ENVIRONMENT AGENCY AUSTRIA umweltbundesamt

Austria's National Inventory Report 2014

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

AUSTRIA'S NATIONAL INVENTORY REPORT 2014

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

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PREFACE

As a Party to the United Nations Framework Convention on Climate Change (UNFCCC), Austria is required to produce and regularly update National Greenhouse Gas Inventories. To date, National Greenhouse Gas Inventories have been produced for the years 1990 to 2012. With the submission of 2012 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.11[1]. According to this decision Parties shall submit a National Inventory Report (NIR) containing detailed and complete information on their inventories, in order to ensure the transparency of the inventory (see paragraph 38 of FCCC/CP/2002/8). This is the 13th version of the National Inventory Report (NIR) submitted by Austria, it is largely an update of the NIR submitted in 2013[2].

This report is based on data submitted to the UNFCCC in the common reporting format (CRF submission 2014). They differ from last years' 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 2014 and as submitted to the UNFCCC in the data submission 2014 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 secretariat[3]: The report consists of two parts – Part I for reporting the annual inventory submission under the Convention, and Part II for reporting supplementary information required under Article 7, paragraph 1, of the Kyoto Protocol. First, there is an Executive Summary that gives an overview of Austria's greenhouse gas inventory. Chapters 1 and 2 provide general information on the inventory preparation process and summarize the overall trends in emissions, both including information on activities according to Article 3.3 of the Kyoto Protocol. Comprehensive information on the methodologies used for estimating emissions of Austria's greenhouse gas inventory is presented in the Sector Analysis Chapters 3–8. Chapter 9 gives an overview of actions planned to further improve the inventory and of changes previously made (recalculations), it also describes improvements made in response to the UNFCCC reviews. Finally, Chapters 10–14, which form Part II of this report, entail supplementary information required under Article 7, paragraph 1, of the Kyoto Protocol regarding changes to the national system and registry, information on Kyoto Protocol Units[4], methodological information concerning activities under Article 3.3 of the Kyoto Protocol and information on minimization of adverse impacts in accordance with Article 3, paragraph 14.

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

[2] Austria's National Inventory Report 2013 – Submission under the United Nations Framework Convention of Climate Change and the Kyoto Protocol. Report REP-0416; Umweltbundesamt, Vienna.

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

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

The Annex presents detailed information on the methodology of emission estimates for the fuel combustion sector, the CO_2 reference approach and the National Energy Balance, detailed results from the key category analysis as well as information on gas specific recalculations and the uncertainty assessment. Furthermore underlying emission data for the year 2012 as reported in the tables of the common reporting format of the data submission 2014 under the Convention and Tables for reporting emissions and removals of greenhouse gases from acitivities under Article 3.3 under the Kyoto Protocol are included.

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

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

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

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- Annex 6 ....Katja Pazdernik, Michael Anderl
- Annex 7 ....Andreas Zechmeister
- Annex 8 ....Stephan Poupa
- Annex 9 ....Stephan Poupa

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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 2013 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.

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 80 059 Gg CO_2 equivalents in 2012 and increased by 2.5% compared to 1990. The base year for all greenhouse gases is 1990.

The most important GHG in Austria is carbon dioxide (CO_2), it contributed 84.6% to the total national GHG emissions expressed in CO_2 equivalents in 2012, followed by CH_4 (6.6%) and N_2O (6.5%). PFCs, HFCs and SF_6 amounted together to 2.2% of the overall GHG emissions in the country. The sector *Energy* accounted for 74.6% of the total GHG emissions followed by *Industrial Processes* (13.6%), *Agriculture* (9.4%), *Waste* (2.1%) and *Solvent and other product use* (0.4%).

