽³⁾	Recovery ⁽⁴⁾
	Description ⁽¹⁾	(kt)	(t/t)			(Gg)					
C. Metal Production						5 479.91	NA,NO	0.00	NA,NO	NA	NO
1. Iron and Steel Production			0.32	0.00		5 460.19	NA,NO	0.00	NA,NO		
Steel	Steel Production [kt]	6 570.36	0.12	IE		791.63	NO	IE	NO		
Pig Iron	Iron Production [kt]	5 643.86	0.82	IE		4 621.61	NO	IE	NO		
Sinter	Sinter Production [kt]	3 527.74	NA	NA		NA	NA	NA	NA		
Coke	Coke Production [kt]	1 390.74	NA	NA		NA	NA	NA	NA		
Other (please specify)						46.95	NO	0.00	NO		
Electric Furnace Steel production	Electric Furnace Steel Production	637.38	0.07	0.00		46.95	NO	0.00	NO		
Foundries	Product	167.85	NA	NA		NA	NO	NA	NO		
Rolling mills	Product	6 570.36	NA	0.00		NA	NO	0.00	NO		
2. Ferroalloys Production	Ferroalloys Production [kt]	14.50	1.36	NA		19.72	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]	138.00	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]	1 473.13	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 SF₆

(Sheet 1 of 2)

Inventory 2010

Submission 2012 v1.3

AUSTRIA

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	HFC-23	HFC-32	HFC-41	HFC-43-10mce	HFC-125	HFC-134	HFC-134a	HFC-152a	HFC-143	HFC-143a	HFC-227ea	HFC-236fa	HFC-245ea	Unspecified mix of listed HFCs ⁽¹⁾	Total HFCs	CF ₄	C ₂ F ₆	C ₃ F ₈	C ₄ F ₁₀	e-C ₃ F ₆	C ₃ F ₁₂	C ₄ F 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	3.29	16.69	NA,NO	NA,NO	104.38	NA,NO	362.43	135.90	NA,NO	86.10	0.00	NA,NO	NA,NO	1.62		IE,NA,NO	IE,NA,NO	0.84	NA,NO	IE,NA,NO	NA,NO	NA,NO	63.93		14.44
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		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	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	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	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	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	NA
F(a). Consumption of Halocarbons and SF ₆ (actual)	3.29	16.69	NO	NO	104.38	NO	362.43	135.90	NO	86.10	0.00	NO	NO	1.62		IE,NO	IE,NO	0.84	NO	IE,NO	NO	NO	63.93		14.42
1. Refrigeration and Air Conditioning Equipment	2.43	16.69	NO	NO	104.38	NO	337.81	1.53	NO	86.10	NO	NO	NO	NO		NO	NO	0.84	NO	NO	NO	NO	NO		NA
2. Foam Blowing	NO	NO	NO	NO	NO	NO	9.38	134.36	NO	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	NO	NA
4. Aerosols/Metered Dose Inhalers	NO	NO	NO	NO	NO	NO	15.24	NO	NO	NO	NO	NO	NO	NO		NO	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	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	NO	NA
7. Semiconductor Manufacture	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	1.62		IE	IE	IE	NO	IE	NO	NO	63.93		2.88
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	NO	1.31
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	NA,NO	NO	NO	NO	NO	NO		10.24
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	NO	10.19
Research and other use	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NA		NO	NO	NA,NO	NO	NO	NO	NO	NO	NO	0.05
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	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 SF₆

(Sheet 2 of 2)

Inventory 2010

Submission 2012 v1.3

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GREENHOUSE GAS SOURCE AND SINK CATEGORIES	HFC-23	HFC-32	HFC-41	HFC-43-10mcc	HFC-125	HFC-134	HFC-134a	HFC-152a	HFC-143	HFC-143a	HFC-227ea	HFC-236fa	HFC-245ea	Unspecified mix of listed HFCs ⁽¹⁾	Total HFCs	CF ₄	C ₂ F ₆	C ₃ F ₈	C ₄ F ₁₀	c-C ₄ F ₈	C ₃ F ₁₂	C ₄ F 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⁾	7.76	43.64	NE,NO	NE,NO	235.75	NE,NO	340.87	128.13	NE,NO	150.02	2.60	NE,NO	NE,NO	19.61		IE,NE,NO	IE,NE,NO	0.84	IE,NE,NO	IE,NO	NO	NO	343.47		25.71
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:	7.76	43.64	NE,NO	NE,NO	235.75	NE,NO	340.87	128.13	NE,NO	150.02	2.60	NE,NO	NE,NO	19.61		IE,NO	IE,NO	0.84	NO	IE,NO	NO	NO	343.47		25.71
In bulk	7.76	43.64	NO	NO	235.75	NO	340.87	128.13	NO	150.02	2.60	NO	NO	19.61		IE	IE	0.84	NO	IE	NO	NO	343.47		25.71
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))		38.54	10.85	NA,NO	NA,NO	292.27	NA,NO	471.16	19.03	NA,NO	327.17	0.00	NA,NO	NA,NO	1.62	1 160.63	IE,NA,NO	IE,NA,NO	5.91	NA,NO	IE,NA,NO	NA,NO	NA,NO	63.93	69.85	345.01
C. Metal Production		NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO			NO	NO	NO	NO	NO	NO	NO	NO	0.29	
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	
F(a). Consumption of Halocarbons and SF ₆		38.54	10.85	NO	NO	292.27	NO	471.16	19.03	NO	327.17	0.00	NO	NA	1.62	1 160.63	IE,NO	IE,NO	5.91	NO	IE,NO	NO	NO	63.93	69.85	344.73
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	

Ratio of Potential/Actual Emissions from Consumption of Halocarbons and SF ₆																										
Actual emissions - F(a) (Gg CO ₂ eq.)		38.54	10.85	NO	NO	292.27	NO	471.16	19.03	NO	327.17	0.00	NO	NO	1.62	1 160.63	IE,NO	IE,NO	5.91	NO	IE,NO	NO	NO	63.93	69.85	344.73
Potential emissions - F(p) ⁽⁸⁾ (Gg CO ₂ eq.)		90.82	28.37	NE,NO	NE,NO	660.10	NE,NO	443.13	17.94	NE,NO	570.07	7.53	NE,NO	NE,NO	19.61	1 837.57	IE,NE,NO	IE,NE,NO	5.91	IE,NE,NO	IE,NO	NO	NO	343.47	349.38	614.38
Potential/Actual emissions ratio		2.36	2.62	NE,NO	NE,NO	2.26	NE,NO	0.94	0.94	NE,NO	1.74	12 290.63	NE,NO	NE,NO	12.08	1.58	IE,NE,NO	IE,NE,NO	1.00	IE,NE,NO	IE,NO	NO	NO	5.37	5.00	1.78

⁽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. instead of Gg.

⁽³⁾ ODS: ozone-depleting substances

⁽⁴⁾ Potential emissions of each chemical of halocarbons and SF₆ 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 SF₆ 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 SF₆ 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 SF₆, where data are available, providing disaggregated data by chemical and source category in units of mass and in CQ 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)

Inventory 2010

Submission 2012 v1.3

AUSTRIA

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	ACTIVITY DATA		IMPLIED EMISSION FACTORS ⁽²⁾			EMISSIONS					
			CF ₄	C ₂ F ₆	SF ₆	CF ₄		C ₂ F 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 SF₆

(Sheet 1 of 1)

Inventory 2010

Submission 2012 v1.3

AUSTRIA

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	ACTIVITY DATA		IMPLIED EMISSION FACTORS ⁽²⁾	EMISSIONS	
	Description ⁽¹⁾	(t)		Emissions ⁽³⁾	Recovery ⁽⁴⁾
				(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 d.⁽³⁾ Final emissions are to be reported (after subtracting the amounts of emission recovery, oxidation, destruction or transformation).⁽⁴⁾ Amounts of emission recovery, oxidation, destruction or transformation**Documentation box:**

- Parties should provide detailed explanations on the industrial processes sector in Chapter 4: Industrial processes (CRF sector 2) of the NIR. Use this documentation box to provide references to relevant sections of the NIR if any additional
- Where only aggregate figures for activity data are provided, e.g. due to reasons of confidentiality (see footnote 1 to table 2(II)), a note indicating this should be provided in this documentation box.
- Where applying Tier 2 and country-specific methods, specify any other relevant activity data used in this documentation box, including a reference to the section of the NIR where more detailed information can be found.
- Use this documentation box for providing clarification on emission recovery, oxidation, destruction and/or transformation, and provide a reference to the section of the NIR where more detailed information can be found

TABLE 2(II).F SECTORAL BACKGROUND DATA FOR INDUSTRIAL PROCESSES

Consumption of Halocarbons and SF₆

(Sheet 1 of 2)

Inventory 2010

Submission 2012 v1.3

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GREENHOUSE GAS SOURCE AND SINK CATEGORIES	ACTIVITY DATA <i>Amount of fluid</i>			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	6.00	0.38	NA	0.30	30.00	NO	0.12	0.11
Commercial Refrigeration									
C3F8	NO	5.23	NO	NA	16.14	NA	NO	0.84	NO
HFC-125	142.02	417.29	7.70	0.19	17.15	30.00	0.27	71.57	2.31
HFC-134a	113.24	797.07	22.86	0.19	12.54	30.00	0.21	99.97	6.86
HFC-143a	102.63	405.16	8.37	0.18	15.18	30.00	0.19	61.50	2.51
HFC-152a	NO	3.91	NO	NA	21.02	NA	NO	0.82	0.26
HFC-23	NO	24.22	NO	0.20	10.04	NA	NO	2.43	NO
HFC-32	15.74	43.43	NO	0.20	24.85	NA	0.03	10.79	0.16
Transport Refrigeration									
HFC-125	NO	18.19	1.49	NA	29.00	30.00	NO	5.27	0.45
HFC-134a	NO	10.86	0.91	NA	29.00	30.00	NO	3.15	0.27
HFC-143a	NO	18.62	1.50	NA	29.00	30.00	NO	5.40	0.45
HFC-152a	NO	0.21	0.02	NA	29.00	30.00	NO	0.06	0.01
HFC-32	NO	2.39	0.22	NA	29.00	30.00	NO	0.69	0.06
Industrial Refrigeration									
HFC-125	8.73	75.51	2.14	0.15	12.06	30.00	0.01	9.11	0.64
HFC-134a	13.52	50.14	0.71	0.15	5.64	30.00	0.02	2.83	0.21
HFC-143a	5.88	62.31	6.73	0.15	15.51	30.00	0.01	9.66	2.02
HFC-152a	NO	NO	NO	NO	NO	NO	NO	NO	NO
HFC-32	1.34	19.01	0.17	0.15	1.15	30.00	0.00	0.22	0.05
Stationary Air-Conditioning									
HFC-125	12.01	191.33	2.90	0.04	7.25	30.00	0.00	13.87	0.87
HFC-134a	65.14	512.72	20.50	0.05	3.44	29.78	0.03	17.64	6.11
HFC-143a	0.61	58.83	3.42	0.05	5.66	30.00	0.00	3.33	1.03
HFC-152a	NO	3.68	NO	NA	10.58	NA	NO	0.39	NO
HFC-32	9.91	143.99	NO	0.04	3.24	NA	0.00	4.66	NO
Mobile Air-Conditioning									
HFC-134a	122.24	1 638.97	104.46	0.61	10.26	30.00	0.75	168.18	31.34
2. Foam Blowing⁽¹⁾									
Hard Foam									
HFC-134a	NO	1 574.80	NO	NA	0.60	NA	NO	9.38	NO
HFC-152a	126.88	7.48	NO	100.00	100.00	NA	126.88	7.48	NO
Soft Foam									
HFC-134a	NO	NO	NO	NO	NO	NO	NO	NO	NO

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HFC-152a	NO	NO	NO	NO	NO	NO	NO	NO	NO
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⁽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 SF₆ 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 SF₆

(Sheet 2 of 2)

Inventory 2010

Submission 2012 v1.3

AUSTRIA

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	ACTIVITY DATA <i>Amount of fluid</i>			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 <i>(please specify chemical)</i> ⁽¹⁾									
C4F10	NO	NO	NO	NO	NO	NO	NO	NO	NO
HFC-227ea	0.42	41.97	NO	0.05	NO	1.00	0.00	NO	NO
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	0.31	15.24	NO	1.50	100.00	NA	IE	15.24	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	8.69	NO	NA	33.08	NA	NO	2.88	NO
Unspecified mix of HFCs	NO	19 609.20	NO	NA	8.28	NA	NO	1 622.79	NO
Unspecified mix of PFCs	NO	343 465.10	NO	NA	18.61	NA	NO	63 933.98	NO
8. Electrical Equipment ⁽¹⁾									
SF6	16.21	213.99	0.38	0.78	0.55	2.00	0.13	1.18	0.01
9. Other <i>(please specify)</i> ⁽¹⁾									
Double glaze windows									
SF6	NO	201.67	8.18	33.00	1.00	100.00	NO	2.02	8.18
Research and other use									
C3F8	NO	NO	NO	NA	NA	100.00	NA	NA	NO
SF6	0.00	0.77	NO	NA	6.11	NA	NO	0.05	NO

⁽¹⁾ Under each of the listed source categories, specify the chemical consumed (e.g. HFC-32) as indicated under category Fire Extinguishers; use one row per chemical.⁽²⁾ ODS: ozone-depleting substances.**Documentation box:**

- Parties should provide detailed explanations on the industrial processes sector in Chapter 4: Industrial processes (CRF sector 2) of the NIR. Use this documentation box to provide references to relevant sections of the NIR if any additional information and/or further details are needed to understand the content of this table.
- Where only aggregate figures for activity data are provided, e.g. due to reasons of confidentiality (see footnote 1 to table 2(II)), a note indicating this should be provided in this documentation box.
- With regard to data on the amounts of fluid that remained in retired products at decommissioning, use this documentation box to provide a reference to the section of the NIR where information on the amount of the chemical recovered (recovery efficiency) and other relevant information used in the emission estimation can be found.
- Parties that estimate their actual emissions following the alternative top-down approach might not be able to report emissions using this table. As indicated in the note to sheet 1 of this table, Parties should in these cases provide, in the NIR, alternative formats for

TABLE 3 SECTORAL REPORT FOR SOLVENT AND OTHER PRODUCT USE

(Sheet 1 of 1)

Inventory 2010

Submission 2012 v1.3

AUSTRIA

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	CO ₂	N ₂ O	NM VOC
	(Gg)		
Total Solvent and Other Product Use	176.89	0.48	74.09
A. Paint Application	55.30		20.80
B. Degreasing and Dry Cleaning	26.91	NA	10.18
C. Chemical Products, Manufacture and Processing	11.86		6.29
D. Other	82.82	0.48	36.82
1. Use of N ₂ O for Anaesthesia		0.08	
2. N ₂ O from Fire Extinguishers		NO	
3. N ₂ O from Aerosol Cans		0.40	
4. Other Use of N ₂ O		NO	
5. Other (<i>as specified in table 3.A-D</i>)	82.82	NA	36.82
Other non-specified	82.82	NA	36.82

Note: The quantity of carbon released in the form of NMVOCs should be accounted for in both the NMVOC and the CO₂ columns. The quantities of NMVOCs should be converted into CO₂ equivalent emissions before being added to the CO₂ amounts in the CO₂ 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 N₂O 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 2010

Submission 2012 v1.3

AUSTRIA

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	ACTIVITY DATA		IMPLIED EMISSION FACTORS ⁽¹⁾	
	Description	(kt)	CO ₂ (t/t)	N ₂ O (t/t)
A. Paint Application	Solvents used [kt]	47.86	1.16	
B. Degreasing and Dry Cleaning	Solvents used [kt]	18.38	1.46	NA
C. Chemical Products, Manufacture and Processing	Solvents used [kt]	12.36	0.96	
D. Other				
1. Use of N ₂ O for Anaesthesia	Use of N ₂ O for Anaesthesia [kt]	0.08		1.00
2. N ₂ O from Fire Extinguishers	N ₂ O from Fire Extinguishers	NO		NO
3. N ₂ O from Aerosol Cans	N ₂ O from Aerosol Cans	NA		NA
4. Other Use of N ₂ O	(specify)	NO		NO
5. Other <i>(please specify)</i> ⁽²⁾				
Other non-specified	Solvents used [kt]	49.81	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 2010

Submission 2012 v1.3

AUSTRIA

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	CH ₄	N ₂ O	NO _x	CO	NMVOC
	(Gg)				
Total Agriculture	171.33	12.43	5.58	0.66	1.78
A. Enteric Fermentation	155.07				
1. Cattle ⁽¹⁾	145.00				
<i>Option A:</i>					
Dairy Cattle	61.78				
Non-Dairy Cattle	83.22				
<i>Option B:</i>					
Mature Dairy Cattle					
Mature Non-Dairy Cattle					
Young Cattle					
2. Buffalo	NO				
3. Sheep	2.87				
4. Goats	0.36				
5. Camels and Llamas	NO				
6. Horses	1.57				
7. Mules and Asses	IE				
8. Swine	4.70				
9. Poultry	0.25				
10. Other (as specified in table 4.A)	0.33				
Deer	0.33				
B. Manure Management	15.75	2.99			NA,NO
1. Cattle ⁽¹⁾	10.90				
<i>Option A:</i>					
Dairy Cattle	4.79				
Non-Dairy Cattle	6.11				
<i>Option B:</i>					
Mature Dairy Cattle					
Mature Non-Dairy Cattle					
Young Cattle					
2. Buffalo	NO				
3. Sheep	0.07				
4. Goats	0.01				
5. Camels and Llamas	NO				
6. Horses	0.11				
7. Mules and Asses	IE				
8. Swine	3.68				
9. Poultry	0.97				
10. Other livestock (as specified in table 4.B(a))	0.01				
Deer	0.01				

Note: All footnotes for this table are given at the end of the table on sheet 2.

TABLE 4 SECTORAL REPORT FOR AGRICULTURE
(Sheet 2 of 2)

Inventory 2010
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GREENHOUSE GAS SOURCE AND SINK CATEGORIES	CH ₄	N ₂ O	NO _x	CO	NM VOC
	(Gg)				
B. Manure Management (continued)					
11. Anaerobic Lagoons		NO			NO
12. Liquid Systems		0.09			NA
13. Solid Storage and Dry Lot		2.20			NA
14. Other AWMS		0.70			NA
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⁾	0.46	9.45			1.68
1. Direct Soil Emissions	0.46	5.61			1.68
2. Pasture, Range and Paddock Manure ⁽³⁾		0.31			NA
3. Indirect Emissions	NA	3.53			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	0.04	0.00	0.02	0.66	0.10
1. Cereals	0.02	0.00	0.02	0.45	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		0.00	0.00	0.21	0.05
G. Other (please specify)	NA	NA	5.56	NA	NA
NOX from livestock and fertilizers	NA	NA	5.56	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 CO₂ 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 CO₂ estimates.

⁽³⁾ Direct N₂O emissions from pasture, range and paddock manure are to be reported in the "4.D Agricultural Soils" category. All other N₂O 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 CH₄ emissions and CH₄ and N₂O removals from agricultural soils, or CO₂ 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: Usage of "NO" notation keys in table 1.A(a)s1 to s4 : Energy statistics does not inquire all consumers but is limited to statistical samples. In the case that a statistical inquiry results in zero consumption of a specific sector and fuel group it is not always possible to decide if there occurs a consumption of a specific fuel category in a specific sector and year. However, as the energy statistics is based on a top down/bottom up approach it is assured that total national fuel consumption is equivalent to category 1A fuel consumption. Thus "NO" may be sometimes interpreted as "included elsewhere".

4.B Swine/2010: In the calculation of 4.B.8 emissions the piglet number is not considered, because the emission factor of breeding sows already considers emissions from piglets. However, for reasons of consistency with CRF category "4.A.8 Swine", the activity data of CRF category "4.B.8 Swine" includes piglet number.