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

GHG		Total	CO_2	CH_4	N_2O	HFCs	PFCs	SF_6
1990*		**78 086.35**	62 017.75	8 332.12	6 197.92	22.55	1 022.65	493.37
1991		**82 135.09**	65 602.05	8 304.63	6 529.38	24.73	1 030.48	643.82
1992		**75 410.77**	60 100.21	8 022.12	6 134.15	26.51	439.81	687.97
1993		**75 484.11**	60 482.17	7 972.23	5 960.22	237.01	52.57	779.93
1994		**76 345.45**	60 877.09	7 737.86	6 441.00	260.33	58.30	970.88
1995		**79 743.56**	63 924.04	7 651.93	6 606.37	339.64	68.39	1 153.20
1996		**82 754.78**	67 365.30	7 429.43	6 267.87	392.57	65.92	1 233.69
1997		**82 277.81**	67 162.49	7 119.09	6 299.94	460.99	96.48	1 138.81
1998		**81 653.02**	66 743.98	6 978.46	6 418.93	555.40	44.40	911.84
1999		**79 966.28**	65 343.17	6 823.58	6 393.87	632.48	64.19	708.98
2000		**80 276.96**	65 992.86	6 676.68	6 290.90	646.82	67.46	602.25
2001	[Gg CO_2 equivalent]	**84 274.66**	70 029.31	6 545.01	6 176.77	773.86	90.03	659.69
2002		**85 975.56**	71 747.63	6 447.39	6 179.42	874.78	83.46	642.89
2003		**91 984.60**	77 800.99	6 447.66	6 105.65	952.51	102.20	575.58
2004		**91 569.35**	78 229.22	6 277.01	5 410.39	1 020.17	125.49	507.07
2005		**92 580.94**	79 392.94	6 099.43	5 449.04	997.37	125.04	517.12
2006		**89 710.79**	76 633.08	5 978.84	5 482.90	1 004.15	136.94	474.88
2007		**86 967.42**	73 980.07	5 866.55	5 510.22	1 042.65	183.72	384.22
2008		**86 882.03**	73 804.48	5 743.37	5 694.16	1 082.02	167.13	390.87
2009		**80 147.97**	67 567.76	5 642.35	5 417.43	1 134.26	28.64	357.54
2010		**84 807.85**	72 366.12	5 562.12	5 178.53	1 285.65	63.93	351.50
2011		**82 760.84**	70 353.70	5 393.54	5 283.00	1 349.00	60.07	321.53
2012		**80 059.36**	67 733.47	5 306.18	5 221.63	1 431.45	40.46	326.18

**1990 = Base Year for CO_2, CH_4 and N_2O, HFCs, PFCs and SF_6*
NOTE: Emissions without LULUCF

Over the period 1990–2012 CO_2 emissions increased by 9.2%, mainly due to increased emissions from transport. Methane emissions decreased during the same period by 36.3% mainly due to lower emissions from solid waste disposal; N_2O emissions decreased by 15.8% over the same period due to lower emissions from agricultural soils and from chemical industry. In 2012 HFC emissions are more than 60 times higher than in the base year, whereas PFC and SF_6 emissions decreased by 96.0% and 33.9% respectively from the base year to 2012.

ES.2.2 KP-LULUCF activities

In 2012 Article 3.3 activities were a net sink in Austria: Net CO_2 removals amounted to 1 506 Gg CO_2.

Removals from Afforestation/Reforestation (AR) amounted to 2 052 Gg CO_2. 60% of these gains were caused by the C stock increases in soil and litter, 40% was due to biomass growth at the AR areas. Approximately 31% of these gains occurred on AR areas from grassland, 10% from settlement, 44% on AR areas from other land, 11% from cropland and 4% from wetlands.

In the same year, emissions from deforestation amounted to 546 Gg CO_2 equivalent. Approximately 60% were due to C stock losses in litter and soil, 40% due to biomass losses at the D areas. Approximately 34% of these losses occurred on D areas to other land, 27% to settlement, 23% to grassland, and the rest at D areas to wetlands and cropland.

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

ES.3.1 GHG inventory

The dominant sector regarding GHG emissions in Austria is the energy sector (74.6%), followed by Industrial Processes (13.6%).

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*		**68 209.13**	**78 086.35**	55 425.27	10 005.29	511.80	8 556.71	-9 877.23	3 587.28
1991		**66 535.33**	**82 135.09**	59 328.01	10 022.82	465.98	8 746.36	-15 599.76	3 571.93
1992		**64 604.49**	**75 410.77**	54 400.84	8 844.74	417.65	8 283.60	-10 806.28	3 463.94
1993		**64 230.94**	**75 484.11**	54 818.29	8 782.55	418.48	8 049.85	-11 253.17	3 414.94
1994	[Gg CO_2 equivalent]	**66 160.29**	**76 345.45**	54 844.64	9 287.45	403.26	8 555.85	-10 185.16	3 254.24
1995		**68 259.73**	**79 743.56**	57 703.82	9 800.84	422.45	8 719.98	-11 483.83	3 096.47
1996		**74 300.64**	**82 754.78**	61 505.05	9 649.57	405.66	8 245.83	-8 454.13	2 948.66
1997		**65 083.50**	**82 277.81**	60 579.98	10 233.17	424.37	8 223.61	-17 194.31	2 816.67
1998		**66 278.12**	**81 653.02**	60 567.66	9 725.80	406.32	8 227.18	-15 374.90	2 726.05
1999		**61 675.27**	**79 966.28**	59 368.36	9 469.35	392.26	8 104.83	-18 291.00	2 631.47
2000		**65 046.00**	**80 276.96**	59 343.60	10 037.96	425.12	7 912.11	-15 230.97	2 558.17
2001		**67 113.84**	**84 274.66**	63 473.31	10 006.96	424.82	7 865.46	-17 160.83	2 504.11
2002		**74 880.22**	**85 975.56**	64 594.65	10 668.71	427.08	7 763.42	-11 095.34	2 521.70
2003		**90 901.77**	**91 984.60**	70 725.45	10 717.51	418.42	7 557.19	-1 082.82	2 566.02
2004		**85 426.69**	**91 569.35**	71 143.15	10 151.01	374.23	7 453.77	-6 142.66	2 447.19
2005	[Gg CO_2 equivalent]	**84 955.67**	**92 580.94**	71 821.10	10 612.62	386.59	7 415.93	-7 625.27	2 344.70
2006		**87 903.30**	**89 710.79**	68 589.60	10 985.76	415.03	7 451.60	-1 807.49	2 268.81
2007		**86 217.01**	**86 967.42**	65 477.86	11 425.20	388.34	7 516.97	-750.41	2 159.06
2008		**87 021.88**	**86 882.03**	64 888.46	11 910.88	367.24	7 652.61	139.85	2 062.84

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
2009	**76 243.58**	**80 147.97**	60 548.85	9 738.75	299.16	7 633.61	-3 904.39	1 927.59
2010	**80 915.05**	**84 807.85**	64 405.46	10 780.73	327.12	7 468.13	-3 892.80	1 826.42
2011	**78 889.87**	**82 760.84**	62 000.40	11 125.32	319.75	7 578.42	-3 870.97	1 736.95
2012	**76 220.84**	**80 059.36**	59 691.53	10 877.24	334.56	7 499.03	-3 838.52	1 657.00

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

In 2012, 59 692 Gg CO_2 equivalents, that is 74.6% of total national emissions, arose from sector *Energy*; 99.2% of these emissions arose from fuel combustion activities. The most important fuel combustion sub-sector was transport with a share of 36.5% (2012). From 1990 to 2012, GHG emissions from *Energy* increased by 7.7%.

Industrial processes was the second largest sector in Austria with a share of 13.6% of total GHG emissions in 2012 (10 877 Gg CO_2 equivalents). The main source of greenhouse gas emissions was metal production, which caused 50.4% of the emissions from this sector in 2012. From the base year to 2012, emissions from *Industrial Processes* increased by 8.7%.