TABLE 4.A SECTORAL BACKGROUND DATA FOR AGRICULTURE

Enteric Fermentation
(Sheet 1 of 1)

Inventory 2010
Submission 2012 v1.3
AUSTRIA

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	ACTIVITY DATA AND OTHER RELATED INFORMATION			IMPLIED EMISSION FACTORS (3)
	Population size ⁽¹⁾ (1000s)	Average gross energy intake (MJ/head/day)	Average CH ₄ conversion rate (Y _m) (%)	CH ₄ (kg CH ₄ /head/yr)
1. Cattle	2 013.28			72.02
Option A:				
Dairy Cattle ⁽⁴⁾	532.74	294.69	6.00	115.97
Non-Dairy Cattle	1 480.55	142.83	6.00	56.21
Option B:				
Mature Dairy Cattle				
Mature Non-Dairy Cattle				
Young Cattle				
2. Buffalo	NO	NO	NO	NO
3. Sheep	358.42	20.00	6.00	8.00
4. Goats	71.77	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	3 134.16	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)		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
Indicators:																
Weight	(kg)	700.00	425.35					NO	NA	NA	NO	NA	NA	NA	NA	NA
Feeding situation ^(c)	Stall/Pasture	Stall/Pasture						NO	NA	NA	NO	NA	NA	NA	NA	NA
Milk yield	(kg/day)	16.71	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	15.86	0.00	0.00	0.00		NO	NA	NA	NO	NA	NA	NA	NA	NA
Digestibility of feed	(%)	70.12	72.98	0.00	0.00	0.00	NO	NA	NA	NO	NA	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

CH₄ Emissions from Manure Management

(Sheet 1 of 2)

Inventory 2010

Submission 2012 v1.3

AUSTRIA

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	ACTIVITY DATA AND OTHER RELATED INFORMATION							IMPLIED EMISSION FACTORS ⁽⁴⁾
	Population size (1000s)	Allocation by climate region ⁽¹⁾			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)	
		Cool	Temperate	Warm				
								(%)
1. Cattle	2 013.28							5.41
Option A:								
Dairy Cattle ⁽³⁾	532.74	100.00	NO	NO	700.00	4.25	0.24	9.00
Non-Dairy Cattle	1 480.55	100.00	NO	NO	425.35	1.95	0.17	4.13
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	358.42	100.00	NO	NO	43.00	0.40	0.19	0.19
4. Goats	71.77	100.00	NO	NO	30.00	0.28	0.17	0.12
5. Camels and Llamas	NO	NO	NO	NO	NO	NO	NO	NO
6. Horses	87.07	100.00	NO	NO	238.00	1.72	0.33	1.28
7. Mules and Asses	IE	IE	NO	NO	IE	IE	IE	IE
8. Swine	3 134.16	100.00	NO	NO	82.00	0.27	0.45	1.18
9. Poultry	13 027.15	100.00	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:
 - 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.
 - parameters relevant to the application of IPCC good practice guidance;
 - information on how the MCFs are derived, if relevant data could not be provided in the additional information box.

4.B Swine: Usage of "NO" notation keys in table 1.A(a)s1 to s4 : Energy statistics does not inquire all consumers but is limited to statistical samples. In the case that a statistical inquiry results in zero consumption of a specific sector and fuel group it is not always possible to decide if there occurs a consumption of a specific fuel category in a specific sector and year. However, as the energy statistics is based on a top down/bottom up approach it is assured that total national fuel consumption is equivalent to category 1A fuel consumption. Thus "NO" may be sometimes interpreted as "included elsewhere".

4.B Swine/2010: In the calculation of 4.B.8 emissions the piglet number is not considered, because the emission factor of breeding sows already considers emissions from piglets. However, for reasons of consistency with CRF category "4.A.8 Swine", the activity data of CRF category "4.B.8 Swine" includes piglet number.

TABLE 4.B(a) SECTORAL BACKGROUND DATA FOR AGRICULTURE
CH₄ Emissions from Manure Management
(Sheet 2 of 2)

Inventory 2010
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Additional information (for Tier 2)^(a)

Animal category	Indicator	Climate region	Animal waste management system						
			Anaerobic lagoon	Liquid system	Daily spread	Solid storage	Dry lot	Pasture range paddock	Other
Dairy Cattle	Allocation (%)	Cool	0.00	31.95	0.00	49.09	NO	2.91	16.05
		Temperate	NO	NO	NO	NO	NO	NO	NO
		Warm	NO	NO	NO	NO	NO	NO	NO
	MCF ^(b)	Cool	NA	8.71	NA	1.00	NO	1.00	1.90
		Temperate	NO	NO	NO	NO	NO	NO	NO
		Warm	NO	NO	NO	NO	NO	NO	NO
Non-Dairy Cattle	Allocation (%)	Cool	0.00	22.90	0.00	44.26	NO	4.80	28.04
		Temperate	NO	NO	NO	NO	NO	NO	NO
		Warm	NO	NO	NO	NO	NO	NO	NO
	MCF ^(b)	Cool	NA	8.44	NA	1.00	NO	1.00	10.05
		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	80.58	0.00	4.07	NO	0.00	15.35
		Temperate	NO	NO	NO	NO	NO	NO	NO
		Warm	NO	NO	NO	NO	NO	NO	NO
	MCF ^(b)	Cool	NA	3.39	NA	1.00	NO	1.00	9.44
		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

	MCF ^(b)	Warm	NA	NA	NA	NA	NA	NA	NA
		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
N₂O Emissions from Manure Management
(Sheet 1 of 1)

Inventory 2010
Submission 2012 v1.3
AUSTRIA

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	ACTIVITY DATA AND OTHER RELATED INFORMATION								IMPLIED EMISSION FACTORS ⁽¹⁾	
	Population size (1000s)	Nitrogen excretion (kg N/head/yr)	Nitrogen excretion per animal waste management system (AWMS) (kg N/yr)						Emission factor per animal waste management system	
			Anaerobic lagoon	Liquid system	Daily spread	Solid storage and dry lot	Pasture range and	Other	(kg N ₂ O-N/kg N)	
Cattle	2 013.28		NO	33 410 317.72	NO	55 145 572.53	5 892 276.52	26 530 443.43	Anaerobic lagoon	NO
<i>Option A:</i>									Liquid system	0.00
Dairy Cattle	532.74	97.40	NO	16 577 549.17	NO	25 472 774.90	1 509 952.12	8 328 112.81	Solid storage and dry lot	0.02
Non-Dairy Cattle	1 480.55	46.67	NO	16 832 768.55	NO	29 672 797.63	4 382 324.40	18 202 330.62	Other AWMS	0.01
<i>Option B:</i>										
Mature Dairy Cattle										
Mature Non-Dairy Cattle										
Young Cattle										
Sheep	358.42	13.10	NO	NO	NO	2 347 618.25	2 347 618.25	NO		
Swine	3 134.16	9.50	NO	22 424 147.37	NO	2 148 488.63	NO	5 186 579.00		
Poultry	13 027.15	0.55	NO	251 374.11	NO	6 585 992.46	NO	326 965.29		
Buffalo	NO	NO	NO	NO	NO	NO	NO	NO		
Goats	71.77	12.30	NO	NO	NO	441 373.20	441 373.20	NO		
Camels and Llamas	NO	NO	NO	NO	NO	NO	NO	NO		
Horses	87.07	47.90	NO	NO	NO	2 987 940.20	834 149.76	348 658.84		
Mules and Asses	IE	IE	IE	IE	IE	IE	IE	IE		
Other livestock (<i>please specify</i>)										
Deer	41.19	13.10	NO	NO	NO	269 794.50	269 794.50	NO		
Total per AWMS			IE,NO	56 085 839.20	IE,NO	69 926 779.77	9 785 212.23	32 392 646.56		

⁽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:Usage of "NO" notation keys in table 1.A(a)s1 to s4 : Energy statistics does not inquire all consumers but is limited to statistical samples. In the case that a statistical inquiry results in zero consumption of a specific sector

4.B Swine/2010:In the calculation of 4.B.8 emissions the piglet number is not considered, because the emission factor of breeding sows already considers emissions from piglets. However, for reasons of consistency with CRF category

TABLE 4.C SECTORAL BACKGROUND DATA FOR AGRICULTURE

Rice Cultivation

(Sheet 1 of 1)

Inventory 2010

Submission 2012 v1.3

AUSTRIA

GREENHOUSE GAS SOURCE AND SINK CATEGORIES			ACTIVITY DATA AND OTHER RELATED INFORMATION			IMPLIED EMISSION FACTOR ⁽¹⁾ CH ₄ (g/m ²)	EMISSIONS CH ₄ (Gg)
			Harvested area ⁽²⁾ (10 ⁹ m ² /yr)	Organic amendments added ⁽³⁾			
				type	(t/ha)		
1. Irrigated							NO
Continuously Flooded			NO	(specify type)	NO	NO	NO
Intermittently Flooded	Single Aeration	NO	(specify type)	NO	NO	NO	NO
	Multiple Aeration	NO	(specify type)	NO	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 (<i>please specify</i>)			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 2010

Submission 2012 v1.3

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GREENHOUSE GAS SOURCE AND SINK CATEGORIES	ACTIVITY DATA AND OTHER RELATED INFORMATION		IMPLIED EMISSION FACTORS kg N ₂ O-N/kg N ⁽²⁾	EMISSIONS N ₂ O (Gg)
	Description	Value kg N/yr		
1. Direct Soil Emissions	N input to soils			5.61
1. Synthetic Fertilizers	Nitrogen input from application of synthetic fertilizers	84 811 316.50	0.01	1.67
2. Animal Manure Applied to Soils	Nitrogen input from manure applied to soils	111 889 999.99	0.01	2.20
3. N-fixing Crops	Nitrogen fixed by N-fixing crops	23 224 046.79	0.01	0.46
4. Crop Residue	Nitrogen in crop residues returned to soils	64 038 470.93	0.01	1.26
5. Cultivation of Histosols ⁽²⁾	Area of cultivated organic soils (ha/yr)	NO	NO	NO
6. Other direct emissions (<i>please specify</i>)				0.03
Sewage Sludge Spreading	(specify)	1 453 033.76	0.01	0.03
2. Pasture, Range and Paddock Manure	N excretion on pasture range and paddock	9 785 212.23	0.02	0.31
3. Indirect Emissions				3.53
1. Atmospheric Deposition	Volatized N from fertilizers, animal manures and other	49 389 581.20	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	70 222 807.14	0.02	2.76
4. Other (<i>please specify</i>)				NA

⁽¹⁾ To convert from N₂O-N to N₂O emissions, multiply by 44/28. Note that for cultivation of Histosols the unit of the IEF is kg N₂O-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:
 - Background information on CH₄ emissions from agricultural soils, if accounted for under the Agriculture sector;
 - Disaggregated values for Frac_{GRAZ} according to animal type, and for Frac_{BURN} according to crop types;
 - Full list of assumptions and fractions used.

TABLE 4.D SECTORAL BACKGROUND DATA FOR AGRICULTURE

Inventory 2010

Agricultural Soils⁽¹⁾

Submission 2012 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 NO _x	0.04
Frac _{GASM}	Fraction of livestock N excretion that volatilizes as NH ₃ and NO _x	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 (<i>please specify</i>)		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)

Inventory 2010

Submission 2012 v1.3

AUSTRIA

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	ACTIVITY DATA AND OTHER RELATED INFORMATION					IMPLIED EMISSION FACTORS		EMISSIONS	
	Area of savanna burned	Average above-ground biomass density	Fraction of savanna burned	Biomass burned	Nitrogen fraction in biomass	CH ₄	N ₂ O	CH ₄	N ₂ O
	(k ha/yr)	(t dm/ha)		(Gg dm)		(kg/t dm)		(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 2010

Submission 2012 v1.3

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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 (Gg dm)	C fraction of residue	N-C ratio in biomass residues	CH ₄	N ₂ O	CH ₄	N ₂ O
	(t)								(kg/t dm)		(Gg)	
1. Cereals											0.02	0.00
Wheat	1 517 804.73	1.00	0.86	0.00	0.90	4.10	0.49	0.01	2.91	0.06	0.01	0.00
Barley	777 960.67	1.10	0.86	0.00	0.90	2.31	0.46	0.01	2.74	0.05	0.01	0.00
Maize	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
Oats	97 888.55	1.50	0.86	0.00	0.90	0.40	0.49	0.01	2.91	0.06	0.00	0.00
Rye	161 148.29	1.40	0.86	0.00	0.90	0.61	0.49	0.01	2.91	0.06	0.00	0.00
Rice	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
Other (<i>please specify</i>)											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 (<i>please specify</i>)											NA	NA
3 Tubers and Roots											NA,NO	NA,NO
Potatoes	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
Other (<i>please specify</i>)											NA	NA
4 Sugar Cane	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
5 Other (<i>please specify</i>)											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)

Inventory 2010

Submission 2012 v1.3

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GREENHOUSE GAS SOURCE AND SINK CATEGORIES	Net CO ₂ emissions/removals ^{(1), (2)}	CH ₄ ⁽²⁾	N ₂ O ⁽²⁾	NO _x	CO	NM VOC
	(Gg)					
Total Land-Use Categories	-3 660.75	0.01	0.16	IE,NA,NE	IE,NA,NE	NA,NE
A. Forest Land	-5 411.09	0.01	0.00	NE	NE	NE
1. Forest Land remaining Forest Land	-2 968.01	0.01	0.00	NE	NE	NE
2. Land converted to Forest Land	-2 443.08	NO	NO	NE	NE	NE
B. Cropland	518.20	NA,NO	0.16	IE	IE	NE
1. Cropland remaining Cropland	64.21	NA	NA	IE	IE	NE
2. Land converted to Cropland	453.99	NO	0.16	IE	IE	NE
C. Grassland	280.75	NO	NO	IE	IE	NE
1. Grassland remaining Grassland	-86.18	NO	NO	IE	IE	NE
2. Land converted to Grassland	366.93	NO	NO	IE	IE	NE
D. Wetlands	355.78	NO	NO	NA	NA	NA
1. Wetlands remaining Wetlands ⁽³⁾	NE,NO	NO	NO	NA	NA	NA
2. Land converted to Wetlands	355.78	NO	NO	NA	NA	NA
E. Settlements	248.40	NA,NO	NA,NO	NA	NA	NA
1. Settlements remaining Settlements ⁽³⁾	NE,NO	NA	NA	NA	NA	NA
2. Land converted to Settlements	248.40	NA	NA	NA	NA	NA
F. Other Land	347.22	NA,NO	NA,NO	NA	NA	NA
1. Other Land remaining Other Land ⁽⁴⁾						
2. Land converted to Other Land	347.22	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	1 372.94	NA	0.01	NA	NA	NA
Grassland converted to other Land-Use Categories	-319.15	NO	0.15	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 CO₂ emissions and removals shown in tables 5.A to 5.F, and the CO₂, CH₄ and N₂O 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.

5.B Cropland: Usage of "NO" notation keys in table 1.A(a)s1 to s4 : Energy statistics does not inquire all consumers but is limited to statistical samples. In the case that a statistical inquiry results in zero consumption of a specific sector and fuel group it is not always possible to decide if there occurs a consumption of a specific fuel category in a specific sector and year. However, as the energy statistics is based on a top down/bottom up approach it is assured that total national fuel consumption is equivalent to category 1A fuel consumption. Thus "NO" may be sometimes interpreted as "included elsewhere".

TABLE 5.A SECTORAL BACKGROUND DATA FOR LAND USE, LAND-USE CHANGE AND FORESTRY

Forest Land
(Sheet 1 of 1)

Inventory 2010

Submission 2012 v1.3

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GREENHOUSE GAS SOURCE AND SINK CATEGORIES		ACTIVITY DATA		IMPLIED CARBON-STOCK-CHANGE FACTORS						CHANGES IN CARBON STOCK						Net CO ₂ emissions/ removals ^{(8) (9)}	
Land-Use Category	Sub-division ⁽¹⁾	Area ⁽²⁾ (kha)	Area of organic soil ⁽²⁾ (kha)	Carbon stock change in living biomass per area ^{(3) (4)}			Net carbon stock change in dead organic matter per area ⁽⁴⁾	Net carbon stock change in soils per area ⁽⁴⁾		Carbon stock change in living biomass ^{(3) (4)}			Net carbon stock change in dead organic matter ⁽⁴⁾	Net carbon stock change in soils ^{(4) (6)}			
				Gains	Losses	Net change		Mineral soils ⁽⁵⁾	Organic soils	Gains	Losses	Net change		Mineral soils	Organic soils ⁽⁷⁾		
				(Mg C/ha)						(Gg C)							(Gg)
A. Total Forest Land		3 999.86	NA,NO	2.41	-2.03	0.38	0.13	-0.14	NO	9 658.69	-8 133.71	1 524.98	508.55	-557.78	NO	-5 411.09	
1. Forest Land remaining Forest Land		3 780.84	NA,NO	2.49	-2.14	0.34	0.06	-0.19	NO	9 401.13	-8 105.64	1 295.49	230.26	-716.29	NO	-2 968.01	
		Coniferous	2 557.14	NA	2.64	-2.50	0.14	0.07	-0.28	NO	6 749.86	-6 381.87	367.99	172.69	-716.29	NO	643.90
		Deciduous	984.60	NA	2.69	-1.75	0.94	0.06	IE	NO	2 651.27	-1 723.77	927.50	57.57	IE	NO	-3 611.91
		Forest not in yield	239.10	NO	NA	NA	NA	NO	NO	NA	NA	NA	NA	NO	NO	NA,NO	
2. Land converted to Forest Land ⁽¹⁰⁾		219.02	NO	1.18	-0.13	1.05	1.27	0.72	NO	257.56	-28.07	229.49	278.29	158.51	NO	-2 443.08	
2.1 Cropland converted to Forest Land		31.88	NO	1.18	IE	1.18	1.26	0.98	NO	37.50	IE	37.50	40.12	31.24	NO	-399.12	
		Total	31.88	NO	1.18	IE	1.18	1.26	0.98	NO	37.50	IE	37.50	40.12	31.24	NO	-399.12
2.2 Grassland converted to Forest Land		129.10	NO	1.18	IE	1.18	1.27	-0.48	NO	151.82	IE	151.82	164.60	-62.41	NO	-931.39	
		Total	129.10	NO	1.18	IE	1.18	1.27	-0.48	NO	151.82	IE	151.82	164.60	-62.41	NO	-931.39
2.3 Wetlands converted to Forest Land		9.39	NO	1.18	IE	1.18	1.55	6.31	NO	11.04	IE	11.04	14.57	59.23	NO	-311.07	
		Total	9.39	NO	1.18	IE	1.18	1.55	6.31	NO	11.04	IE	11.04	14.57	59.23	NO	-311.07
2.4 Settlements converted to Forest Land		25.58	NO	1.18	-1.10	0.08	1.21	2.20	NO	30.08	-28.07	2.01	30.99	56.18	NO	-327.00	
		Total	25.58	NO	1.18	-1.10	0.08	1.21	2.20	NO	30.08	-28.07	2.01	30.99	56.18	NO	-327.00
2.5 Other Land converted to Forest Land		23.07	NO	1.18	IE	1.18	1.21	3.22	NO	27.13	IE	27.13	28.01	74.27	NO	-474.51	
		Total	23.07	NO	1.18	IE	1.18	1.21	3.22	NO	27.13	IE	27.13	28.01	74.27	NO	-474.51

⁽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 CO₂ 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 (+). 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 2010

Submission 2012 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			1 434.41	NO	0.14	-0.17	-0.04	-0.01	-0.03	NO	194.84	-250.32	-55.48	-17.10	-44.74	NO	430.18
1. Cropland remaining Cropland			1 332.95	NO	0.12	-0.16	-0.04	NO	0.04	NO	156.49	-207.10	-50.61	NO	57.11	NO	-23.81
		Annual converted to cropland	15.82	NO	2.10	-0.39	1.71	NO	0.35	NO	33.22	-6.19	27.03	NO	5.54	NO	-119.40
		Annual remaining in cropland	1 304.24	NO	0.09	-0.11	-0.02	NO	0.04	NO	116.96	-141.29	-24.33	NO	56.08	NO	-116.42
		Perennial converted to cropland	12.89	NO	0.49	-4.63	-4.14	NO	-0.35	NO	6.31	-59.62	-53.31	NO	-4.51	NO	212.00
2. Land converted to Cropland ⁽¹²⁾			101.46	NO	0.38	-0.43	-0.05	-0.17	-1.00	NO	38.35	-43.22	-4.87	-17.10	-101.84	NO	453.99
2.1 Forest Land converted to Cropland			8.67	NO	IE	-1.54	-1.54	-1.97	-1.12	NO	IE	-13.36	-13.36	-17.10	-9.74	NO	147.44
		Total	8.67	NO	IE	-1.54	-1.54	-1.97	-1.12	NO	IE	-13.36	-13.36	-17.10	-9.74	NO	147.44
2.2 Grassland converted to Cropland			92.79	NO	0.41	-0.32	0.09	NO	-0.99	NO	38.35	-29.86	8.49	NO	-92.10	NO	306.55
		Grassland converted to cropland	90.82	NO	0.38	-0.32	0.06	NO	-1.00	NO	34.23	-29.23	5.01	NO	-90.82	NO	314.67
		Grassland converted to cropland	1.96	NO	2.10	-0.32	1.78	NO	-0.65	NO	4.12	-0.63	3.49	NO	-1.28	NO	-8.12
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 CO₂ 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 (+). Note that carbon stock changes in a single pool are not necessarily equal to emissions or removals, because some carbon stock changes result from carbon transfers among pools rather than exchanges with the atmosphere.