In 2012, 0.4% of total GHG emissions in Austria (335 Gg CO_2 equivalent) arose from sector *Solvent and other product use*. From 1990 to 2012, emissions from this sector decreased by 34.6%.

Emissions from sector *Agriculture* amounted to 7 499 Gg CO_2 equivalent in 2012, which corresponded to 9.4% of total national emissions. In 2012 the most important sub-sector enteric fermentation contributed 42.6% to total greenhouse gas emissions from this sector. In 2012 emissions from *Agriculture* were 12.4% below the level of the base year.

In 2012 greenhouse gas emissions from sector *Waste* amounted to 1 657 Gg CO_2 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 72.5% of the sectoral emissions. In 2012 emissions from *Waste* were 53.8% below the level of the base year.

ES.3.1 KP-LULUCF activities

In 2012 Article 3.3 activities were a net sink in Austria: Net CO_2 removals amounted to 1 506 Gg CO_2.

CO_2 removals from Afforestation/Reforestation (AR) in Austria amounted to 2 052 Gg CO_2. 221 Gg CO_2 resulted from cropland converted to forest land, 645 Gg CO_2 from grassland, 903 Gg CO_2 from other land, 201 Gg CO_2 from settlement and 83 Gg CO_2 from wetland. Emissions from Deforestation (D) activities were approximately 544 Gg CO_2 (546 Gg CO_2 equivalent) in 2012. Forest land converted to cropland amounted to 32 Gg CO_2, to grassland 127 Gg CO_2, to other land 187 Gg CO_2, to settlement 149 Gg CO_2 and to wetland 49 Gg CO_2.

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

Emissions of indirect greenhouse gases decreased in the period from 1990 to 2012: NO_x by 8.5%, CO by 57.7%, NMVOC by 50.6%, and SO_2 by 76.8%. The most important emission source for NO_x, SO_2 and CO is *Energy* (fuel combustion). The most important emission source for NMVOC is *Solvent and other Product Use*.

Table 3: Emissions of indirect GHGs and SO_2 1990–2012.

Year		NO_x	CO	NMVOC	SO_2
1990	[Gg]	194.74	1 435.60	274.19	74.40
1991		201.95	1 499.70	265.90	71.51
1992		192.31	1 470.72	239.93	55.12
1993		186.92	1 438.82	239.75	53.49
1994		181.03	1 385.50	222.80	47.86
1995		180.94	1 272.49	222.53	47.45
1996		202.94	1 247.21	213.79	44.73
1997		190.90	1 150.11	199.07	40.19
1998		204.80	1 109.13	184.31	35.55
1999		197.63	1 030.66	170.38	33.75
2000		205.18	957.37	175.23	31.69
2001		215.30	918.92	175.48	32.77
2002		221.42	883.15	177.13	31.24
2003		232.97	876.52	175.30	31.98
2004		231.48	838.05	156.76	27.38
2005		235.75	812.58	164.96	27.13
2006		221.48	771.94	174.94	27.83
2007		217.42	720.08	161.26	24.75
2008		204.78	683.06	151.68	22.40
2009		188.98	635.92	123.15	17.03
2010		193.07	640.40	134.82	18.57
2011		182.54	603.63	128.51	18.01
2012		178.26	607.21	135.54	17.23

PART 1:
ANNUAL INVENTORY SUBMISSION

1 INTRODUCTION

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

1.1.1 Background information on climate change

1.1.1.1 Global Warming

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

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

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

1.1.1.2 Climate Change in Austria

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

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

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

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

The UNFCCC covers all greenhouse gases not covered by the Montreal protocol[5]: carbon dioxide (CO_2), methane (CH_4), nitrous oxide (N_2O) as well as hydrogenated fluorocarbons (HFCs), perfluorated halocarbons (PFCs) and sulphur hexafluoride (SF_6).

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

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

The KP entered into force on 16 February 2005, triggered by Russia's ratification in November 2004 which fulfilled the requirement that at least 55 Parties to the Convention ratified (or approved, accepted, or acceded to) the Protocol, including Annex I Parties accounting for 55% of that group's carbon dioxide emissions in 1990: by 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 2012. 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 accreditated 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[6] and a centralized review in 2001 (during the trial period of the review process), during the centralized reviews in 2003, 2004, 2005, 2008, 2009, 2010, 2011 and 2012 as well as – most recently – by an In-Country Review in 2013. The reports on these reviews can be found on the UNFCCC website[7].

In 2012 GHG inventories were subject to a technical review performed according to the ESD Review Guidelines, with the aim of supporting the determination of Member States' annual emission allocations under Decision No 406/2009/EC (Effort-Sharing Decision).

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 remov-

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[6] 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.

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

als 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).

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. Parties may also maintain their national registries in a consolidated system. Since 2012, the EU Member States who are also Parties to the Kyoto Protocol (25) plus Iceland, Liechtenstein and Norway have operated their registries in the Consolidated System of EU Registries (CSEUR).

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.

In addition to the Kyoto registries the CSEUR also includes the Union Registry for administrating the European Emissions Trading Scheme (EU ETS) in which EU allowances (EUAs) and EU aviation allowances (aEUAs) are traded.

Changes in the national system

The national system remains unchanged compared to the description given in the Austrian Initial Report under the Kyoto Protocol[8].

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 ex-

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

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

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 (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).

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).