⁽¹¹⁾ Where Parties directly estimate emissions and removals rather than carbon stock changes, they may report emissions/removals directly in this column and use notation keys in the stock change columns.

⁽¹²⁾ A Party may report aggregate estimates for all land conversions to cropland, when data are not available to report them separately. A Party should specify in the documentation box which types of land conversion are included. Separate estimates for forest land and grassland conversion should be provided in table 5 as an information item.

Documentation box:

Parties should provide detailed explanations on the Land Use, Land-Use Change and Forestry sector in Chapter 7: Land Use, Land-Use Change and Forestry (CRF sector 5) of the NIR. Use this documentation box to provide references to relevant sections of the NIR if any additional information and/or further details are needed to understand the content of this table.

TABLE 5.C SECTORAL BACKGROUND DATA FOR LAND USE, LAND-USE CHANGE AND FORESTRY

Inventory 2010

Grassland

Submission 2012 v1.3

(Sheet 1 of 1)

AUSTRIA

GREENHOUSE GAS SOURCE AND SINK CATEGORIES		ACTIVITY DATA		IMPLIED CARBON-STOCK-CHANGE FACTORS						CHANGES IN CARBON STOCK						Net CO ₂ emissions/ removals ⁽¹⁰⁾ (11)
Land-Use Category	Sub-division ⁽¹⁾	Area ⁽²⁾ (kha)	Area of organic soil ⁽²⁾ (kha)	Carbon stock change in living biomass per area ^{(3) (4)}			Net carbon stock change in dead organic matter per area ⁽⁴⁾	Net carbon stock change in soils per area ⁽⁴⁾		Carbon stock change in living biomass ^{(3), (4), (6)}			Net carbon stock change in dead organic matter ^{(4) (7)}	Net carbon stock change in soils ^{(4) (8)}		
				Gains	Losses	Net change		Mineral soils ⁽⁵⁾	Organic soils	Gains	Losses	Net change		Mineral soils	Organic soils ⁽⁹⁾	
				(Mg C/ha)						(Gg C)						
C. Total Grassland		1 796.17	IE,NO	0.01	-0.05	-0.04	-0.05	0.05	IE,NO	10.91	-86.46	-75.55	-86.30	85.28	IE,NO	280.7
1. Grassland remaining Grassland		1 710.93	IE	NO	NO	NO	NO	0.01	IE	NO	NO	NO	NO	23.50	IE	-86.1
Total		1 710.93	IE	NO	NO	NO	NO	0.01	IE	NO	NO	NO	NO	23.50	IE	-86.1
2. Land converted to Grassland ⁽¹²⁾		85.24	NO	0.13	-1.01	-0.89	-1.01	0.72	NO	10.91	-86.46	-75.55	-86.30	61.78	NO	366.9
2.1 Forest Land converted to Grassland		61.71	NO	IE	-1.18	-1.18	-1.40	0.62	NO	IE	-72.76	-72.76	-86.30	38.32	NO	442.7
Total		61.71	NO	IE	-1.18	-1.18	-1.40	0.62	NO	IE	-72.76	-72.76	-86.30	38.32	NO	442.7
2.2 Cropland converted to Grassland		23.53	NO	0.46	-0.58	-0.12	NO	1.00	NO	10.91	-13.71	-2.80	NO	23.46	NO	-75.7
Annual cropland converted to Grassland		23.33	NO	0.46	-0.54	-0.08	NO	1.00	NO	10.82	-12.67	-1.85	NO	23.33	NO	-78.7
Perennial cropland converted to Grassland		0.20	NO	0.46	-5.13	-4.67	NO	0.65	NO	0.09	-1.04	-0.94	NO	0.13	NO	2.9
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 CO₂ 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 (+). Note that carbon stock changes in a single pool are not necessarily equal to emissions or removals, because some carbon stock changes result from carbon transfers among pools rather than exchanges with the atmosphere.

⁽¹¹⁾ Where Parties directly estimate emissions and removals rather than carbon stock changes, they may report emissions/removals directly in this column and use notation keys in the stock change columns.

⁽¹²⁾ A Party may report aggregate estimates for all land conversions to grassland, when data are not available to report them separately. A Party should specify in the documentation box which types of land conversion are included. Separate estimates for forest land conversion should be provided in table 5 as an information item.

Documentation box:

Parties should provide detailed explanations on the Land Use, Land-Use Change and Forestry sector in Chapter 7: Land Use, Land-Use Change and Forestry (CRF sector 5) of the NIR. Use this documentation box to provide references to relevant sections of the NIR if any additional information and/or further details are needed to understand the content of this table.

TABLE 5.D SECTORAL BACKGROUND DATA FOR LAND USE, LAND-USE CHANGE AND FORESTRY
Wetlands

(Sheet 1 of 1)

Inventory 2010

Submission 2012 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 ^{(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)			
D. Total Wetlands		146.12	IE,NE,NO	-0.08	-0.08	-0.03	-0.56	IE,NE,NO	-11.29	-11.29	-3.70	-82.04	355.78
1. Wetlands remaining Wetlands ⁽⁷⁾		123.68	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE
	Total	123.68	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE
2. Land converted to Wetlands ⁽⁸⁾		22.44	IE,NO	-0.50	-0.50	-0.16	-3.66	IE,NO	-11.29	-11.29	-3.70	-82.04	355.78
2.1 Forest Land converted to Wetlands		3.36	IE	-1.25	-1.25	-1.10	-4.54	IE	-4.21	-4.21	-3.70	-15.24	84.87
	Total	3.36	IE	-1.25	-1.25	-1.10	-4.54	IE	-4.21	-4.21	-3.70	-15.24	84.87
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		19.09	NO	-0.37	-0.37	NO	-3.50	NO	-7.08	-7.08	NO	-66.80	270.91
	Total	19.09	NO	-0.37	-0.37	NO	-3.50	NO	-7.08	-7.08	NO	-66.80	270.91
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		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 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 CO₂ by multiplying C by 44/12 and changing the sign for net CQ removals to be negative (-) and for net CO₂ 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:

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TABLE 5.E SECTORAL BACKGROUND DATA FOR LAND USE, LAND-USE CHANGE AND FORESTRY
Settlements
(Sheet 1 of 1)

Inventory 2010

Submission 2012 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 ^{(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)					
E. Total Settlements		529.19	0.21	-0.16	0.06	-0.05	-0.14	113.23	-82.68	30.55	-26.80	-71.50	248.40
1. Settlements remaining Settlements ⁽⁸⁾		358.11	NE	NE	NE	NO	NE	NE	NE	NE	NO	NE	NE,NO
	Total	358.11	NE	NE	NE	NO	NE	NE	NE	NE	NO	NE	NE,NO
2. Land converted to Settlements ⁽⁹⁾		171.08	0.66	-0.48	0.18	-0.16	-0.42	113.23	-82.68	30.55	-26.80	-71.50	248.40
2.1 Forest Land converted to Settlements		19.05	0.58	-1.21	-0.63	-1.41	-3.04	11.09	-23.01	-11.92	-26.80	-57.86	354.11
	Total	19.05	0.58	-1.21	-0.63	-1.41	-3.04	11.09	-23.01	-11.92	-26.80	-57.86	354.11
2.2 Cropland converted to Settlements		138.38	0.67	-0.40	0.27	NO	NO	93.17	-55.78	37.39	NO	NO	-137.09
	Total	138.38	0.67	-0.40	0.27	NO	NO	93.17	-55.78	37.39	NO	NO	-137.09
2.3 Grassland converted to Settlements		13.64	0.66	-0.28	0.37	NO	-1.00	8.97	-3.89	5.09	NO	-13.64	31.38
	Total	13.64	0.66	-0.28	0.37	NO	-1.00	8.97	-3.89	5.09	NO	-13.64	31.38
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		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 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 CO₂ by multiplying C by 44/12 and changing the sign for net CQ removals to be negative (-) and for net CO₂ emissions to be positive (+). Note that carbon stock changes in a single pool are not necessarily equal to emissions or removals, because some carbon stock changes result from carbon transfers among pools rather than exchanges with the atmosphere.

⁽⁷⁾ Where Parties directly estimate emissions and removals rather than carbon stock changes, they may report emissions/removals directly in this column and use notation keys in the stock change columns.

⁽⁸⁾ Parties may decide not to prepare estimates for this category contained in appendix 3a.4 of the IPCC good practice guidance for LULUCF, although they may do so if they wish.

⁽⁹⁾ A Party may report aggregate estimates for all land conversions to settlements, when data are not available to report them separately. A Party should specify in the documentation box which types of land conversion are included. Separate estimates for forest land and grassland conversion should be provided in table 5 as an information item.

Documentation box:

Parties should provide detailed explanations on the Land Use, Land-Use Change and Forestry sector in Chapter 7: Land Use, Land-Use Change and Forestry (CRF sector 5) of the NIR. Use this documentation box to provide references to relevant sections of the NIR if any additional information and/or further details are needed to understand the content of this table.

TABLE 5.F SECTORAL BACKGROUND DATA FOR LAND USE, LAND-USE CHANGE AND FORESTRY

Other land

(Sheet 1 of 1)

Inventory 2010

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GREENHOUSE GAS SOURCE AND SINK CATEGORIES		ACTIVITY DATA	IMPLIED CARBON-STOCK-CHANGE FACTORS					CHANGES IN CARBON STOCK					Net CO ₂ emissions/ removals ^{(5) (6)}
Land-Use Category	Sub-division ⁽¹⁾	Area ⁽²⁾ (kha)	Carbon stock change in living biomass per area ^{(3) (4)}			Net carbon stock change in dead organic matter per area ⁽⁴⁾	Net carbon stock change in soils per area ⁽⁴⁾	Carbon stock change in living biomass ^{(3) (4)}			Net carbon stock change in dead organic matter ⁽⁴⁾	Net carbon stock change in soils ⁽⁴⁾	
			Gains	Losses	Net change			Gains	Losses	Net change			
			(Mg C/ha)					(Gg C)					
F. Total Other Land		481.25	0.01	-0.04	-0.03	-0.03	-0.14	4.08	-18.77	-14.69	-14.12	-65.88	347.22
1. Other Land remaining Other Land ⁽⁷⁾		438.27											
2. Land converted to Other Land ⁽⁸⁾		42.99	0.09	-0.44	-0.34	-0.33	-1.53	4.08	-18.77	-14.69	-14.12	-65.88	347.22
2.1 Forest Land converted to Other Land		20.51	IE	-0.60	-0.60	-0.69	-3.28	IE	-12.37	-12.37	-14.12	-67.28	343.82
	Total	20.51	IE	-0.60	-0.60	-0.69	-3.28	IE	-12.37	-12.37	-14.12	-67.28	343.82
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		22.48	0.18	-0.28	-0.10	NO	0.06	4.08	-6.40	-2.32	NO	1.39	3.40
	Total	22.48	0.18	-0.28	-0.10	NO	0.06	4.08	-6.40	-2.32	NO	1.39	3.40
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 CO₂ by multiplying C by 44/12 and changing the sign for net CQ removals to be negative (-) and for net CO₂ emissions to be positive (+). Note that carbon stock changes in a single pool are not necessarily equal to emissions or removals, because some carbon stock changes result from carbon transfers among pools rather than exchanges with the atmosphere.

⁽⁶⁾ Where Parties directly estimate emissions and removals rather than carbon stock changes, they may report emissions/removals directly in this column and use notation keys in the stock change columns.

⁽⁷⁾ This land-use category is to allow the total of identified land area to match the national area.

⁽⁸⁾ A Party may report aggregate estimates for all land conversions to other land, when data are not available to report them separately. A Party should specify in the documentation box which types of land conversion are included. Separate estimates for forest land and grassland conversion should be provided in table 5 as an information item.

Documentation box:

Parties should provide detailed explanations on the Land Use, Land-Use Change and Forestry sector in Chapter 7: Land Use, Land-Use Change and Forestry (CRF sector 5) of the NIR. Use this documentation box to provide references to relevant sections of the NIR if any additional information and/or further details are needed to understand the content of this table.

TABLE 5 (I) SECTORAL BACKGROUND DATA FOR LAND USE, LAND-USE CHANGE AND FORESTRY

Inventory 2010

Direct N₂O emissions from N fertilization⁽¹⁾ of Forest Land and Other

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GREENHOUSE GAS SOURCE AND SINK CATEGORIES	ACTIVITY DATA	IMPLIED EMISSION FACTORS	EMISSIONS ⁽⁴⁾
Land-Use Category ⁽²⁾	Total amount of fertilizer applied	N ₂ O-N emissions per unit of fertilizer	N ₂ O
	(Gg N/yr)	(kg N ₂ O-N/kg N) ⁽³⁾	(Gg)
Total for all Land Use Categories	NO	NA,NO	NA,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)			NA

⁽¹⁾ Direct N₂O 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⁾ N₂O 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, N₂O emissions are converted to N₂O-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 N₂O 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 separately.

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-CO₂ emissions from drainage of soils and wetlands⁽¹⁾

(Sheet 1 of 1)

Inventory 2010

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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 ₂ O-N per area ⁽⁴⁾ (kg N ₂ O-N/ha)	CH ₄ per area (kg CH ₄ /ha)	N ₂ O	CH ₄
					(Gg)	
Total all Land-Use Categories					NA,NO	NA,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)					NA	NA

⁽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⁾ N₂O 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 different

⁽⁴⁾ In the calculation of the implied emission factor, N₂O emissions are converted to N₂O-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 2010

N₂O emissions from disturbance associated with land-use conversion to cropland ⁽¹⁾

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(Sheet 1 of 1)

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GREENHOUSE GAS SOURCE AND SINK CATEGORIES	ACTIVITY DATA	IMPLIED EMISSION FACTORS	EMISSIONS ⁽⁴⁾
Land-Use Category ⁽²⁾	Land area converted	N ₂ O-N emissions per area converted ⁽³⁾	N ₂ O
	(kha)	(kg N ₂ O-N/ha)	(Gg)
Total all Land-Use Categories ⁽⁵⁾	101.46	1.01	0.16
B. Cropland	101.46	1.01	0.16
2. Lands converted to Cropland ⁽⁶⁾	101.46	1.01	0.16
Organic Soils	NO	NO	NO
Mineral Soils	101.46	1.01	0.16
2.1 Forest Land converted to Cropland	8.67	0.74	0.01
Organic Soils	NO	NO	NO
Mineral Soils	8.67	0.74	0.01
2.2 Grassland converted to Cropland	92.79	1.03	0.15
Organic Soils	NO	NO	NO
Mineral Soils	92.79	1.03	0.15
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 N₂O 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. NO 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, N₂O emissions from disturbance of soils are only relevant for land conversions to cropland. NO 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, N₂O emissions are converted to N₂O-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 include

⁽⁷⁾ Parties should avoid double counting with N₂O emissions from drainage and from cultivation of organic soils reported in Agriculture under Cultivation of Histosols

Documentation box:

Parties should provide detailed explanations on the Land Use, Land-Use Change and Forestry sector in Chapter 7: Land Use, Land-Use Change and Forestry (CRF Sector 5) of the NIR. Use this documentation box to provide references to relevant sections of the NIR if any additional information and/or further details are needed to understand the content of this table.

TABLE 5 (IV) SECTORAL BACKGROUND DATA FOR LAND USE, LAND-USE CHANGE AND FORESTRY

Inventory 2010

CO₂ emissions from agricultural lime application ⁽¹⁾

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GREENHOUSE GAS SOURCE AND SINK CATEGORIES	ACTIVITY DATA	IMPLIED EMISSION FACTORS	EMISSIONS ⁽³⁾
Land-Use Category	Total amount of lime applied (Mg/yr)	CO ₂ -C per unit of lime ⁽²⁾ (Mg CO ₂ -C /Mg)	CO ₂ (Gg)
Total all Land-Use Categories ^{(4), (5), (6)}	200 039.08	0.12	88.02
B. Cropland ^{(6) (7)}	200 039.08	0.12	88.02
Limestone CaCO ₃	200 039.08	0.12	88.02
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)}			NA

⁽¹⁾ CO₂ 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 facilitate 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 category.

⁽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 CO₂ emissions will be added to 5.B.1 Cropland remaining Cropland.

⁽⁸⁾ In table 5, these CO₂ 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 2010

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 ₂ O	CO ₂ ⁽⁴⁾	CH ₄	N ₂ O
Land-Use Category ⁽²⁾		(ha or kg dm)		(Mg/activity data unit)			(Gg)		
Total for Land-Use Categories	Area burned	ha	49.00	IE,NA,NO	0.14	0.00	IE,NA,NO	0.01	0.00
A. Forest Land	Area burned	ha	49.00	IE,NO	0.14	0.00	IE,NO	0.01	0.00
1. Forest land remaining Forest Land	Area burned	ha	49.00	IE,NO	0.14	0.00	IE,NO	0.01	0.00
Controlled Burning	Area burned	ha	NO	NO	NO	NO	NO	NO	NO
Wildfires	Area burned	ha	49.00	IE	0.14	0.00	IE	0.01	0.00
2. Land converted to Forest Land	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
B. Cropland	Area burned	ha	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO
1. Cropland remaining Cropland ⁽⁶⁾	Area burned	ha	NA	NA	NA	NA	NA	NA	NA
Controlled Burning	Area burned	ha	NA	NA	NA	NA	NA	NA	NA
Wildfires	Area burned	ha	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⁾	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. 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⁾	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. 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⁾	Area burned	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 CO₂ emissions from biomass burning are not already included in tables 5.A - 5.F, they should be reported here. This should be clearly documented in the documentation box and in the NIR. Double counting should be avoided. Parties that include all carbon stock changes in the carbon stock tables (5.A, 5.B, 5.C, 5.D, 5.E and 5.F), should report IE (included elsewhere) in this column.
- ⁽⁵⁾ Emissions are reported with a positive sign.
- ⁽⁶⁾ In-situ above-ground woody biomass burning is reported here. Agricultural residue burning is reported in the Agriculture sector.
- ⁽⁷⁾ Includes only emissions from controlled biomass burning on grasslands outside the tropics (prescribed savanna burning is reported under the Agriculture sector).
- ⁽⁸⁾ Parties may decide not to prepare estimates for these categories contained in appendices 3a.2, 3a.3 and 3a.4 of the IPCC good practice guidance for LULUCF, although they may do so if they wish.
- ⁽⁹⁾ This land-use category is to allow the total of identified land area to match the national area.

Documentation box:
Parties should provide detailed explanations on the Land Use, Land-Use Change and Forestry sector in Chapter 7: Land Use, Land-Use Change and Forestry (CRF sector 5) of the NIR. Use this documentation box to provide references to relevant sections of the NIR if any additional information and/or further details are needed to understand the content of this table.

TABLE 6 SECTORAL REPORT FOR WASTE
(Sheet 1 of 1)

Inventory 2010

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GREENHOUSE GAS SOURCE AND SINK CATEGORIES	CO ₂ ⁽¹⁾	CH ₄	N ₂ O	NO _x	CO	NMVOC	SO ₂
	(Gg)						
Total Waste	2.03	68.13	1.20	0.01	4.54	0.06	0.01
A. Solid Waste Disposal on Land	NA,NO	64.29		NA,NO	4.53	0.06	
1. Managed Waste Disposal on Land	NA	64.29		NA	4.53	0.06	
2. Unmanaged Waste Disposal Sites	NO	NO		NO	NO	NO	
3. Other (<i>as specified in table 6.A</i>)	NA	NA		NA	NA	NA	
B. Waste Water Handling		1.30	0.85	NA	NA	NA	
1. Industrial Wastewater		NA	0.18	NA	NA	NA	
2. Domestic and Commercial Waste Water		1.30	0.67	NA	NA	NA	
3. Other (<i>as specified in table 6.B</i>)		NA	NA	NA	NA	NA	
C. Waste Incineration	2.03	0.00	0.00	0.01	0.01	0.00	0.01
D. Other (<i>please specify</i>)	NA	2.54	0.35	NA	NA	NA	NA
Compost production	NA	2.54	0.35	NA	NA	NA	NA

⁽¹⁾ CO₂ emissions from source categories Solid waste disposal on land and Waste incineration should only be included if they derive from non-biological or inorganic waste sources.

Documentation box:

- Parties should provide detailed explanations on the waste sector in Chapter 8: Waste (CRF sector 6) of the NIR. Use this documentation box to provide references to relevant sections of the NIR if any additional information and/or further details are needed to understand the content of this table.
- If estimates are reported under "6.D Other", use this documentation box to provide information regarding activities covered under this category and to provide reference to the section in the NIR where background information can be found.

TABLE 6.A SECTORAL BACKGROUND DATA FOR WASTE
Solid Waste Disposal

(Sheet 1 of 1)

Inventory 2010

Submission 2012 v1.3

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GREENHOUSE GAS SOURCE AND SINK CATEGORIES	ACTIVITY DATA AND OTHER RELATED INFORMATION			IMPLIED EMISSION FACTOR		EMISSIONS		
	Annual MSW at the SWDS	MCF	DOC degraded	CH ₄ ⁽¹⁾	CO ₂	CH ₄		CO ₂ ⁽⁴⁾
						Emissions ⁽²⁾	Recovery ⁽³⁾	
				(Gg)	%	(t / t MSW)	(Gg)	
1 Managed Waste Disposal on Land	244.79	1.00	0.16	0.31	NA	64.29	10.88	NA
2 Unmanaged Waste Disposal Sites	NO	NO	NO	NO	NO	NO	NO	NA
a. Deep (>5 m)	NO	NO	NO	NO	NO	NO	NO	NA
b. Shallow (<5 m)	NO	NO	NO	NO	NO	NO	NO	NA
3 Other (please specify)						NA	NA	NA

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 CH₄ implied emission factor (IEF) is calculated on the basis of gross CH₄ emissions, as follows: IEF = (CH₄ emissions + CH₄ recovered)/annual MSW at the SWDS.

⁽²⁾ Actual emissions (after recovery).

⁽³⁾ CH₄ recovered and flared or utilized.

⁽⁴⁾ Under Solid Waste Disposal, CO₂ emissions should be reported only when the disposed waste is combusted at the disposal site as a management practice. CO₂ emissions from non-biogenic wastes are included in the total emissions, whereas the CO₂ emissions from biogenic wastes are not included in the total emissions.

Additional information

Description	Value
Total population (1000s) ^(a)	8 387.74
Urban population (1000s) ^(a)	5 535.91
Waste generation rate (kg/capita/day)	0.08
Fraction of MSW disposed to SWDS	0.00
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)	61.00

^(a) Specify whether total or urban population is used and the rationale for doing so.

^(b) See IPCC Guidelines (Volume 3. Reference Manual, p. 6.9).

^(c) Only for Parties using Tier 2 methods.

TABLE 6.C SECTORAL BACKGROUND DATA FOR WASTE
Waste Incineration

(Sheet 1 of 1)

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	ACTIVITY DATA Amount of incinerated wastes (Gg)	IMPLIED EMISSION FACTOR			EMISSIONS		
		CO ₂	CH ₄	N ₂ O	CO ₂ ⁽¹⁾	CH ₄	N ₂ O
		(kg/t waste)			(Gg)		
Waste Incineration	1.00				2.03	0.00	0.00
a. Biogenic ⁽¹⁾	NA	NA	NA	NA	NA	NA	NA
b. Other (non-biogenic - <i>please specify</i>) ^{(1), (2)}	1.00				2.03	0.00	0.00
Hospital waste	0.50	836.00	0.10	0.01	0.42	0.00	0.00
Municipal waste burning	NO	NO	NO	NO	NO	NO	NO
Waste oil	0.50	3 224.00	0.00	0.02	1.61	0.00	0.00

⁽¹⁾ Under Solid Waste Disposal, CO₂ emissions should be reported only when the disposed waste is combusted at the disposal site as a management practice. CO₂ emissions from non-biogenic wastes are included in the total emissions, while the CO₂ 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: <ul style="list-style-type: none"> 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 is provided. 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: <ul style="list-style-type: none"> (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)

Inventory 2010

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GREENHOUSE GAS SOURCE AND SINK CATEGORIES	ACTIVITY DATA AND RELATED INFORMATION ⁽¹⁾		IMPLIED EMISSION FACTOR		EMISSIONS		
	Total organic product		CH ₄ ⁽²⁾	N ₂ O ⁽³⁾	CH ₄		N ₂ O ⁽³⁾
					Emissions ⁽⁴⁾	Recovery ⁽⁵⁾	
	(Gg DC ⁽¹⁾ /yr)			(kg/kg DC)		(Gg)	
1. Industrial Waste Water					NA	NA	0.18
a. Waste Water	510.00		NA	0.00	NA	NA	0.18
b. Sludge	NA		NA	NA	NA	NA	NA
2. Domestic and Commercial Wastewater					1.30	NA	0.67
a. Waste Water	334.71		0.00	NA	1.30	NA	NA
b. Sludge	NA		NA	NA	NA	NA	NA
3. Other <i>(please specify)</i> ⁽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 ₂ O (kg N ₂ O-N/kg sewage N produced)		N ₂ O (Gg)	
N ₂ O from human sewage ⁽³⁾	8 387.74	39.06	0.16	0.01		0.67	

⁽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 CH₄ implied emission factor (IEF) is calculated on the basis of gross CH₄ emissions, as follows: IEF = (CH₄ emissions + CH₄ recovered or flared) / total organic product.

⁽³⁾ Parties using methods other than those from the IPCC for estimating N₂O emissions from human sewage or waste-water treatment should provide aggregate data in this table.

⁽⁴⁾ Actual emissions (after recovery).

⁽⁵⁾ CH₄ 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 N₂O 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 N₂O emissions from human sewage or waste-water treatment should provide, in the NIR, corresponding information on methods, activity data and emission factors used, and should provide a reference to the relevant section of the NIR in this documentation box.

TABLE 6.B SECTORAL BACKGROUND DATA FOR WASTE Inventory 2010
Waste Water Handling Submission 2012 v1.3
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Additional information

	Domestic	Industrial
Total waste water (m ³):	1 061 381.00	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	NA	NA	100.00	NA
Anaerobic	NA	NA	NO	NA
Other (please specify)	NA	NA	NO	NA

SUMMARY 1.A SUMMARY REPORT FOR NATIONAL GREENHOUSE GAS INVENTORIES (IPCC TABLE 7A)

(Sheet 1 of 3)

Inventory 2010

Submission 2012 v1.3

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GREENHOUSE GAS SOURCE AND SINK CATEGORIES		Net CO ₂	CH ₄	N ₂ O	HFCs ⁽¹⁾		PFCs ⁽¹⁾		SF ₆		NO _x	CO	NMVOC	SO ₂
		emissions/removals			P	A	P	A	P	A				
		(Gg)			CO ₂ equivalent (Gg)				(Gg)					
Total National Emissions and Removals		68 629.72	265.46	16.79	1 837.57	1 160.63	349.38	69.85	0.03	0.01	187.31	636.95	132.52	18.67
1. Energy		63 088.31	25.12	2.30							180.22	607.90	51.86	17.44
A. Fuel Combustion	Reference Approach ⁽²⁾	67 585.42												
	Sectoral Approach ⁽²⁾	62 851.15	11.84	2.30							180.22	607.90	49.88	17.21
1. Energy Industries		14 173.77	0.37	0.36							13.83	5.23	0.80	3.24
2. Manufacturing Industries and Construction		15 455.70	0.68	0.48							31.81	138.30	2.40	10.85
3. Transport		22 205.42	0.72	0.75							111.62	161.96	13.10	0.21
4. Other Sectors		10 969.98	10.07	0.71							22.89	302.12	33.57	2.90
5. Other		46.27	0.00	0.00							0.08	0.28	0.02	0.01
B. Fugitive Emissions from Fuels		237.17	13.29	IE,NA							IE,NA	IE,NA	1.98	0.23
1. Solid Fuels		IE,NA,NO	IE,NA,NO	IE,NA							IE,NA	IE,NA	IE,NA	IE,NA
2. Oil and Natural Gas		237.17	13.29	IE,NA							IE,NA	IE,NA	1.98	0.23
2. Industrial Processes		9 023.24	0.87	0.20	1 837.57	1 160.63	349.38	69.85	0.03	0.01	1.50	23.86	4.73	1.21
A. Mineral Products		2 935.52	NA	NA							NA	9.78	IE,NA	NA
B. Chemical Industry		607.80	0.87	0.20	NO	NO	NO	NO	NO	NO	0.42	11.12	1.32	0.77
C. Metal Production		5 479.91	0.00	NA				NO		0.00	0.10	2.24	0.43	0.45
D. Other Production ⁽³⁾		NA									0.97	0.71	2.98	NA
E. Production of Halocarbons and SF ₆						NA		NA		NA				
F. Consumption of Halocarbons and SF ₆					1 837.57	1 160.63	349.38	69.85	0.03	0.01				
G. Other		NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA

Note: A = Actual emissions based on Tier 2 approach of the IPCC Guidelines.

P = Potential emissions based on Tier 1 approach of the IPCC Guidelines.

Note: All footnotes for this table are given at the end of the table on sheet 3.

SUMMARY 1.A SUMMARY REPORT FOR NATIONAL GREENHOUSE GAS INVENTORIES (IPCC TABLE 7A)

(Sheet 2 of 3)

Inventory 2010
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GREENHOUSE GAS SOURCE AND SINK CATEGORIES	Net CO ₂ emissions/removals	CH ₄	N ₂ O	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	176.89		0.48							NA	NA	74.09	NA
4. Agriculture		171.33	12.43							5.58	0.66	1.78	0.00
A. Enteric Fermentation		155.07											
B. Manure Management		15.75	2.99									NA,NO	
C. Rice Cultivation		NO										NO	
D. Agricultural Soils ⁽⁴⁾		0.46	9.45									1.68	
E. Prescribed Burning of Savannas		NO	NO							NO	NO	NO	
F. Field Burning of Agricultural Residues		0.04	0.00							0.02	0.66	0.10	
G. Other		NA	NA							5.56	NA	NA	0.00
5. Land Use, Land-Use Change and Forestry	⁽⁵⁾ -3 660.75	0.01	0.16							IE,NA,NE	IE,NA,NE	NA,NE	NA
A. Forest Land	⁽⁵⁾ -5 411.09	0.01	0.00							NE	NE	NE	
B. Cropland	⁽⁵⁾ 518.20	NA,NO	0.16							IE	IE	NE	
C. Grassland	⁽⁵⁾ 280.75	NO	NO							IE	IE	NE	
D. Wetlands	⁽⁵⁾ 355.78	NO	NO							NA	NA	NA	
E. Settlements	⁽⁵⁾ 248.40	NA,NO	NA,NO							NA	NA	NA	
F. Other Land	⁽⁵⁾ 347.22	NA,NO	NA,NO							NA	NA	NA	
G. Other	⁽⁵⁾ NE	NA	NA							NA	NA	NA	NA
6. Waste	2.03	68.13	1.20							0.01	4.54	0.06	0.01
A. Solid Waste Disposal on Land	⁽⁶⁾ NA,NO	64.29								NA,NO	4.53	0.06	
B. Waste-water Handling		1.30	0.85							NA	NA	NA	
C. Waste Incineration	⁽⁶⁾ 2.03	0.00	0.00							0.01	0.01	0.00	0.01
D. Other	NA	2.54	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)

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GREENHOUSE GAS SOURCE AND SINK CATEGORIES	Net CO ₂	CH ₄	N ₂ O	HFCs		PFCs		SF ₆		NO _x	CO	NM VOC	SO ₂
	emissions/removals			P	A	P	A	P	A				
	(Gg)			CO ₂ equivalent (Gg)				(Gg)					
Memo Items: ⁽⁸⁾													
International Bunkers	2 080.68	0.04	0.08							9.08	2.78	0.86	0.67
Aviation	2 049.55	0.04	0.07							8.50	2.27	0.86	0.65
Marine	31.13	0.00	0.01							0.58	0.51	NA	0.02
Multilateral Operations	NO	NO	NO							NO	NO	NO	NO
CO₂ Emissions from Biomass	22 600.50												

⁽¹⁾ The emissions of HFCs and PFCs are to be expressed as CO₂ 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 CO₂ 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⁾ CO₂ 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 CQ 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 CQ 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 CQ emissions are accounted for as a loss of biomass stocks in the Land Use, Land-use Change and Forestry sector.

SUMMARY 1.B SHORT SUMMARY REPORT FOR NATIONAL GREENHOUSE GAS INVENTORIES (IPCC TABLE 7B)

(Sheet 1 of 1)

Inventory 2010

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GREENHOUSE GAS SOURCE AND SINK CATEGORIES		Net CO ₂	CH ₄	N ₂ O	HFCs ⁽¹⁾		PFCs ⁽¹⁾		SF ₆		NO _x	CO	NM VOC	SO ₂
		emissions/removals			P	A	P	A	P	A				
		(Gg)			CO ₂ equivalent (Gg)				(Gg)					
Total National Emissions and Removals		68 629.72	265.46	16.79	1 837.57	1 160.63	349.38	69.85	0.03	0.01	187.31	636.95	132.52	18.67
1. Energy		63 088.31	25.12	2.30							180.22	607.90	51.86	17.44
A. Fuel Combustion	Reference Approach ⁽²⁾	67 585.42												
	Sectoral Approach ⁽²⁾	62 851.15	11.84	2.30							180.22	607.90	49.88	17.21
B. Fugitive Emissions from Fuels		237.17	13.29	IE,NA							IE,NA	IE,NA	1.98	0.23
2. Industrial Processes		9 023.24	0.87	0.20	1 837.57	1 160.63	349.38	69.85	0.03	0.01	1.50	23.86	4.73	1.21
3. Solvent and Other Product Use		176.89		0.48							NA	NA	74.09	NA
4. Agriculture⁽³⁾			171.33	12.43							5.58	0.66	1.78	0.00
5. Land Use, Land-Use Change and Forestry		⁽⁴⁾ -3 660.75	0.01	0.16							IE,NA,NE	IE,NA,NE	NA,NE	NA
6. Waste		2.03	68.13	1.20							0.01	4.54	0.06	0.01
7. Other		NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Memo Items:⁽⁵⁾														
International Bunkers		2 080.68	0.04	0.08							9.08	2.78	0.86	0.67
Aviation		2 049.55	0.04	0.07							8.50	2.27	0.86	0.65
Marine		31.13	0.00	0.01							0.58	0.51	NA	0.02
Multilateral Operations		NO	NO	NO							NO	NO	NO	NO
CO₂ Emissions from Biomass		22 600.50												

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 CO₂ 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 CO₂ 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 CQ 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 CQ 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 CO₂ 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 CO₂ EQUIVALENT EMISSIONS

(Sheet 1 of 1)

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GREENHOUSE GAS SOURCE AND SINK CATEGORIES	CO ₂ ⁽¹⁾	CH ₄	N ₂ O	HFCs ⁽²⁾	PFCs ⁽²⁾	SF ₆ ⁽²⁾	Total
	CO ₂ equivalent (Gg)						
Total (Net Emissions) ⁽¹⁾	68 629.72	5 574.65	5 203.35	1 160.63	69.85	345.01	80 983.22
1. Energy	63 088.31	527.61	711.74				64 327.66
A. Fuel Combustion (Sectoral Approach)	62 851.15	248.58	711.74				63 811.47
1. Energy Industries	14 173.77	7.80	111.38				14 292.95
2. Manufacturing Industries and Construction	15 455.70	14.24	148.42				15 618.36
3. Transport	22 205.42	15.06	231.26				22 451.74
4. Other Sectors	10 969.98	211.45	219.67				11 401.10
5. Other	46.27	0.03	1.01				47.32
B. Fugitive Emissions from Fuels	237.17	279.03	IE,NA				516.20
1. Solid Fuels	IE,NA,NO	IE,NA,NO	IE,NA				IE,NA,NO
2. Oil and Natural Gas	237.17	279.03	IE,NA				516.20
2. Industrial Processes	9 023.24	18.25	63.49	1 160.63	69.85	345.01	10 680.47
A. Mineral Products	2 935.52	NA	NA				2 935.52
B. Chemical Industry	607.80	18.17	63.49	NO	NO	NO	689.46
C. Metal Production	5 479.91	0.08	NA	NO	NO	0.29	5 480.28
D. Other Production	NA						NA
E. Production of Halocarbons and SF ₆				NA	NA	NA	NA
F. Consumption of Halocarbons and SF ₆ ⁽²⁾				1 160.63	69.85	344.73	1 575.21
G. Other	NA	NA	NA	NA	NA	NA	NA
3. Solvent and Other Product Use	176.89		150.23				327.12
4. Agriculture		3 597.84	3 854.80				7 452.64
A. Enteric Fermentation		3 256.57					3 256.57
B. Manure Management		330.77	925.48				1 256.24
C. Rice Cultivation		NO					NO
D. Agricultural Soils ⁽³⁾		9.69	2 929.13				2 938.82
E. Prescribed Burning of Savannas		NO	NO				NO
F. Field Burning of Agricultural Residues		0.82	0.19				1.01
G. Other		NA	NA				NA
5. Land Use, Land-Use Change and Forestry ⁽¹⁾	-3 660.75	0.14	49.89				-3 610.72
A. Forest Land	-5 411.09	0.14	0.03				-5 410.92
B. Cropland	518.20	NA,NO	49.86				568.06
C. Grassland	280.75	NO	NO				280.75
D. Wetlands	355.78	NO	NO				355.78
E. Settlements	248.40	NA,NO	NA,NO				248.40
F. Other Land	347.22	NA,NO	NA,NO				347.22
G. Other	NE	NA	NA				NA,NE
6. Waste	2.03	1 430.81	373.21				1 806.05
A. Solid Waste Disposal on Land	NA,NO	1 350.08					1 350.08
B. Waste-water Handling		27.39	264.81				292.20
C. Waste Incineration	2.03	0.00	0.01				2.04
D. Other	NA	53.33	108.40				161.73
7. Other (as specified in Summary 1.A)	NA	NA	NA	NA	NA	NA	NA

Memo Items: ⁽⁴⁾							
International Bunkers	2 080.68	0.89	25.03				2 106.60
Aviation	2 049.55	0.86	21.27				2 071.68
Marine	31.13	0.03	3.76				34.92
Multilateral Operations	NO	NO	NO				NO
CO₂ Emissions from Biomass	22 600.50						22 600.50

Total CO ₂ Equivalent Emissions without Land Use, Land-Use Change and Forestry	84 593.94
Total CO ₂ Equivalent Emissions with Land Use, Land-Use Change and Forestry	80 983.22

⁽¹⁾ For CO₂ 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 CO₂ from soils in the Agriculture sector should note this in the NIR.

⁽⁴⁾ See footnote 8 to table Summary 1.A.