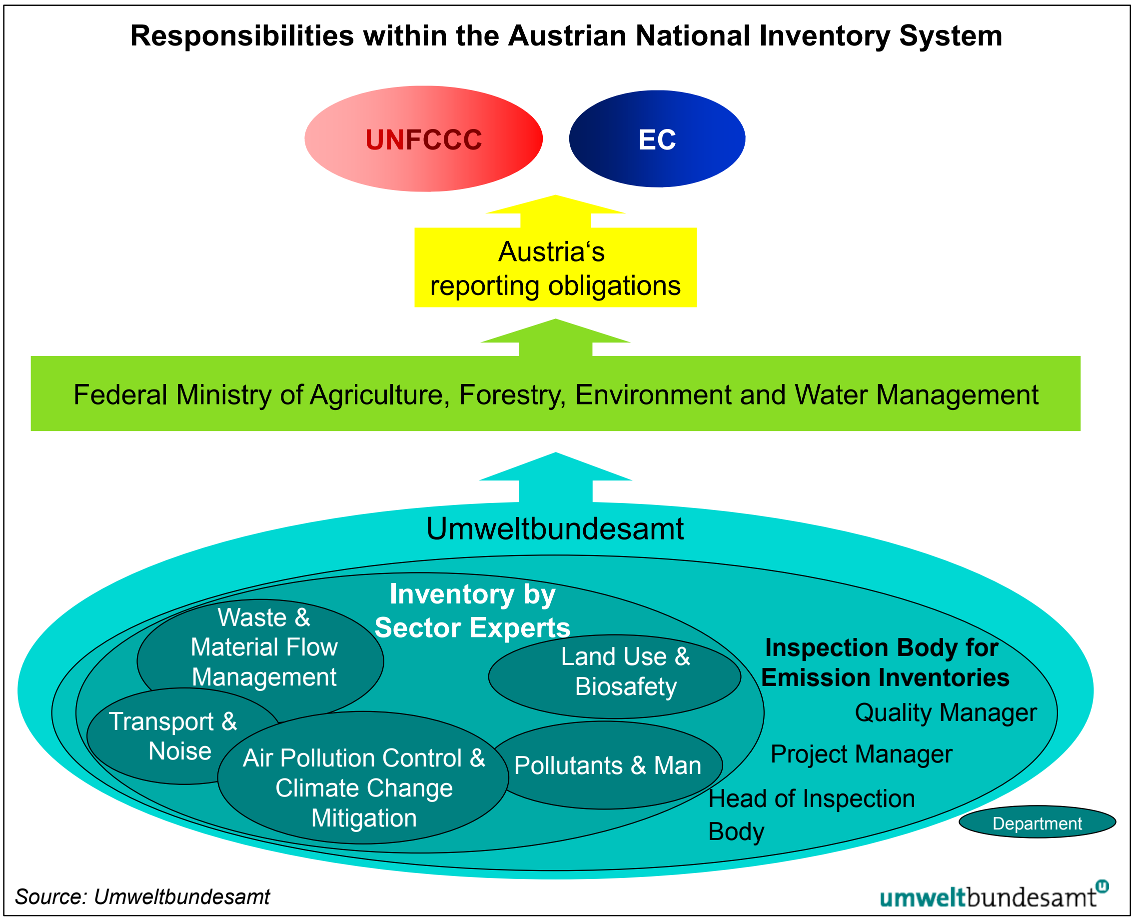

Figure 1: Responsibilities within the Austrian National Inventory System (greenhouse gases).

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. 208/2012. Umweltbundesamt is responsible for the operational management of the registry and serves as a contact point for national and international authorities.

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 Emission Inventories' within the Umweltbundesamt is responsible for the compilation of the greenhouse gas inventory.

Since 23 December 2005, the Umweltbundesamt is accredited as Inspection Body for Emission inventories, Type A (Id.No. 241), in accordance with EN ISO/IEC 17020 and the Austrian Accreditation Law (AkkG), by decree of Accreditation Austria/Federal Ministry of Economics, Family and Youth (No. BMWA-92.715/0036-I/12/2005, issued on 19 January 2006) for the field as published on www.bmwfj.gv.at/akkreditierung.

For more information on the accreditation please refer to Annex 6.

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 Emissions[9]
- This ordinance pertains to the Austrian Emissions Certificate Trading Act[10] 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 (Bundesstatistikgesetz[11]), the Austrian statistical office has to prepare annual import/export statistics, production statistics and statistics on agricultural issues (livestock counts etc.), providing an important data basis for calculating emissions from the sectors *Industrial Processes*, *Solvents and Other Product Use* and *Agriculture*.
- In order to comply with the reporting obligations, the Umweltbundesamt has the possibility to obtain confidential data from the national statistical institute (of course these data have to be treated confidentially). The legal basis for this data exchange is the „Bundesstatistikgesetz"[11] (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)[12] each licencee of an operating boiler with a thermal capacity of 2 megawatts (MW) or more is obligated to report the emissions to the competent authority. The Umweltbundesamt can request copies of these emission declarations. These data are used to verify the data from the national energy balance for the Energy sector.
- According to the Landfill Ordinance (Deponieverordnung)[13] 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.

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[9] *„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

[10] *„Emissionszertifikate-Gesetz"*; Federal Law Gazette I No. 46/2004

[11] *„Bundesstatistikgesetz"*; Federal Law Gazette I No. 163/1999

[12] *„Emissionsschutzgesetz für Kesselanlagen"*; Federal Law Gazette I No. 150/2004

[13] *„Deponieverordnung";* Federal Law Gazette No 164/1996, last amended by by Federal Law Gazette II No 49/2004

- 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).[14] Responsible for data collection and analysis is the BMLFUW. The necessary data is requested by the Umweltbundes for the purpose of inventory preparation.
- Since 2004 there is a reporting obligation to the BMLFUW under the Austrian Fluorinated Compounds (FC) Ordinance[15] for users of FCs for the following applications: refrigeration and air-conditioning, foam blowing, semiconductor manufacture, electrical equipment, fire extinguishers and aerosols. These data are used for estimating emissions from the consumption of fluorinated compounds (IPCC sector *2.F*).

1.2.2 Overview of inventory planning

For the Austrian greenhouse gas inventory the main planning is performed once a year during summer at the so called Management Review: a meeting of the managing director 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 managing director. It includes i.a. an overview of activites 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.