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Use the following notation keys to specify the method applied:

D (IPCC default)	T1a, T1b, T1c (IPCC Tier 1a, Tier 1b and Tier 1c, respectively)	CR (CORINAIR)
RA (Reference Approach)	T2 (IPCC Tier 2)	CS (Country Specific)
T1 (IPCC Tier 1)	T3 (IPCC Tier 3)	OTH (Other)

If using more than one method within one source category, list all the relevant methods. Explanations regarding country-specific methods, other methods or any modifications to the default IPCC methods, as

Use the following notation keys to specify the emission factor used:

D (IPCC default)	CS (Country Specific)	OTH (Other)
CR (CORINAIR)	PS (Plant Specific)	

Where a mix of emission factors has been used, list all the methods in the relevant cells and give further explanations in the documentation box. Also use the documentation box to explain the use of notation

SUMMARY 3 SUMMARY REPORT FOR METHODS AND EMISSION FACTORS USED

(Sheet 2 of 2)

Inventory 2010
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GREENHOUSE GAS SOURCE AND SINK CATEGORIES	CO ₂		CH ₄		N ₂ O		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	CS,D,T1,T1a,	CS,D						
A. Enteric Fermentation			T1,T2	CS,D								
B. Manure Management			T1,T2	CS,D	T1	D						
C. Rice Cultivation			NA	NA								
D. Agricultural Soils			CS	CS	T1,T1a,T1b,T2	D						
E. Prescribed Burning of Savannas			NA	NA	NA	NA						
F. Field Burning of Agricultural Residues			CS,D	CS,D	CS,D	CS,D						
G. Other			NA	NA	NA	NA						
5. Land Use, Land-Use Change and Forestry	T1,T2,T3	CS,D	T1	CS,D	T1,T2	CS,D						
A. Forest Land	T2,T3	CS	T1	CS,D	T1	CS,D						
B. Cropland	T1,T2	CS,D	NA	NA	T1,T2	CS,D						
C. Grassland	T2	CS	NA	NA	NA	NA						
D. Wetlands	T2	CS	NA	NA	NA	NA						
E. Settlements	T2	CS	NA	NA	NA	NA						
F. Other Land	T2	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 of

Use the following notation keys to specify the emission factor used:

D (IPCC default) **CS** (Country Specific) **OTH** (Other)
CR (CORINAIR) **PS** (Plant Specific)

Where a mix of emission factors has been used, list all the methods in the relevant cells and give further explanations in the documentation box. Also use the documentation box to explain the use of notation OTH.

Documentation box:

- Parties should provide the full information on methodological issues, such as methods and emission factors used, in the relevant sections of Chapters 3 to 9 (see section 2.2 of each of Chapters 3 - 9) of the NIR. Use this documentation box to provide references to relevant sections of the NIR if any additional information and further details are needed to understand the content of this table.
- Where a mix of methods/emission factors has been used within one source category, use this documentation box to specify those methods/emission factors for the various sub-sources where they have been applied.
- Where the notation OTH (Other) has been entered in this table, use this documentation box to specify those other methods/emission factors.

TABLE 7 SUMMARY OVERVIEW FOR KEY CATEGORIES
(Sheet 1 of 1)

Inventory 2010
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KEY CATEGORIES OF EMISSIONS AND REMOVALS	Gas	Criteria used for key source identification			Key category excluding LULUCF ⁽¹⁾	Key category including LULUCF ⁽¹⁾	Comments ⁽¹⁾
		L	T	Q			
Specify key categories according to the national level of disaggregation used:							
1 A 1 a liquid	CO2	x	x		x	x	
1 A 1 a other	CO2	x	x		x	x	
1 A 1 a solid	CO2	x	x		x	x	
1 A 1 b gaseous	CO2	x	x		x	x	
1 A 1 b liquid	CO2	x	x		x	x	
1 A 1 c gaseous	CO2	x	x		x	x	Trend: including only
1 A 2 gaseous	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 b diesel oil	CO2	x	x		x	x	
1 A 3 b gasoline	CO2	x	x		x	x	
1 A 3 e gaseous	CO2	x	x		x	x	
1 A 4 biomass	CH4		x		x		
1 A 4 gaseous	CO2	x	x		x	x	
1 A 4 mobile, diesel	CO2	x			x	x	
1 A 4 other	CO2		x		x	x	
1 A 4 solid	CO2		x		x	x	
1 A 4 stationary, liquid	CO2	x	x		x	x	
1 B 2 a	CO2		x			x	
2 A 1 Cement Production	CO2	x	x		x	x	Trend: Excluding only
2 A 2 Lime Production	CO2	x			x	x	Trend: including only
2 A 3 Limestone and Dolomite Use	CO2	x			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 4 SF6 Used in Al and Mg Foundries	CO2		x		x	x	
2 F 1 to 2 F 5: ODS Substitutes	HFC, PFC	x	x		x	x	
2 F 9 Other Sources of SF6	PFC, SF6	x	x		x	x	Level: excluding only. Trend: including only
4 A 1 Cattle	CH4	x	x		x	x	
4 B 1 Cattle	N2O	x				x	
4 D 1 Direct Soil Emissions	N2O	x	x		x	x	Trend: Excluding only
4 D 3 Indirect Emissions	N2O	x	x		x	x	Trend: Excluding only
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 2 Land converted to cropland	CO2	x				x	
5 C 2 Land converted to grassland	CO2	x				x	
5 D 2 Land converted to wetland	CO2	x	x			x	
5 E 2 Land converted to settlements	CO2	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		x	x	

Note: L = Level assessment; T = Trend assessment; O = Qualitative assessment.

⁽¹⁾ The term “key categories” refers to both the key source categories as addressed in the IPCC good practice guidance and the key categories as addressed in the IPCC good practice guidance for LULUCF.

⁽²⁾ For estimating key categories Parties may chose the disaggregation level presented as an example in table 7.1 of the IPCC good practice guidance (page 7.6) and table 5.4.1 (page 5.31) of the IPCC good practice guidance for LULUCF, the level used in table Summary 1.A of the common reporting format or any other disaggregation level that the Party used to determine its key categories.

Documentation box:

Parties should provide the full information on methodologies used for identifying key categories and the quantitative results from the level and trend assessments (according to tables 7.1–7.3 of the IPCC good practice guidance and tables 5.4.1–5.4.3 of the IPCC good practice guidance for LULUCF) in Annex 1 to the NIR.

TABLE 8(a) RECALCULATION - RECALCULATED DATA
(Sheet 1 of 2)

Recalculated year: Inventory 2010

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GREENHOUSE GAS SOURCE AND SINK CATEGORIES	CO ₂						CH ₄						N ₂ O					
	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		68 629.72					5 574.65						5 203.35					
1. Energy		63 088.31					527.61						711.74					
1.A. Fuel Combustion Activities		62 851.15					248.58						711.74					
1.A.1. Energy Industries		14 173.77					7.80						111.38					
1.A.2. Manufacturing Industries and Construction		15 455.70					14.24						148.42					
1.A.3. Transport		22 205.42					15.06						231.26					
1.A.4. Other Sectors		10 969.98					211.45						219.67					
1.A.5. Other		46.27					0.03						1.01					
1.B. Fugitive Emissions from Fuels		237.17					279.03						IE,NA					
1.B.1. Solid fuel		IE,NA,NO					IE,NA,NO						IE,NA					
1.B.2. Oil and Natural Gas		237.17					279.03						IE,NA					
2. Industrial Processes		9 023.24					18.25						63.49					
2.A. Mineral Products		2 935.52					NA						NA					
2.B. Chemical Industry		607.80					18.17						63.49					
2.C. Metal Production		5 479.91					0.08						NA					
2.D. Other Production		NA																
2.G. Other		NA					NA						NA					
3. Solvent and Other Product Use		176.89											150.23					
4. Agriculture							3 597.84						3 854.80					
4.A. Enteric Fermentation							3 256.57											
4.B. Manure Management							330.77						925.48					
4.C. Rice Cultivation							NO											
4.D. Agricultural Soils ⁽⁴⁾							9.69						2 929.13					
4.E. Prescribed Burning of Savannas							NO						NO					
4.F. Field Burning of Agricultural Residues							0.82						0.19					
4.G. Other							NA						NA					
5. Land Use, Land-Use Change and Forestry (net)⁽⁵⁾		-3 660.75					0.14						49.89					
5.A. Forest Land		-5 411.09					0.14						0.03					
5.B. Cropland		518.20					NA,NO						49.86					
5.C. Grassland		280.75					NO						NO					
5.D. Wetlands		355.78					NO						NO					
5.E. Settlements		248.40					NA,NO						NA,NO					
5.F. Other Land		347.22					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 2010

Submission 2012 v1.3

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[illegible]

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		1 160.63					69.85						345.01																									
2.C.3 Aluminium Production							NO																															
2.E. Production of Halocarbons and SE ₄		NA					NA						NA																									
2.F. Consumption of Halocarbons and SE ₄		1 160.63					69.85						344.73																									
2.G. Other		NA					NA						NA																									
Potential Emissions from Consumption of HFCs/PFCs and SF ₆		1 837.57					349.38						614.38																									
<table><tr><td></td><td>Previous submission</td><td>Latest submission</td><td>Difference</td><td>Difference⁽¹⁾</td></tr><tr><td></td><td colspan="3">CO₂ equivalent (Gg)</td><td>(%)</td></tr><tr><td>Total CO₂ Equivalent Emissions with Land Use, Land-Use Change and Forestry</td><td></td><td>80 983.22</td><td></td><td></td></tr><tr><td>Total CO₂ Equivalent Emissions without Land Use, Land-Use Change and Forest</td><td></td><td>84 593.94</td><td></td><td></td></tr></table>																				Previous submission	Latest submission	Difference	Difference ⁽¹⁾		CO ₂ equivalent (Gg)			(%)	Total CO ₂ Equivalent Emissions with Land Use, Land-Use Change and Forestry		80 983.22			Total CO ₂ Equivalent Emissions without Land Use, Land-Use Change and Forest		84 593.94		
	Previous submission	Latest submission	Difference	Difference ⁽¹⁾																																		
	CO ₂ equivalent (Gg)			(%)																																		
Total CO ₂ Equivalent Emissions with Land Use, Land-Use Change and Forestry		80 983.22																																				
Total CO ₂ Equivalent Emissions without Land Use, Land-Use Change and Forest		84 593.94																																				

^(t) Estimate the percentage change due to recalculation with respect to the previous submission (percentage change = $100 \times [(\text{LS}-\text{PS})/\text{PS}]$, 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 CO₂ equivalent, excluding GHGs from the LULUCF sector. The impact of the recalculation on the total emissions is calculated as follows: impact of recalculation (%) = $100 \times [(source\ (LS) - source\ (PS)) / total\ emissions\ (LS)]$, where LS = latest submission, PS = previous submission.

(3) Total emissions refer to total aggregate GHG emissions expressed in terms of CO₂ 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 CQ from soils in the Agriculture sector should note this in the NIR.

⁽⁵⁾ Net CO₂ 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)

Inventory 2010

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Sources and sinks not estimated (NE) ⁽¹⁾				
GHG	Sector ⁽²⁾	Source/sink category ⁽²⁾	Explanation	
Carbon	5 LULUCF	5.D.1 Total	no sufficient data for estimates.	
Carbon	5 LULUCF	5.E.1 Total	no sufficient data for estimates.	
Carbon	5 LULUCF	5.D.1 Total	no sufficient data for estimates.	
Carbon	5 LULUCF	5.E.1 Total	no sufficient data for estimates.	
Carbon	5 LULUCF	5.D.1 Total	no sufficient data for estimates.	
Carbon	5 LULUCF	5.D.1 Total	no sufficient data for estimates.	
Carbon	5 LULUCF	5.E.1 Total	no sufficient data for estimates.	
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	
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
Carbon	Total	5.B.2.1 Forest land converted to Cropland - Gains	Forest land converted to Cropland - Losses	only net figures are reported.
Carbon	Total	5.C.2.1 Forest Land converted to Grassland - Gains	Forest Land converted to Grassland - Losses	only net figures are reported.
Carbon	Total	5.D.2 Land converted to Wetlands - Gains	D.2 Land converted to Wetlands - Losses	only net figures are reported.
Carbon	Total	5.F.2.1 Forest Land converted to Other Land - Gains	Forest Land converted to Other Land - Losses	only net figures are reported.
Carbon	Total	5 A 2 1 Cropland converted to Forest Land -Total - Losses	Land converted to Forest Land -Total - Gains	only net figures are reported.
Carbon	Total	5 A 2 2 Grassland converted to Forest Land -Total - Losses	Land converted to Forest Land -Total - Gains	only net figures are reported.
Carbon	Total	5 A 2 3 Wetlands converted to Forest Land -Total - Losses	Land converted to Forest Land -Total - Gains	only net figures are reported.
Carbon	Total	5 A 2 5 Other Land converted to Forest Land -Total - Losses	Land converted to Forest Land -Total - Gains	only net figures are reported.
Carbon	Deciduous	5.A.1 Forest Land remaining Forest Land - Mineral soils - Deciduous	Forest Land - Mineral soils - Coniferous	
Carbon	Total	5.C.1 Grassland remaining Grassland - Organic Soils	Land and remaining Grassland - 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	on fields are reported here (total figures are reported from the Association of Oil Industry)
CH4	1.B.2.A.3 Transport	1 B 2 A 3 Oil Transport	1 B 2 A 2 Oil Production	on fields are reported here (total figures are reported from the Association of Oil Industry)
CH4	1.B.2.B.1 Exploration	1 B 2 B 1 Exploration	1 B 2 A 2 Oil Production	on fields are reported here (total figures are reported from the Association of Oil Industry)
CH4	2.B.2 Production / Processing	1 B 2 B 2 Natural Gas Production/Processing	1 B 2 A 2 Oil Production	on fields are reported here (total figures are reported from the Association of Oil Industry)
CH4	1.B.2.C.1 Venting	1.B.2.C.1 Venting	1.A.1.b Petroleum Refining	The emission declaration of the refinery includes all emissions from all sources
CH4	1.B.2.C.2 Flaring	1.B.2.C.2 Flaring	1.A.3.b Petroleum Refining	The emission declaration of the refinery includes all emissions from all sources
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	n all activities of integrated iron and steel plants are reported under 1 A 2 a Iron and Steel
CH4	2.C.1.2 Pig Iron	2 C 1 2 Pig Iron	1 A 2 a Iron and Steel	n all activities of integrated iron and steel plants are reported under 1 A 2 a Iron and Steel
CH4	1.AA.1.B Petroleum Refining	1 A 1 b Petroleum Refining / Liquid Fuels.	1 B 2 fugitive Emissions from fuels.	4 emissions from fuel combustion are a minor source of total CH4 emissions from refinery
CH4	1.AA.1.B Petroleum Refining	1 A 1 b Petroleum Refining / Gaseous Fuels.	1 B 2 fugitive Emissions from fuels.	4 emissions from fuel combustion are a minor source of total CH4 emissions from refinery
CH4	AA.3.B Road Transportation	1.A.3.b - biomass (biofuels)	1.A.3.b - diesel and gasoline.	Emissions from blended biofuels can not be calculated separately.
CH4	AA.3.B Road Transportation	1.A.3.b - gaseous fuels (CNG)	1.A.3.b - gasoline	
CH4	AA.3.B Road Transportation	1A3b LPG	1A3b Gasoline	
CH4	Military use	1.A.5.b - biomass (biofuels).	1.A.5.b - diesel and gasoline.	

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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	on fields are reported here (total figures are reported from the Association of Oil Industry)
CO2	1.B.2.A.3 Transport	1 B 2 A 3 Oil Transport	1 B 2 A 2 Oil Production	on fields are reported here (total figures are reported from the Association of Oil Industry)
CO2	1.B.2.C.1 Venting	1.B.2.C.1 Venting	1.A.1.b Petroleum Refining	The emission declaration of the refinery includes all emissions from all sources.
CO2	1.B.2.C.2 Flaring	1.B.2.C.2 Flaring	1.A.3.b Petroleum Refining	The emission declaration of the refinery includes all emissions from all sources.
CO2	2.A.4.1 Soda Ash Production	2 A 4 1 Soda Ash Production	1 A 2 c Chemicals	#####
CO2	2.A.4.1 Soda Ash Production	2 A 4 1 Soda Ash Production	1 A 2 c Chemicals	#####
CO2	2.A.5 Asphalt Roofing	2 A 5 Asphalt Roofing	3 Solvent Use	5 Asphalt Roofing and 2A6 Road Paving with Asphalt are included in the Solvent Sector.
CO2	2.A.6 Road Paving with Asphalt	2 A 6 Road Paving	3 Solvent Use	5 Asphalt Roofing and 2A6 Road Paving with Asphalt are included in the Solvent Sector.
CO2	Forest Land remaining Forest Land	5 A 1 Wildfires	Forest Land remaining Forest Land	stock change due to wildfires at forest land is included in figures of table 5.A Sektor 5.A.1
CO2	Cropland remaining Cropland	5 B Cropland / lime application / Dolomite	Cropland / lime application / Limestone	Emissions from dolomite liming include emissions from limestone liming
CO2	Grassland remaining Grassland	5 C Grassland / lime application	Cropland / lime application / Limestone	Emissions from cropland dolomite liming include emissions from grassland liming.
CO2	Grassland 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	on fields are reported here (total figures are reported from the Association of Oil Industry)
N2O	1.B.2.C.2 Flaring	1.B.2.C.2 Flaring	1.A.3.b Petroleum Refining	The emission declaration of the refinery includes all emissions from all sources.
N2O	1.AA.3.B Road Transportation	1.A.3.b - biomass (biofuels)	1.A.3.b - diesel and gasoline.	Emissions from blended biofuels can not be calculated separately.
N2O	1.AA.3.B Road Transportation	1.A.3.b - gaseous fuels (CNG)	1.A.3.b - gasoline	
N2O	1.AA.3.B Road Transportation	1A3b LPG	1A3b Gasoline	
N2O	Military use	1.A.5.b - biomass (biofuels)	1.A.5.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	tion 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	tion 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	tion is based on consumption data of halocarbons and SF6 or products (net import/export)

⁽¹⁾ Clearly indicate sources and sinks which are considered in the IPCC Guidelines but are not considered in the submitted inventory. Explain the reason for excluding these sources and sinks, in order to avoid arbitrary interpretations. An entry should be made for each source/sink category for which the notation key NE (not estimated) is entered in the sectoral tables.

⁽²⁾ Indicate omitted source/sink following the IPCC source/sink category structure (e.g. sector: Waste, source category: Waste-Water Handling).

⁽³⁾ Clearly indicate sources and sinks in the submitted inventory that are allocated to a sector other than that indicated by the IPCC Guidelines. Show the sector indicated in the IPCC Guidelines and the sector to which the source or sink is allocated in the submitted inventory. Explain the reason for reporting these sources and sinks in a different sector. An entry should be made for each source/sink for which the notation key IE (included elsewhere) is used in the sectoral tables.

TABLE 9(b) COMPLETENESS - INFORMATION ON ADDITIONAL GREENHOUSE GAS
(Sheet 1 of 1)

Inventory 2010
Submission 2012 v1.3
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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				Third Assessment Report of the Intergovernmental Panel on Climate Change	CHF2CH2CF3
HFC-365mfc	Hard Foam				Third Assessment Report of the Intergovernmental Panel 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

CO₂

(Part 1 of 3)

Inventory 2010

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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	54 171.69	57 963.28	53 065.21	53 465.97	53 537.96	56 355.12	60 112.28	59 299.50	59 256.20	58 001.63
A. Fuel Combustion (Sectoral Approach)	54 069.60	57 852.19	52 945.09	53 353.84	53 410.33	56 227.97	60 041.14	59 178.87	59 114.26	57 830.98
1. Energy Industries	13 792.28	14 622.47	11 314.87	11 466.07	11 761.35	12 918.64	13 804.55	13 874.68	13 002.69	12 526.98
2. Manufacturing Industries and Construction	12 685.28	13 074.17	11 948.01	12 247.67	13 235.01	13 487.03	13 700.68	15 240.07	13 990.36	13 179.88
3. Transport	13 772.38	15 235.42	15 209.29	15 342.30	15 393.80	15 677.97	17 236.96	16 254.01	18 354.81	17 826.87
4. Other Sectors	13 784.66	14 883.04	14 439.24	14 258.40	12 978.59	14 111.77	15 260.04	13 773.02	13 724.00	14 255.68
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	7 581.71	7 423.68	6 877.10	6 853.58	7 180.38	7 387.93	7 086.99	7 677.03	7 321.04	7 171.20
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	582.56	603.24	565.70	600.61	546.56	583.54	590.17	582.72	579.50	585.61
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⁾	-10 064.17	-15 781.10	-10 983.01	-11 419.08	-10 286.15	-11 636.65	-8 530.99	-17 195.02	-15 299.35	-18 173.46
A. Forest Land	-11 862.92	-17 612.32	-12 869.02	-13 355.05	-12 196.39	-13 143.37	-10 012.15	-18 651.87	-16 725.50	-19 592.47
B. Cropland	203.64	203.06	224.72	241.60	243.94	254.63	266.82	280.23	286.70	287.67
C. Grassland	257.02	251.90	246.87	241.78	251.98	53.33	65.79	78.29	91.33	97.04
D. Wetlands	191.08	205.66	220.24	234.82	242.09	241.34	248.79	256.24	263.70	274.63
E. Settlements	281.46	288.34	295.23	302.11	286.49	210.77	190.50	170.22	149.94	140.38
F. Other Land	865.55	882.26	898.97	915.68	885.74	746.64	709.25	671.87	634.48	619.30
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 CO₂ emissions including net CO₂ from LULUCF	51 995.41	49 862.74	49 155.32	49 097.05	50 613.60	52 307.32	58 852.74	49 985.00	51 463.66	47 171.39
Total CO₂ emissions excluding net CO₂ from LULUCF	62 059.59	65 643.84	60 138.33	60 516.13	60 899.75	63 943.97	67 383.73	67 180.02	66 763.01	65 344.86
Memo Items:										
International Bunkers	904.53	1 013.54	1 097.58	1 160.60	1 205.87	1 347.24	1 485.85	1 544.61	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	18.56	19.66	20.15	20.62	20.21	19.82	19.43	19.05	18.67	18.46
Multilateral Operations	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
CO₂ Emissions from Biomass	9 903.46	10 787.09	10 548.40	11 114.59	10 729.53	11 422.77	12 158.66	11 724.73	11 483.61	13 186.03

Note: All footnotes for this table are given at the end of the table on sheet 5

TABLE 10 EMISSION TRENDS

CO₂

(Part 2 of 3)

Inventory 2010

Submission 2012 v1.3

AUSTRIA

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009
	(Gg)	(Gg)	(Gg)	(Gg)	(Gg)	(Gg)	(Gg)	(Gg)	(Gg)	(Gg)
1. Energy	57 991.22	62 085.59	63 218.98	69 308.67	69 783.93	70 792.85	67 660.35	64 582.13	63 752.74	59 016.72
A. Fuel Combustion (Sectoral Approach)	57 826.57	61 902.73	63 051.83	69 075.52	69 573.77	70 587.69	67 428.20	64 344.97	63 540.58	58 751.56
1. Energy Industries	12 221.05	13 825.71	13 473.50	16 287.24	16 324.94	16 274.46	15 159.58	13 842.49	13 627.84	12 751.75
2. Manufacturing Industries and Construction	13 860.68	13 715.61	14 045.90	14 679.06	15 098.71	16 367.95	16 100.60	15 931.88	15 932.80	14 538.21
3. Transport	18 625.31	20 116.15	22 016.41	23 861.12	24 377.15	24 676.51	23 401.42	23 576.57	22 323.08	21 544.80
4. Other Sectors	13 078.73	14 203.90	13 474.10	14 205.63	13 729.96	13 225.20	12 722.54	10 949.42	11 611.69	9 871.11
5. Other	40.80	41.36	41.91	42.47	43.03	43.56	44.06	44.61	45.17	45.70
B. Fugitive Emissions from Fuels	164.65	182.85	167.15	233.15	210.15	205.15	232.16	237.16	212.16	265.16
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	164.65	182.85	167.15	233.15	210.15	205.15	232.16	237.16	212.16	265.16
2. Industrial Processes	7 776.11	7 702.91	8 270.70	8 216.04	8 230.86	8 705.79	9 111.29	9 544.40	9 952.02	8 051.45
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	2 915.62
B. Chemical Industry	589.70	541.95	553.66	595.00	589.62	559.25	593.00	525.08	593.32	539.08
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	5 827.79	4 596.75
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	192.62	204.10	218.14	221.26	188.85	212.99	250.73	228.07	210.69	153.46
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⁾	-15 072.78	-16 959.99	-11 015.25	-967.91	-6 024.33	-7 431.49	-1 621.88	-561.49	337.25	-3 693.53
A. Forest Land	-16 452.00	-18 352.99	-12 651.32	-2 613.20	-7 695.76	-9 148.49	-3 333.89	-2 305.75	-1 410.95	-5 459.25
B. Cropland	293.91	299.79	376.04	386.18	407.95	403.69	413.66	444.96	466.52	516.90
C. Grassland	102.74	109.59	303.18	305.83	308.13	309.94	309.12	311.88	311.87	287.69
D. Wetlands	285.56	296.49	313.96	324.24	335.06	329.47	332.01	346.88	345.94	347.46
E. Settlements	91.45	95.33	164.05	170.56	178.73	249.28	249.53	249.78	250.03	252.39
F. Other Land	605.55	591.81	478.84	458.48	441.55	424.62	407.69	390.76	373.83	361.28
G. Other	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE
6. Waste	12.26	12.26	12.26	12.26	12.26	12.26	10.15	8.12	6.09	4.06
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	12.26	12.26	12.26	12.26	12.26	12.26	10.15	8.12	6.09	4.06
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 CO₂ emissions including net CO₂ from LULUCF	50 899.43	53 044.87	60 704.83	76 790.33	72 191.57	72 292.40	75 410.65	73 801.23	74 258.78	63 532.16
Total CO₂ emissions excluding net CO₂ from LULUCF	65 972.21	70 004.86	71 720.08	77 758.24	78 215.90	79 723.89	77 032.53	74 362.72	73 921.54	67 225.70
Memo Items:										
International Bunkers	1 715.80	1 671.50	1 561.07	1 470.24	1 742.20	2 024.37	2 091.30	2 211.96	2 213.56	1 924.31
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	1 893.40
Marine	20.22	20.22	20.22	17.27	17.27	64.54	42.42	36.17	31.59	30.91
Multilateral Operations	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
CO₂ Emissions from Biomass	12 442.81	13 514.62	12 470.62	12 940.28	13 104.22	16 086.14	17 494.89	19 316.51	20 783.19	21 099.92

Note: All footnotes for this table are given at the end of the table on sheet 5

TABLE 10 EMISSION TRENDS
CO₂
(Part 3 of 3)

Inventory 2010

Submission 2012 v1.3

AUSTRIA

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	2010	Change from base to latest reported year
	(Gg)	%
1. Energy	63 088.31	16.46
A. Fuel Combustion (Sectoral Approach)	62 851.15	16.24
1. Energy Industries	14 173.77	2.77
2. Manufacturing Industries and Construction	15 455.70	21.84
3. Transport	22 205.42	61.23
4. Other Sectors	10 969.98	-20.42
5. Other	46.27	32.19
B. Fugitive Emissions from Fuels	237.17	132.31
1. Solid Fuels	IE,NA,NO	0.00
2. Oil and Natural Gas	237.17	132.31
2. Industrial Processes	9 023.24	19.01
A. Mineral Products	2 935.52	-10.34
B. Chemical Industry	607.80	4.33
C. Metal Production	5 479.91	47.11
D. Other Production	NA	0.00
E. Production of Halocarbons and SF ₆		
F. Consumption of Halocarbons and SF ₆		
G. Other	NA	0.00
3. Solvent and Other Product Use	176.89	-36.67
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⁾	-3 660.75	-63.63
A. Forest Land	-5 411.09	-54.39
B. Cropland	518.20	154.47
C. Grassland	280.75	9.23
D. Wetlands	355.78	86.20
E. Settlements	248.40	-11.75
F. Other Land	347.22	-59.88
G. Other	NE	0.00
6. Waste	2.03	-92.45
A. Solid Waste Disposal on Land	NA,NO	0.00
B. Waste-water Handling		
C. Waste Incineration	2.03	-92.45
D. Other	NA	0.00
7. Other (as specified in Summary I.A)	NA	0.00
Total CO₂ emissions including net CO₂ from LULUCF	68 629.72	31.99
Total CO₂ emissions excluding net CO₂ from LULUCF	72 290.47	16.49
Memo Items:		
International Bunkers	2 080.68	130.03
Aviation	2 049.55	131.33
Marine	31.13	67.71
Multilateral Operations	NO	0.00
CO₂ Emissions from Biomass	22 600.50	128.21

Note: All footnotes for this table are given at the end of the table on sheet 5.

TABLE 10 EMISSION TRENDS

CH₄

(Part 1 of 3)

Inventory 2010

Submission 2012 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	31.90	33.70	32.72	32.48	30.36	31.14	31.82	27.30	26.53	26.03
A. Fuel Combustion (Sectoral Approach)	21.97	23.86	22.02	21.68	19.95	20.39	21.13	16.54	15.95	16.01
1. Energy Industries	0.16	0.18	0.15	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	0.40	0.42	0.43	0.42	0.42
3. Transport	3.07	3.40	3.38	3.38	3.31	3.08	2.77	2.48	2.42	2.11
4. Other Sectors	18.40	19.90	18.12	17.78	16.10	16.76	17.76	13.44	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	9.93	9.84	10.69	10.80	10.41	10.75	10.69	10.76	10.58	10.02
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	9.41	9.39	10.32	10.43	10.11	10.47	10.46	10.52	10.33	9.78
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	188.77	188.94	188.83	192.09	188.85	185.59	184.22	182.08
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	20.54	20.21	19.63	19.72	19.48	19.51	19.04	18.77	18.65	17.92
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	0.06	0.06	0.06	0.05	0.05	0.05	0.05	0.05	0.05	0.05
G. Other	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
5. Land Use, Land-Use Change and Forestry	0.03	0.01	0.02	0.02	0.01	0.00	0.00	0.00	0.01	0.00
A. Forest Land	0.03	0.01	0.02	0.02	0.01	0.00	0.00	0.00	0.01	0.00
B. Cropland	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO
C. Grassland	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
D. Wetlands	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
E. Settlements	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO
F. Other Land	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO
G. Other	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
6. Waste	163.20	162.62	158.13	155.73	147.17	138.86	130.94	124.20	119.16	113.79
A. Solid Waste Disposal on Land	157.82	157.23	152.77	150.35	141.80	133.61	125.98	119.60	114.85	109.68
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 I.A)	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Total CH₄ emissions including CH₄ from LULUCF	395.49	393.73	380.31	377.85	367.08	362.77	352.31	337.81	330.65	322.59
Total CH₄ emissions excluding CH₄ from LULUCF	395.46	393.72	380.29	377.84	367.07	362.77	352.31	337.81	330.64	322.59
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
CO₂ Emissions from Biomass										

TABLE 10 EMISSION TRENDS

CH₄

(Part 2 of 3)

Inventory 2010

Submission 2012 v1.3

AUSTRIA

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009
	(Gg)	(Gg)	(Gg)	(Gg)	(Gg)	(Gg)	(Gg)	(Gg)	(Gg)	(Gg)
1. Energy	25.20	25.17	23.91	23.69	23.90	24.27	23.65	23.40	23.63	23.80
A. Fuel Combustion (Sectoral Approach)	15.05	15.12	13.91	13.60	12.93	13.05	11.95	11.31	11.40	10.77
1. Energy Industries	0.16	0.19	0.20	0.24	0.27	0.25	0.29	0.30	0.31	0.34
2. Manufacturing Industries and Construction	0.44	0.46	0.46	0.52	0.57	0.61	0.62	0.62	0.65	0.64
3. Transport	1.92	1.80	1.77	1.67	1.50	1.33	1.16	1.02	0.86	0.77
4. Other Sectors	12.53	12.66	11.48	11.16	10.58	10.85	9.88	9.37	9.58	9.01
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	10.15	10.05	10.00	10.09	10.97	11.22	11.69	12.09	12.23	13.03
1. Solid Fuels	0.27	0.26	0.30	0.25	0.05	0.00	0.00	IE,NA,NO	IE,NA,NO	IE,NA,NO
2. Oil and Natural Gas	9.88	9.79	9.69	9.85	10.92	11.22	11.69	12.09	12.23	13.03
2. Industrial Processes	0.70	0.67	0.71	0.70	0.70	0.75	0.92	0.91	0.89	0.85
A. Mineral Products	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
B. Chemical Industry	0.70	0.67	0.70	0.69	0.70	0.75	0.92	0.90	0.88	0.84
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	180.64	178.30	174.44	172.66	172.30	170.22	169.56	170.25	169.55	171.77
A. Enteric Fermentation	162.71	160.48	157.20	155.71	155.69	153.74	153.23	153.84	153.52	155.49
B. Manure Management	17.43	17.33	16.82	16.50	16.16	16.06	15.87	15.94	15.57	15.83
C. Rice Cultivation	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
D. Agricultural Soils	0.45	0.43	0.38	0.41	0.37	0.37	0.41	0.42	0.41	0.42
E. Prescribed Burning of Savannas	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
F. Field Burning of Agricultural Residues	0.05	0.05	0.05	0.05	0.07	0.05	0.04	0.04	0.04	0.04
G. Other	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
5. Land Use, Land-Use Change and Forestry	0.01	0.00	0.03	0.03	0.00	0.00	0.01	0.01	0.01	0.01
A. Forest Land	0.01	0.00	0.03	0.03	0.00	0.00	0.01	0.01	0.01	0.01
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	108.97	104.93	105.40	107.30	100.80	94.98	90.55	85.08	78.86	73.27
A. Solid Waste Disposal on Land	105.05	101.08	101.64	103.62	96.84	91.00	86.63	81.16	75.05	69.43
B. Waste-water Handling	2.68	2.43	2.18	1.95	1.79	1.64	1.48	1.39	1.30	1.30
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	1.24	1.41	1.58	1.74	2.16	2.33	2.44	2.52	2.51	2.53
7. Other (as specified in Summary I.A)	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Total CH ₄ emissions including CH ₄ from LULUCF	315.52	309.06	304.48	304.38	297.70	290.22	284.69	279.64	272.93	269.69
Total CH ₄ emissions excluding CH ₄ from LULUCF	315.51	309.06	304.46	304.35	297.70	290.22	284.68	279.63	272.93	269.68
Memo Items:										
International Bunkers	0.03	0.03	0.04	0.04	0.04	0.04	0.04	0.04	0.05	0.04
Aviation	0.03	0.03	0.03	0.04	0.04	0.04	0.04	0.04	0.04	0.04
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
CO₂ Emissions from Biomass										

Note: All footnotes for this table are given at the end of the table on sheet 5

TABLE 10 EMISSION TRENDS

CH₄

(Part 3 of 3)

Inventory 2010

Submission 2012 v1.3

AUSTRIA

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	2010	Change from base to latest reported year
	(Gg)	%
1. Energy	25.12	-21.24
A. Fuel Combustion (Sectoral Approach)	11.84	-46.12
1. Energy Industries	0.37	130.56
2. Manufacturing Industries and Construction	0.68	99.81
3. Transport	0.72	-76.65
4. Other Sectors	10.07	-45.27
5. Other	0.00	26.94
B. Fugitive Emissions from Fuels	13.29	33.82
1. Solid Fuels	IE,NA,NO	-100.00
2. Oil and Natural Gas	13.29	41.28
2. Industrial Processes	0.87	23.04
A. Mineral Products	NA	0.00
B. Chemical Industry	0.87	22.89
C. Metal Production	0.00	71.40
D. Other Production		
E. Production of Halocarbons and SF ₆		
F. Consumption of Halocarbons and SF ₆		
G. Other	NA	0.00
3. Solvent and Other Product Use		
4. Agriculture	171.33	-14.19
A. Enteric Fermentation	155.07	-13.24
B. Manure Management	15.75	-23.33
C. Rice Cultivation	NO	0.00
D. Agricultural Soils	0.46	40.46
E. Prescribed Burning of Savannas	NO	0.00
F. Field Burning of Agricultural Residues	0.04	-30.54
G. Other	NA	0.00
5. Land Use, Land-Use Change and Forestry	0.01	-75.50
A. Forest Land	0.01	-75.50
B. Cropland	NA,NO	0.00
C. Grassland	NO	0.00
D. Wetlands	NO	0.00
E. Settlements	NA,NO	0.00
F. Other Land	NA,NO	0.00
G. Other	NA	0.00
6. Waste	68.13	-58.25
A. Solid Waste Disposal on Land	64.29	-59.26
B. Waste-water Handling	1.30	-73.10
C. Waste Incineration	0.00	-98.41
D. Other	2.54	388.01
7. Other (as specified in Summary I.A)	NA	0.00
Total CH₄ emissions including CH₄ from LULUCF	265.46	-32.88
Total CH₄ emissions excluding CH₄ from LULUCF	265.45	-32.87
Memo Items:		
International Bunkers	0.04	174.28
Aviation	0.04	181.79
Marine	0.00	55.89
Multilateral Operations	NO	0.00
CO₂ Emissions from Biomass		

TABLE 10 EMISSION TRENDS

N₂O

(Part 1 of 3)

Inventory 2010

Submission 2012 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	1.79	2.00	1.97	2.04	2.06	2.13	2.24	2.20	2.32	2.34
A. Fuel Combustion (Sectoral Approach)	1.79	2.00	1.97	2.04	2.06	2.13	2.24	2.20	2.32	2.34
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	0.28	0.30	0.31	0.32	0.35	0.36	0.38	0.41
3. Transport	0.62	0.73	0.77	0.81	0.86	0.87	0.90	0.88	0.98	0.95
4. Other Sectors	0.75	0.81	0.78	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	13.96	14.06	13.81
A. Enteric Fermentation										
B. Manure Management	3.02	3.02	2.93	2.97	2.99	3.08	3.05	3.04	3.05	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	0.13	0.13	0.13	0.13	0.13	0.13	0.12	0.12	0.12	0.12
A. Forest Land	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
B. Cropland	0.13	0.13	0.13	0.13	0.13	0.13	0.12	0.12	0.12	0.12
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	0.43	0.43	0.49	0.55	0.61	0.63	0.68	0.74
A. Solid Waste Disposal on Land										
B. Waste-water Handling	0.35	0.35	0.33	0.32	0.36	0.40	0.45	0.49	0.53	0.58
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 I.A)	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Total N₂O emissions including N₂O from LULUCF	20.13	21.19	19.92	19.36	20.91	21.44	20.34	20.44	20.82	20.74
Total N₂O emissions excluding N₂O from LULUCF	19.99	21.06	19.79	19.23	20.78	21.31	20.22	20.32	20.70	20.62
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
CO₂ Emissions from Biomass										

Note: All footnotes for this table are given at the end of the table on sheet 5.

TABLE 10 EMISSION TRENDS

N₂O

(Part 2 of 3)

Inventory 2010

Submission 2012 v1.3

AUSTRIA

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009
	(Gg)	(Gg)	(Gg)	(Gg)	(Gg)	(Gg)	(Gg)	(Gg)	(Gg)	(Gg)
1. Energy	2.36	2.45	2.47	2.55	2.53	2.61	2.54	2.49	2.42	2.27
A. Fuel Combustion (Sectoral Approach)	2.36	2.45	2.47	2.55	2.53	2.61	2.54	2.49	2.42	2.27
1. Energy Industries	0.16	0.19	0.19	0.22	0.24	0.25	0.29	0.30	0.33	0.32
2. Manufacturing Industries and Construction	0.43	0.43	0.40	0.41	0.41	0.47	0.49	0.51	0.51	0.48
3. Transport	0.98	1.01	1.09	1.13	1.10	1.08	1.00	0.95	0.85	0.79
4. Other Sectors	0.78	0.82	0.79	0.79	0.78	0.81	0.76	0.72	0.74	0.67
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	3.07	2.54	2.60	2.85	0.91	0.88	0.90	0.87	1.05	0.53
A. Mineral Products	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
B. Chemical Industry	3.07	2.54	2.60	2.85	0.91	0.88	0.90	0.87	1.05	0.53
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	0.71	0.67	0.64	0.60	0.56	0.53	0.52	0.51	0.47
4. Agriculture	13.28	13.29	13.22	12.67	12.36	12.38	12.54	12.70	13.18	12.98
A. Enteric Fermentation										
B. Manure Management	2.99	2.98	2.93	2.94	2.95	2.92	2.93	2.95	2.95	2.99
C. Rice Cultivation										
D. Agricultural Soils	10.30	10.31	10.28	9.73	9.41	9.45	9.61	9.75	10.23	9.99
E. Prescribed Burning of Savannas	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
F. Field Burning of Agricultural Residues	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
G. Other	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
5. Land Use, Land-Use Change and Forestry	0.12	0.12	0.12	0.12	0.11	0.12	0.12	0.14	0.15	0.16
A. Forest Land	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
B. Cropland	0.12	0.12	0.12	0.12	0.11	0.12	0.12	0.14	0.15	0.16
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	0.83	0.93	0.95	0.97	1.03	1.09	1.15	1.18	1.19	1.20
A. Solid Waste Disposal on Land										
B. Waste-water Handling	0.66	0.74	0.74	0.73	0.73	0.77	0.81	0.83	0.84	0.85
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	0.17	0.19	0.22	0.24	0.30	0.32	0.34	0.35	0.35	0.35
7. Other (as specified in Summary 1.A)	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Total N₂O emissions including N₂O from LULUCF	20.41	20.04	20.04	19.79	17.54	17.64	17.79	17.89	18.50	17.61
Total N₂O emissions excluding N₂O from LULUCF	20.29	19.92	19.92	19.68	17.43	17.53	17.66	17.75	18.35	17.45
Memo Items:										
International Bunkers	0.06	0.06	0.06	0.05	0.06	0.09	0.09	0.09	0.09	0.08
Aviation	0.06	0.06	0.05	0.05	0.06	0.07	0.07	0.07	0.07	0.06
Marine	0.01	0.01	0.01	0.01	0.01	0.02	0.02	0.01	0.01	0.01
Multilateral Operations	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
CO₂ Emissions from Biomass										

Note: All footnotes for this table are given at the end of the table on sheet 5.