Ad ii.)
On the basis of this report, the managing director, 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 iii.)
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:

- <u>Quality management improvement plan:</u> is in particular based 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.
- <u>Inventory improvement plan:</u> is in particular based 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 managing director . On the basis of the decisions at the management review, the project manager works out a detailed working plan including milestones, timelines and responsibilities.

[14] *„Deponieverordnung 2008"*; Federal Law Gazette II No 39/2008

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

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 ot the National Inventory Report to the EC	March 15
UNFCCC Submission NIR	Submission ot the National Inventory Report to the UNFCCC	April 15

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

Table 5: Overview registry related tasks.

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

1.3 Inventory Preparation

1.3.1 GHG Inventory and KP-LULUCF inventory

The present Austrian greenhouse gas inventory for the period 1990 to 2011 was compiled according to the recommendations for inventories set out in the UNFCCC reporting guidelines according to Decision 18/CP.8, the Common Reporting Format (CRF)[16], 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.

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

1.3.2 Data collection, processing and storage, including for KP-LULUCF inventory

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

For the inventory management a reliable data management to fulfil the data collecting and reporting requirements is needed. As mentioned above, data are collected by the different sector experts and the reporting requirements grow rapidly and may change over time. Data management is carried out by using MS Excel™ spreadsheets in combination with Visual Basic™ macros, which is a very flexible system that can easily be adjusted to new requirements. The data

[16] currently applied: CRF 3.4.3

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 QA/QC 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)

Sector	Data Sources for Activity Data	Emission Calculation
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	Federal Waste Management Plan (Data sources: Database on landfills (1998-2007), Electronic Data Management (from 2008 on))	Umweltbundesamt

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

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

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

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

The main sources for emission factors are:

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

Table *Summary 3* of the CRF (Summary Report for Methods and Emission Factors Used) in Annex 8 presents the methods applied and the origin of emission factors used for the greenhouse gas source and sink categories in the IPCC format for the present Austrian inventory.

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

1.4.1.1 Main Data Suppliers

The main data suppliers are also presented in Table 6.

- The main data supplier for the Austrian Air Emission Inventory is Statistik Austria, providing the underlying energy source data. The Austrian energy balances are based on several databases mainly prepared by the Federal Ministry of Economy, Family and Youth, „Bundeslastverteiler" and Statistik Austria. Their methodology follows the IEA and Eurostat conventions. The aggregated balances, for example transformation input and output or final energy use, are harmonised with the IEA tables as well as their sectoral breakdown which follows the NACE classification.
- Information about activity data and emissions of the industry sector is obtained from *Association of the Austrian Industries* or directly from individual plants. Activity data for some sources are obtained from Statistik Austria which provides statistics on production data[17]. The methodology of the statistics changed in 1996, no data are available for that year and there are some product groups no longer reported in the new statistics.
- Operators of steam boilers with more than 50 MW report their emissions and their activity data directly to the Umweltbundesamt. Data from national and sometimes international studies are also used.
- Until 2008, operators of landfill sites reported their activity data directly to the Austrian Ministry of Environment or the Umweltbundesamt, where they were – after a check – in turn incorporated into a database on landfills. Emissions for the years 1998–2007 are calculated on basis of these data. Since 2009 landfill operators have to register and report their waste input directly at the portal of the Electronic Data 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.

1.4.1.2 Data from the EU Emission trading Scheme

The European Emissions Trading Scheme (EU-ETS) has been established by Directive 2003/87/EC of the European Parliament and of the Council[1]. 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. From 2012 onwards, CO_2 emissions from aviation have also been included. For the trading period 2013–2020 the scope of the EU ETS has been further extended to include additional installations from the metal and chemical industry and compressor stations. For more detailed information on the included activities please refer to Annex I of the above mentioned directive.