TABLE 10 EMISSION TRENDS
N₂O
(Part 3 of 3)

Inventory 2010

Submission 2012 v1.3

AUSTRIA

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	2010	Change from base to latest reported year
	(Gg)	%
1. Energy	2.30	28.16
A. Fuel Combustion (Sectoral Approach)	2.30	28.16
1. Energy Industries	0.36	141.62
2. Manufacturing Industries and Construction	0.48	82.93
3. Transport	0.75	19.67
4. Other Sectors	0.71	-6.12
5. Other	0.00	15.95
B. Fugitive Emissions from Fuels	IE,NA	0.00
1. Solid Fuels	IE,NA	0.00
2. Oil and Natural Gas	IE,NA	0.00
2. Industrial Processes	0.20	-93.04
A. Mineral Products	NA	0.00
B. Chemical Industry	0.20	-93.04
C. Metal Production	NA	0.00
D. Other Production		
E. Production of Halocarbons and SF ₆		
F. Consumption of Halocarbons and SF ₆		
G. Other	NA	0.00
3. Solvent and Other Product Use	0.48	-35.39
4. Agriculture	12.43	-11.69
A. Enteric Fermentation		
B. Manure Management	2.99	-1.04
C. Rice Cultivation		
D. Agricultural Soils	9.45	-14.59
E. Prescribed Burning of Savannas	NO	0.00
F. Field Burning of Agricultural Residues	0.00	-33.99
G. Other	NA	0.00
5. Land Use, Land-Use Change and Forestry	0.16	21.58
A. Forest Land	0.00	-75.50
B. Cropland	0.16	21.90
C. Grassland	NO	0.00
D. Wetlands	NO	0.00
E. Settlements	NA,NO	0.00
F. Other Land	NA,NO	0.00
G. Other	NA	0.00
6. Waste	1.20	180.02
A. Solid Waste Disposal on Land		
B. Waste-water Handling	0.85	141.84
C. Waste Incineration	0.00	-95.78
D. Other	0.35	358.41
7. Other (as specified in Summary 1.A)	NA	0.00
Total N₂O emissions including N₂O from LULUCF	16.79	-16.60
Total N₂O emissions excluding N₂O from LULUCF	16.62	-16.86
Memo Items:		
International Bunkers	0.08	116.12
Aviation	0.07	122.12
Marine	0.01	87.46
Multilateral Operations	NO	0.00
CO₂ 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 SF₆

(Part 1 of 3)

Inventory 2010

Submission 2012 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)
Emissions of HFCs⁽³⁾ - (Gg CO₂ equivalent)	26.32	29.56	32.31	243.56	293.06	411.88	531.93	651.68	769.31	876.61
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 CO₂ 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 ₂ F 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 ₃ F 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 ₄ F ₁₀	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO
c-C ₄ F 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 ₅ F ₁₂	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO
C ₆ F 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 CO₂ 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 SF₆

(Part 2 of 3)

Inventory 2010

Submission 2012 v1.3

AUSTRIA

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009
	(Gg)	(Gg)	(Gg)	(Gg)	(Gg)	(Gg)	(Gg)	(Gg)	(Gg)	(Gg)
Emissions of HFCs⁽³⁾ - (Gg CO₂ equivalent)	901.85	924.89	969.18	949.51	955.10	986.36	962.57	1 061.91	1 057.99	1 056.61
HFC-23	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
HFC-32	0.00	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01
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	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO
HFC-125	0.04	0.05	0.05	0.05	0.05	0.06	0.07	0.08	0.08	0.08
HFC-134	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO
HFC-134a	0.40	0.40	0.40	0.42	0.42	0.40	0.36	0.37	0.38	0.37
HFC-152a	0.60	0.61	0.95	0.64	0.43	0.21	0.25	0.25	0.09	0.13
HFC-143	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO
HFC-143a	0.04	0.04	0.04	0.05	0.05	0.06	0.06	0.07	0.07	0.07
HFC-227ea	0.00	0.00	0.00	0.00	0.00	0.00	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)	3.85	4.14	4.05	3.88	4.06	3.98	5.03	7.07	7.39	1.71
Emissions of PFCs⁽³⁾ - (Gg CO₂ equivalent)	84.79	95.91	97.70	116.44	136.65	133.82	145.72	190.12	173.53	35.05
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	IE,NA,NO
C ₂ F 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	IE,NA,NO
C ₃ F ₈	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
C ₄ F ₁₀	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO
i-C ₄ F 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 ₅ F ₁₂	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO
C ₆ F 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)	67.46	81.67	83.46	102.20	125.49	125.04	135.50	182.55	166.39	28.64
Emissions of SF₆⁽³⁾ - (Gg CO₂ equivalent)	595.54	652.28	634.81	566.62	497.35	507.33	465.15	374.54	382.84	349.14
SF ₆	0.02	0.03	0.03	0.02	0.02	0.02	0.02	0.02	0.02	0.01

Note: All footnotes for this table are given at the end of the table on sheet 5.

TABLE 10 EMISSION TRENDS
HFCs, PFCs and SF₆
(Part 3 of 3)

Inventory 2010
Submission 2012 v1.3
AUSTRIA

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	2010	Change from base to latest reported year
	(Gg)	%
Emissions of HFCs⁽³⁾ - (Gg CO₂ equivalent)	1 160.63	4 309.55
HFC-23	0.00	100.00
HFC-32	0.02	100.00
HFC-41	NA,NO	0.00
HFC-43-10mee	NA,NO	-100.00
HFC-125	0.10	100.00
HFC-134	NA,NO	0.00
HFC-134a	0.36	1 868.92
HFC-152a	0.14	100.00
HFC-143	NA,NO	0.00
HFC-143a	0.09	100.00
HFC-227ea	0.00	100.00
HFC-236fa	NA,NO	0.00
HFC-245ca	NA,NO	0.00
Unspecified mix of listed HFCs ⁽⁴⁾ - (Gg CO ₂ equivalent)	1.62	-15.79
Emissions of PFCs⁽³⁾ - (Gg CO₂ equivalent)	69.85	-93.53
CF ₄	IE,NA,NO	-100.00
C ₂ F ₆	IE,NA,NO	-100.00
C ₃ F ₈	0.00	100.00
C ₄ F ₁₀	NA,NO	0.00
c-C ₄ F ₈	IE,NA,NO	0.00
C ₅ F ₁₂	NA,NO	0.00
C ₆ F ₁₄	NA,NO	0.00
Unspecified mix of listed PFCs ⁽⁴⁾ - (Gg CO ₂ equivalent)	63.93	120.07
Emissions of SF₆⁽³⁾ - (Gg CO₂ equivalent)	345.01	-30.20
SF ₆	0.01	-30.20

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 3)**

Inventory 2010
Submission 2012 v1.3
AUSTRIA

GREENHOUSE GAS EMISSIONS	Base year (1990)	1991	1992	1993	1994	1995	1996	1997	1998	1999
	CO ₂ equivalent (Gg)	CO ₂ equivalent (Gg)	CO ₂ equivalent (Gg)	CO ₂ equivalent (Gg)	CO ₂ equivalent (Gg)	CO ₂ equivalent (Gg)	CO ₂ equivalent (Gg)	CO ₂ equivalent (Gg)	CO ₂ equivalent (Gg)	CO ₂ equivalent (Gg)
CO ₂ emissions including net CO ₂ from LULUCF	51 995.41	49 862.74	49 155.32	49 097.05	50 613.60	52 307.32	58 852.74	49 985.00	51 463.66	47 171.39
CO ₂ emissions excluding net CO ₂ from LULUCF	62 059.59	65 643.84	60 138.33	60 516.13	60 899.75	63 943.97	67 383.73	67 180.02	66 763.01	65 344.86
CH ₄ emissions including CH ₄ from LULUCF	8 305.24	8 268.29	7 986.43	7 934.92	7 708.68	7 618.27	7 398.61	7 094.03	6 943.70	6 774.37
CH ₄ emissions excluding CH ₄ from LULUCF	8 304.66	8 268.14	7 986.05	7 934.59	7 708.51	7 618.18	7 398.53	7 093.97	6 943.43	6 774.34
N ₂ O emissions including N ₂ O from LULUCF	6 239.28	6 570.36	6 174.97	6 000.76	6 481.35	6 645.98	6 306.81	6 337.46	6 455.17	6 429.59
N ₂ O emissions excluding N ₂ O from LULUCF	6 198.25	6 529.63	6 134.39	5 960.40	6 441.57	6 606.82	6 268.29	6 299.48	6 417.65	6 392.50
HFCs	26.32	29.56	32.31	243.56	293.06	411.88	531.93	651.68	769.31	876.61
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)	68 139.78	66 462.78	64 500.27	64 109.74	66 126.83	68 208.78	74 395.94	65 312.59	66 600.99	62 117.78
Total (excluding LULUCF)	78 162.33	82 203.00	75 442.31	75 488.13	76 373.04	79 806.18	82 888.33	82 469.57	81 862.56	80 254.13

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	55 396.89	59 290.61	54 363.89	54 779.83	54 815.08	57 669.86	61 474.07	60 554.13	60 531.37	59 274.55
2. Industrial Processes	10 108.40	10 126.98	8 912.12	8 824.00	9 343.79	9 896.75	9 813.62	10 450.56	9 971.69	9 851.69
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	8 557.96	8 747.51	8 284.72	8 050.88	8 556.67	8 720.66	8 246.32	8 223.84	8 227.12	8 104.16
5. Land Use, Land-Use Change and Forestry ⁽⁵⁾	-10 022.56	-15 740.22	-10 942.04	-11 378.39	-10 246.21	-11 597.40	-8 492.38	-17 156.97	-15 261.56	-18 136.35
6. Waste	3 587.28	3 571.93	3 463.94	3 414.94	3 254.24	3 096.47	2 948.66	2 816.67	2 726.05	2 631.47
7. Other	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Total (including LULUCF)⁽⁵⁾	68 139.78	66 462.78	64 500.27	64 109.74	66 126.83	68 208.78	74 395.94	65 312.59	66 600.99	62 117.78

⁽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 CO₂ 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 CO₂ equivalent and that appropriate notation keys should be entered in the cells for the individual chemicals.

⁽⁵⁾ Includes net CO₂, CH₄ and N₂O from LULUCF.

**TABLE 10 EMISSION TRENDS
SUMMARY
(Part 2 of 3)**

Inventory 2010
Submission 2012 v1.3
AUSTRIA

GREENHOUSE GAS EMISSIONS	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009
	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	50 899.43	53 044.87	60 704.83	76 790.33	72 191.57	72 292.40	75 410.65	73 801.23	74 258.78	63 532.16
CO ₂ emissions excluding net CO ₂ from LULUCF	65 972.21	70 004.86	71 720.08	77 758.24	78 215.90	79 723.89	77 032.53	74 362.72	73 921.54	67 225.70
CH ₄ emissions including CH ₄ from LULUCF	6 625.83	6 490.35	6 394.17	6 391.88	6 251.68	6 094.62	5 978.40	5 872.44	5 731.60	5 663.51
CH ₄ emissions excluding CH ₄ from LULUCF	6 625.71	6 490.28	6 393.61	6 391.35	6 251.63	6 094.53	5 978.19	5 872.33	5 731.45	5 663.35
N ₂ O emissions including N ₂ O from LULUCF	6 326.28	6 211.81	6 213.02	6 136.01	5 437.37	5 469.55	5 513.49	5 546.85	5 735.82	5 458.40
N ₂ O emissions excluding N ₂ O from LULUCF	6 289.48	6 175.35	6 176.67	6 099.84	5 401.82	5 433.59	5 474.91	5 504.04	5 688.19	5 409.51
HFCs	901.85	924.89	969.18	949.51	955.10	986.36	962.57	1 061.91	1 057.99	1 056.61
PFCs	84.79	95.91	97.70	116.44	136.65	133.82	145.72	190.12	173.53	35.05
SF ₆	595.54	652.28	634.81	566.62	497.35	507.33	465.15	374.54	382.84	349.14
Total (including LULUCF)	65 433.72	67 420.12	75 013.73	90 950.80	85 469.71	85 484.08	88 475.99	86 847.10	87 340.55	76 094.87
Total (excluding LULUCF)	80 469.58	84 343.58	85 992.07	91 882.00	91 458.44	92 879.51	90 059.07	87 365.67	86 955.53	79 739.35

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009
	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	59 250.78	63 374.21	64 487.54	70 596.35	71 070.90	72 112.85	68 943.92	65 845.55	65 000.43	60 219.86
2. Industrial Processes	10 324.58	10 176.58	10 794.43	10 746.65	10 115.55	10 623.26	10 984.18	11 460.03	11 910.82	9 675.39
3. Solvent and Other Product Use	425.12	424.82	427.08	418.42	374.23	386.59	415.03	388.34	367.24	299.16
4. Agriculture	7 910.93	7 863.86	7 761.32	7 554.56	7 450.57	7 412.12	7 447.12	7 512.44	7 647.15	7 631.63
5. Land Use, Land-Use Change and Forestry ⁽⁵⁾	-15 035.87	-16 923.46	-10 978.34	-931.20	-5 988.73	-7 395.44	-1 583.08	-518.57	385.02	-3 644.48
6. Waste	2 558.17	2 504.11	2 521.70	2 566.02	2 447.19	2 344.70	2 268.81	2 159.30	2 029.90	1 913.30
7. Other	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Total (including LULUCF)⁽⁵⁾	65 433.72	67 420.12	75 013.73	90 950.80	85 469.71	85 484.08	88 475.99	86 847.10	87 340.55	76 094.87

⁽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 CO₂ 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 CO₂ equivalent and that appropriate notation keys should be entered in the cells for the individual chemicals.

⁽⁵⁾ Includes net CO₂, CH₄ and N₂O from LULUCF.

TABLE 10 EMISSION TRENDS
SUMMARY
(Part 3 of 3)

Inventory 2010
Submission 2012 v1.3
AUSTRIA

GREENHOUSE GAS EMISSIONS	2010	Change from base to latest reported year
	CO ₂ equivalent (Gg)	(%)
CO ₂ emissions including net CO ₂ from LULUCF	68 629.72	31.99
CO ₂ emissions excluding net CO ₂ from LULUCF	72 290.47	16.49
CH ₄ emissions including CH ₄ from LULUCF	5 574.65	-32.88
CH ₄ emissions excluding CH ₄ from LULUCF	5 574.51	-32.87
N ₂ O emissions including N ₂ O from LULUCF	5 203.35	-16.60
N ₂ O emissions excluding N ₂ O from LULUCF	5 153.46	-16.86
HFCs	1 160.63	4 309.55
PFCs	69.85	-93.53
SF ₆	345.01	-30.20
Total (including LULUCF)	80 983.22	18.85
Total (excluding LULUCF)	84 593.94	8.23

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	2010	Change from base to latest reported year
	CO ₂ equivalent (Gg)	(%)
1. Energy	64 327.66	16.12
2. Industrial Processes	10 680.47	5.66
3. Solvent and Other Product Use	327.12	-36.09
4. Agriculture	7 452.64	-12.92
5. Land Use, Land-Use Change and Forestry ⁽⁵⁾	-3 610.72	-63.97
6. Waste	1 806.05	-49.65
7. Other	NA	0.00
Total (including LULUCF)⁽⁵⁾	80 983.22	18.85

⁽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 CO₂ 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 CO₂ equivalent and that appropriate notation keys should be entered in the cells for the individual chemicals.

⁽⁵⁾ Includes net CO₂, CH₄ and N₂O 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 2010

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 2010.

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 ₂ O	N ₂ O	N ₂ O	CO ₂	CO ₂	CH ₄	N ₂ O
Article 3.3 activities	Afforestation and Reforestation	R	R	R	NO	R	NO			NO	NO	NO	NO
	Deforestation	R	R	R	IE	R			R	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	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⁾ N₂O emissions from fertilization for Cropland Management, Grazing Land Management and Revegetation should be reported in the Agriculture sector. If a Party is not able to separate fertilizer applied to Forest Land from Agriculture, it may report all N₂O emissions from fertilization in the Agriculture sector.

⁽⁴⁾ If CO₂ 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 CH₄. Parties that include CO₂ 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)}

To current inventory From previous inventory year		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	223.46	NO						223.46
	Deforestation		114.36						114.36
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 elected)	NA	NA		NA	NA	NA		NA
	Revegetation ⁽⁴⁾ (if elected)	NA			NA	NA	NA		NA
Other ⁽⁵⁾		10.22	5.94	NA	NA	NA	NA	8 033.02	8 049.18
Total area at the end of the current inventory year		233.68	120.30	NA	NA	NA	NA	8 033.02	8 387.00

⁽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. cropland/grassland)

⁽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)}

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GREENHOUSE GAS SOURCE AND SINK ACTIVITIES	Net CO ₂ emissions/ removals ^{(3), (4)}	CH ₄ ⁽⁵⁾	N ₂ O ⁽⁶⁾	Net CO ₂ equivalent emissions/removals
	(Gg)			
A. Article 3.3 activities				-1 258.85
A.1. Afforestation and Reforestation ⁽⁷⁾	-2 620.86	NO	NO	-2 620.86
A.1.1. Units of land not harvested since the beginning of the commitment period	-2 620.86	NO	NO	-2 620.86
A.1.2. Units of land harvested since the beginning of the commitment period	NO	NO	NO	NO
A.2. Deforestation	1 362.00	NO	0.00	1 362.00
B. Article 3.4 activities				NA
B.1. Forest Management (if elected)	NA	NA	NA	NA
B.2. Cropland Management (if elected)	NA	NA	NA	NA
B.3. Grazing Land Management (if elected)	NA	NA	NA	NA
B.4. Revegetation (if elected)	NA	NA	NA	NA
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.

KP.A.1.1 Units of land not harvested since the beginning of the commitment period/2010: Further information on the methodology is provided in the NIR chapters 10.2 (land-related information) and 10.3. (Activity specific information).

KP.B Article 3.4 activities/2010: Supplementary information on LULUCF activities under the Kyoto Protocol see NIR chapter 10. Austria did not elect any activities under Art. 3.4 of the Kyoto Protocol.

⁽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

⁽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

⁽⁴⁾ CO₂ emissions from liming, biomass burning and drained organic soils, where applicable, are included in this column.

⁽⁵⁾ CH₄ emissions reported here for Cropland Management, Grazing Land Management and Revegetation, if elected, include only emissions from biomass burning (with

⁽⁶⁾ N₂O emissions reported here for Cropland Management, if elected, include only emissions from biomass burning (with the exception of savannah burning and agricultural residue burning which are reported in the Agriculture sector) and N₂O emissions from mineral soils from conversion to Cropland of lands other than Forest Land (Table 5(KP-II)3). Any other N₂O emissions from Agriculture should be reported in the Agriculture sector.

⁽⁷⁾ As both Afforestation and Reforestation under Article 3.3 are subject to the same provisions specified in the annex to 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 CO₂ 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

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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 ⁽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⁾
				(Mg C/ha)										(Mg CO ₂ /ha)	(Gg C)										(Gg CO ₂)
Total for activity A.1.1		233.68	NO	1.00	IE	1.00	0.18	IE	0.18	1.19	NO	0.68	NO	-11.22	#####	IE	234.59	42.00	IE	42.00	278.29	NO	159.89	NO	-2 620.86
Austria		233.68	NO	1.00	IE	1.00	0.18	IE	0.18	1.19	NO	0.68	NO	-11.22	234.5	IE	234.59	42.00	IE	42.00	278.29	NO	159.89	NO	-2 620.86
	converted to Forest Land	34.19	NO	1.00	IE	1.00	0.18	IE	0.18	1.17	NO	0.92	NO	-12.00	34.32	IE	34.32	6.14	IE	6.14	40.12	NO	31.30	NO	-410.22
	converted to Forest Land	137.67	NO	1.00	IE	1.00	0.18	IE	0.18	1.20	NO	-0.45	NO	-7.09	#####	IE	138.20	24.74	IE	24.74	164.60	NO	-61.49	NO	-975.53
	converted to Forest land	24.15	NO	1.00	IE	1.00	0.18	IE	0.18	1.16	NO	3.09	NO	-19.91	24.24	IE	24.24	4.34	IE	4.34	28.01	NO	74.53	NO	-480.78
	converted to Forest Land	27.63	NO	1.00	IE	1.00	0.18	IE	0.18	1.12	NO	2.04	NO	-15.92	27.74	IE	27.74	4.97	IE	4.97	30.99	NO	56.29	NO	-439.98
	converted to Forest Land	10.05	NO	1.00	IE	1.00	0.18	IE	0.18	1.45	NO	5.90	NO	-31.27	10.09	IE	10.09	1.81	IE	1.81	14.57	NO	59.26	NO	-314.35

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.

KP.A.1.1 Austria: Further information on the methodology is provided in the NIR chapters 10.2 (land-related information) and 10.3. (Activity specific information).

⁽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" column and net losses should be reported in the "Losses" column. The notation key IE should be filled in, in the other column.

⁽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 CO₂ 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 (+).

⁽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 CO₂ 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

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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	
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		
(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	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	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	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.

KP.A.1.2 D-Area/2010: Further information is provided in the NIR chapter 10.4.3. Austria reports NO for harvesting on AR areas since 1990. Primarily due to the young age of these stand, the growth conditions in Austria and legal aspects thinning and harvesting is not carried out in stands of the first age class (age 1-20 years).

⁽¹⁾ Report here information on anthropogenic change in carbon stock for the inventory year for all geographical locations that encompass units of land subject to Afforestation and Reforestation under Article 3.3 harvested since the beginning of the commitment period.

⁽²⁾ As both Afforestation and Reforestation under Article 3.3 are subject to the same provisions specified in the annex to draft decision 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" column and net losses should be reported in the "Losses" column. The notation key IE should be filled in, in the other column.

⁽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 CO₂ 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 (+).

⁽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

Article 3.3 activities: Afforestation and Reforestation ^{(1), (2)}

Units of land otherwise subject to elected activities under Article 3.4 (information item)

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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.

⁽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 CO₂ EMISSIONS AND REMOVALS FOR LAND USE, LAND-USE CHANGE AND FORESTRY ACTIVITIES UNDER THE KYOTO PROTOCOL
Article 3.3 activities: Deforestation⁽¹⁾

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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⁾	
(Mg C/ha)													(Mg CO ₂ /ha)	(Gg C)										(Gg CO ₂ /ha)	
Total for activity A.2.		120.30	NO	IE	-0.72	-0.72	IE	-0.19	-0.19	-1.23	IE	-0.94	NO	11.32	IE	-87.15	-87.15	IE	-23.01	-23.01	-148.48	IE	-112.82	NO	1 362.00
Austria		120.30	NO	IE	-0.72	-0.72	IE	-0.19	-0.19	-1.23	IE	-0.94	NO	11.32	IE	-87.15	-87.15	IE	-23.01	-23.01	-148.48	IE	-112.82	NO	1 362.00
	converted to Cropland	9.02	NO	IE	-1.03	-1.03	IE	-0.27	-0.27	-1.90	IE	-1.08	NO	15.67	IE	-9.26	-9.26	IE	-2.45	-2.45	-17.10	IE	-9.76	NO	141.43
	converted to Grassland	65.31	NO	IE	-0.77	-0.77	IE	-0.20	-0.20	-1.32	IE	0.58	NO	6.31	IE	-50.44	-50.44	IE	-13.32	-13.32	-86.30	IE	37.62	NO	412.24
	converted to Other Land	22.29	NO	IE	-0.38	-0.38	IE	-0.10	-0.10	-0.65	IE	-3.02	NO	15.27	IE	-8.58	-8.58	IE	-2.27	-2.27	-14.58	IE	-67.41	NO	340.39
	converted to Settlement	20.13	NO	IE	-0.79	-0.79	IE	-0.21	-0.21	-1.33	IE	-2.88	NO	19.12	IE	-15.95	-15.95	IE	-4.21	-4.21	-26.80	IE	-58.02	NO	384.93
	converted to Wetland	3.54	NO	IE	-0.82	-0.82	IE	-0.22	-0.22	-1.04	IE	-4.31	NO	23.45	IE	-2.92	-2.92	IE	-0.77	-0.77	-3.70	IE	-15.25	NO	83.00

Documentation box
Parties should provide detailed explanation on the land use, land-use change and forestry sector in the relevant annex of the NIR: Supplementary information on LULUCF activities under the Kyoto Protocol. Use this documentation box to provide references to relevant sections of the NIR if any additional details are needed to understand the content of this table.
KP.A.2 Carbon stock change/2010: Further information on the methodology is provided in the NIR chapters 10.2 (land-related information) and 10.3. (Activity specific information)

⁽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 3.1

⁽²⁾ Geographical location refers to the boundaries of the areas that encompass units of land subject to Deforestation.

⁽³⁾ Activity data may be further subdivided according to climate zone, management system, soil type, vegetation type, tree species, ecological zone, national land classification or other criteria. Complete one row for each subdivision

⁽⁴⁾ The signs for estimates of gains in carbon stocks are positive (+) and of losses in carbon stocks are negative (-).

⁽⁵⁾ 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 reported in the "Losses" column. The notation key IE should be filled in, in the other column.

⁽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 CQ by multiplying C by 44/12 and changing the sign for net CQ removals to be negative (-) and for net CO₂ 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**

Article 3.3 activities: Deforestation⁽¹⁾

Units of land otherwise subject to elected activities under Article 3.4 (information item)

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GEOGRAPHICAL LOCATION ⁽²⁾	ACTIVITY DATA	
Identification code	Subdivision ⁽³⁾	Area subject to the activity (kha)
Total for activity A.2.1.		NA
<i>Austria</i>		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 land 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 CO₂ EMISSIONS AND REMOVALS FOR LAND USE, LAND-USE CHANGE AND FORESTRY ACTIVITIES UNDER THE KYOTO PROTOCOL

Elected Article 3.4 activities: Forest Management ⁽¹⁾

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Geographic AL	Activity Data			Implied Carbon Stock Change Factors ⁽⁶⁾										Implied emission/ removal factor per area ⁽⁸⁾	Change in Carbon Stock ⁽⁶⁾										Net CO ₂ emission removals
Identification code	Subdivision ⁽³⁾	Area subject to the activity (kha)	Area of organic soils ⁽⁷⁾ (kha)	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	Organi c soils		Gains	Losses	Net change	Gains	Losses	Net change			Minera l soils	Organic soils ⁽⁹⁾	
				(Mg C/ha)													(Mg CO ₂ /ha)	(Gg C)							
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.

⁽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 CO₂ 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 CO₂ 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⁾							
				(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.

⁽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 C_g by multiplying C by 44/12 and changing the sign for net C_g removals to be negative (-) and for net CO₂ emissions to be positive (+).

TABLE 5(KP-1)B.3. SUPPLEMENTARY BACKGROUND DATA ON CARBON STOCK CHANGES AND NET CO₂ 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)}

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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⁾	
(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 if 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 CQ 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-1)B.4. SUPPLEMENTARY BACKGROUND DATA ON CARBON STOCK CHANGES AND NET CO₂ 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⁾		
																										(Mg C/ha)
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	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	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 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.

⁽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 C₂ by multiplying C by 44/12 and changing the sign for net C₂ removals to be negative (-) and for net CO₂ emissions to be positive (+).

Identification code of geographical location	ACTIVITY DATA	IMPLIED EMISSION FACTOR	EMISSIONS
	Total amount of fertilizer applied (Gg N/year)	N ₂ O-N emissions per unit of fertilizer (kg N ₂ O-N/kg N) ⁽³⁾	N ₂ O (Gg)
A.1.1. Afforestation/Reforestation: units of land not harvested since the beginning of the commitment period ⁽⁴⁾	NO	NO	NO
<i>Austria</i>	NO	NO	NO
A.1.2. Afforestation/Reforestation: units of land harvested since the beginning of the commitment period ⁽⁴⁾	NO	NO	NO
<i>Austria</i>	NO	NO	NO
B.1. Forest Management (if elected) ⁽⁵⁾	NA	NA	NA
<i>Austria</i>	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.
KP.A.1.1 Austria/2010: There is no practice of fertilisation at AR areas in Austria. See also NIR chapter 10.3.1.2.
KP.A.1.2 Austria/2010: There is no practice of fertilisation at AR areas in Austria. See also NIR chapter 10.3.1.2.

⁽¹⁾ N₂O emissions from fertilization for Cropland Management, Grazing Land Management and Revegetation should be reported in the Agriculture sector. If a Party is not able to separate fertilizer applied to Forest Land from Agriculture, it may report all N₂O emissions from fertilization in the Agriculture sector. This

⁽²⁾ Direct N₂O emissions from fertilization are estimated following section 3.2.1.4.1 of the IPCC good practice guidance for LULUCF based on the amount of fertilizer applied to land under Forest Management. The indirect N₂O emissions from Afforestation and Reforestation and land under Forest Management are estimated as part of the total indirect emissions in the Agriculture sector based on the total amount of fertilizer used in the country. Parties should show that double counting of N₂O emissions from fertilization with Agriculture sector estimates has been avoided.

⁽³⁾ In the calculation of the implied emission factor, N₂O emissions are converted to N₂O-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**

Elected Article 3.4 activities: Forest Management

N₂O emissions from drainage of soils ^{(1), (2)}

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Identification code of geographical location ⁽³⁾	ACTIVITY DATA	IMPLIED EMISSION FACTOR	EMISSIONS
	Area of drained soils (kha)	N ₂ O-N per area drained (kg N ₂ O-N/ha) ⁽⁴⁾	N ₂ O (Gg)
B.1. Forest Management (if elected)	NA	NA	NA
<i>Total for organic soils</i>	NA	NA	NA
<i>Total for mineral soils</i>	NA	NA	NA
<i>Austria</i>	NA	NA	NA
Organic soils	NA	NA	NA
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 N₂O 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⁾ N₂O emissions from drainage of soils include those resulting from Forest Management. N₂O 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, N₂O emissions are converted to N₂O-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

N₂O 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 ₂ O-N per area converted ⁽⁵⁾ (kg N ₂ O-N/ha)	N ₂ O (Gg)
A.2. Deforestation ^{(3), (6)}	8.67	0.00	0.00
<i>Total organic soils</i>	NO	NO	NO
<i>Total mineral soils</i>	8.67	0.00	0.00
<i>Austria</i>	8.67	0.00	0.00
Organic soils ^{(7), (10)}	NO	NO	NO
Mineral soils ⁽⁷⁾	8.67	0.00	0.00
B.2. Cropland Management (if elected) ^{(4), (8)}	NA	NA	NA
<i>Total organic soils</i>	NA	NA	NA
<i>Total mineral soils</i>	NA	NA	NA
<i>Austria</i>	NA	NA	NA
Organic soils ^{(7), (10)}	NA	NA	NA
Mineral soils ⁽⁷⁾	NA	NA	NA
Information items ⁽⁹⁾			
A.2.1. Deforestation: units of land otherwise	NO		
<i>Total organic soils</i>	NO		
<i>Total mineral soils</i>	NO		
<i>Austria</i>	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.

KP.A.2 Austria/2010: Further information on the methodology is provided in the NIR chapters 10.2 (land-related information) and 10.3. (Activity specific

⁽¹⁾ Methodologies for N₂O emissions from disturbance associated with land-use conversion to Croplands are found in section 3.3.2.3.1.1 of the IPCC good practice guidance for LULUCF. N₂O emissions from fertilization in the preceding land use and new land use should not be reported here. Parties should avoid double counting with N₂O emissions from drainage and from cultivation of organic soils reported in the Agriculture sector under Cultivation of ~~Forest~~ ^{Forest} ~~Land~~ ^{Land}.

⁽²⁾ According to the IPCC good practice guidance for LULUCF N₂O emissions from disturbance of soils are only relevant for land conversions to Cropland. N₂O 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, N₂O emissions are converted to N₂O-N by multiplying by 28/44.

⁽⁶⁾ N₂O emissions associated with Deforestation followed by the establishment of Cropland should be reported under Deforestation even if Cropland Management is not elected under Article 3.4.

⁽⁷⁾ Parties may separate data for organic and mineral soils, if they have data available.

⁽⁸⁾ This includes N₂O emissions in land subject to Cropland Management from disturbance of soils due to the conversion to Cropland of lands other than Forest Lands.

⁽⁹⁾ Units of land subject to Deforestation under Article 3.3 otherwise subject to elected activities under Article 3.4 are implicitly included under A.2. They are reported here for transparency and to fulfil the requirement of paragraph 6 (b) (ii) of the annex to decision 15/CMP.1.

⁽¹⁰⁾ N₂O 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 application⁽¹⁾

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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
<i>Total for limestone</i>	NO	NO	NO
<i>Total for dolomite</i>	NO	NO	NO
<i>Austria</i>	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
<i>Total for limestone</i>	NO	NO	NO
<i>Total for dolomite</i>	NO	NO	NO
<i>Austria</i>	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
<i>Total for limestone</i>	NO	NO	NO
<i>Total for dolomite</i>	NO	NO	NO
<i>Austria</i>	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
<i>Total for limestone</i>	NA	NA	NA
<i>Total for dolomite</i>	NA	NA	NA
<i>Austria</i>	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
<i>Total for limestone</i>	NA	NA	NA
<i>Total for dolomite</i>	NA	NA	NA
<i>Austria</i>	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
<i>Total for limestone</i>	NA	NA	NA
<i>Total for dolomite</i>	NA	NA	NA
<i>Austria</i>	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
<i>Total for limestone</i>	NA	NA	NA
<i>Total for dolomite</i>	NA	NA	NA
<i>Austria</i>	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.

KP.A.1.1 Austria/2010: There is no practice of lime application on ARD areas in Austria. See also NIR chapter 10.3.1.2.

KP.A.1.2 Austria/2010: There is no practice of lime application on ARD areas in Austria. See also NIR chapter 10.3.1.2.

KP.A.2 Austria/2010: There is no practice of lime application on ARD areas in Austria. See also NIR chapter 10.3.1.2

⁽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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Identification code of geographical location	ACTIVITY DATA			IMPLIED EMISSION			EMISSIONS		
	Description ⁽⁷⁾	Unit	Values	CO ₂	CH ₄	N ₂ O	CO ₂ ⁽⁸⁾	CH ₄ ⁽⁸⁾	N ₂ O
	Area (AB) or biomass burned (BB)	ha or kg dm		(Mg/activity data unit)			(Gg)		
since the beginning of the commitment period ^{(1),(9)}	ab	ha	NO	NO	NO	NO	NO	NO	NO
Total for controlled burning	ab	ha	NO	NO	NO	NO	NO	NO	NO
Total for wildfires	ab	ha	NO	NO	NO	NO	NO	NO	NO
Austria	ab	ha	NO	NO	NO	NO	NO	NO	NO
Controlled burning	ab	ha	NO	NO	NO	NO	NO	NO	NO
Wildfires	ab	ha	NO	NO	NO	NO	NO	NO	NO
A.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) ^{(5),(9)}	ab	ha	NA	NA	NA	NA	NA	NA	NA
Total for controlled burning	ab	ha	NA	NA	NA	NA	NA	NA	NA
Total for wildfires	ab	ha	NA	NA	NA	NA	NA	NA	NA
Austria	ab	ha	NA	NA	NA	NA	NA	NA	NA
Controlled burning	ab	ha	NA	NA	NA	NA	NA	NA	NA
Wildfires	ab	ha	NA	NA	NA	NA	NA	NA	NA
B.2. Cropland Management (if elected) ^{(5),(9),(10)}	ab	ha	NA	NA	NA	NA	NA	NA	NA
Total for controlled burning	ab	ha	NA	NA	NA	NA	NA	NA	NA
Total for wildfires	ab	ha	NA	NA	NA	NA	NA	NA	NA
Austria	ab	ha	NA	NA	NA	NA	NA	NA	NA
Controlled burning	ab	ha	NA	NA	NA	NA	NA	NA	NA
Wildfires	ab	ha	NA	NA	NA	NA	NA	NA	NA
B.3. Grazing Land Management (if elected) ^{(5),(9),(11)}	ab	ha	NA	NA	NA	NA	NA	NA	NA
Total for controlled burning	ab	ha	NA	NA	NA	NA	NA	NA	NA
Total for wildfires	ab	ha	NA	NA	NA	NA	NA	NA	NA
Austria	ab	ha	NA	NA	NA	NA	NA	NA	NA
Controlled burning	ab	ha	NA	NA	NA	NA	NA	NA	NA
Wildfires	ab	ha	NA	NA	NA	NA	NA	NA	NA
B.4. Revegetation (if elected) ^{(6),(9)}	ab	ha	NA	NA	NA	NA	NA	NA	NA
Total for controlled burning	ab	ha	NA	NA	NA	NA	NA	NA	NA
Total for wildfires	ab	ha	NA	NA	NA	NA	NA	NA	NA
Austria	ab	ha	NA	NA	NA	NA	NA	NA	NA
Controlled burning	ab	ha	NA	NA	NA	NA	NA	NA	NA
Wildfires	ab	ha	NA	NA	NA	NA	NA	NA	NA

Documentation box

Provide detailed explanation of the data and any data changes and forestry sector in the relevant section of the table, supplementing information on 2008-2010 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.

KP.A.1.1 Austria/2010: There is no practice of biomass burning at ARD areas in Austria. See also NIR chapter 10.3.1.2.

KP.A.1.2 Austria/2010: There is no practice of biomass burning at ARD areas in Austria. See also NIR chapter 10.3.1.2.

KP.A.2 Austria/2010: There is no practice of biomass burning at ARD areas in Austria. See also NIR chapter 10.3.1.2.

⁽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 CO₂ 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 CH₄. This should be clearly documented in the documentation box and in the NIR. Parties that include all carbon stock changes in the carbon stock tables (5(KP-I)A.1.1 to 5(KP-I)B.4) should report IE (included elsewhere) in the CO₂ column.

⁽⁹⁾ Parties should report controlled/prescribed burning and wildfires emissions separately, where appropriate.

⁽¹⁰⁾ Burning of agricultural residues is included in the Agriculture sector.

⁽¹¹⁾ Greenhouse gas emissions from prescribed savannah burning are reported in the Agriculture sector.

INFORMATION TABLE ON ACCOUNTING FOR ACTIVITIES UNDER ARTICLES 3.3 AND 3.4 OF THE KYOTO PROTOCOL

☐ Commitment period accounting: YES
☐ Annual accounting: NO

AUSTRIA
 Inventory 2010
 Submission 2012 v1.3

Number of the reported year in the commitment period: 3

GREENHOUSE GAS SOURCE AND SINK ACTIVITIES		Net emissions/removals(1)				Accounting Parameters ⁽⁷⁾	Accounting Quantity ⁽⁸⁾
		BY(5)	2008	2009	2010		
	(Gg CO ₂ equivalent)						
A. Article 3.3 activities							
A.1. Afforestation and Reforestation							-7 717.57
A.1.1. Units of land not harvested since the beginning of the commitment period ⁽²⁾		-2 488.47	-2 608.25	-2 620.86	-7 717.57		-7 717.57
A.1.2. Units of land harvested since the beginning of the commitment period ⁽²⁾							NO
Austria		NO	NO	NO	NO		NO
A.2. Deforestation		1 361.63	1 377.60	1 362.00	4 101.24		4 101.24
B. Article 3.4 activities							
B.1. Forest Management (if elected)		NA	NA	NA	NA		NA
3.3 offset ⁽³⁾						0.00	NA
FM cap ⁽⁴⁾						11 550.00	NA
B.2. Cropland Management (if elected)	0.00	NA	NA	NA	NA	0.00	0.00
B.3. Grazing Land Management (if elected)	0.00	NA	NA	NA	NA	0.00	0.00
B.4. Revegetation (if elected)	0.00	NA	NA	NA	NA	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 table.

⁽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 values.

⁽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.