At the moment, the greenhouse gases covered under the EU-ETS in Austria are CO_2 (since 2005) and N_2O (since 2010).[2] 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 (~28 Tg CO_2 in 2012).

[17] „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] 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

[2] Austria unilaterally opted-in N_2O as of 2010. Since 2013 N_2O and PFCs have been included in the EU ETS at EU level.

Plant operators have to report their activity data and CO_2 emissions annually; for the first time they reported their emissions of 2005 in March 2006. The first trading period of the EU-ETS ran from 2005–2007. The second trading period, which coincided with the 1st Kyoto commitment period, ran from 2008–2012. The third trading period, which coincides with the 2nd Kyoto commitment period, runs from 2013 to 2020.

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

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 Regulation (EU) No 601/2012[18]. In Austria, Member State specific regulations are defined in the Austrian Emissions Allowance Trading Act[19] and the Austrian Monitoring, Reporting and Verification Ordinance[20]. 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 CO_2 and N_2O 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 fulfil 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 public[21]. 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.

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.

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[18] Commission Regulation (EU) No 601/2012 of 21 June 2012 on the monitoring and reporting of greenhouse gas emissions pursuant to Directive 2003/87/EC of the European Parliament and of the Council.

[19] Emissionszertifikategesetz 2011, Federal Law Gazette I No. 118/2011, as amended

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

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

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 CO_2, CH_4, N_2O, HFC, PFC and SF_6, and all IPCC categories.

The presented key category analysis was performed by the Umweltbundesamt with data for greenhouse gas emissions of the submission 2014 and comprises a level assessment for the years 1990 and 2012 and a trend assessment for the trend of the year 2012 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 (the first time for the NIR 2012, as encouraged in FCCC/ARR/2010/AUT). The results of the Tier 1 analysis are presented in Table 7. Details on the Tier 1 analysis and the results of the Tier 2 analysis can be found in Annex 1.

The key categories without LULUCF (presented in Annex 1) comprise 76 067 Gg CO_2e in the year 2012, which corresponds to 95.0% of Austria's total greenhouse gas emissions (without LULUCF). The key categories including LULUCF amounted to 71 963 Gg CO_2e in 2012.

Table 7: Austrian key categories based on emission data submitted in 2014.

IPCC Category Description		Gas	Emissions 2012 [Gg CO_2e]
1 A 3 b diesel oil	Road Transportation	CO_2	15 808
2 C 1	Iron and Steel Production	CO_2	5 454
1 A 3 b gasoline	Road Transportation	CO_2	4 950
1 A 2 a solid	Iron and Steel	CO_2	4 196
1 A 1 a gaseous	Public Electricity and Heat Production	CO_2	4 021
1 A 4 b liquid	Residential	CO_2	3 880
1 A 1 a solid	Public Electricity and Heat Production	CO_2	3 454
4 A 1	Cattle	CH_4	2 985
1 A 4 b gaseous	Residential	CO_2	2 851
5 A 1	Forest land remaining forest land	CO_2	-2 608
1 A 1 b liquid	Petroleum refining	CO_2	2 368
1 A 2 f gaseous	Other	CO_2	1 955
5 A 2	Land converted to forest land	CO_2	-1 879
4 D 1	Direct Soil Emissions	N_2O	1 807
1 A 2 f liquid	Other	CO_2	1 784
2 A 1	Cement Production	CO_2	1 673
1 A 2 d gaseous	Pulp, Paper and Print	CO_2	1 582
2 F 1	Refrigeration and Air Conditioning Equipment	HFC	1 389
1 A 1 a other	Public Electricity and Heat Production	CO_2	1 288
1 A 2 a gaseous	Iron and Steel	CO_2	1 279
1 A 4 a gaseous	Commercial/Institutional	CO_2	1 217
6 A	SOLID WASTE DISPOSAL ON LAND	CH_4	1 201
1 A 2 c gaseous	Chemicals	CO_2	1 199
4 D 3	Indirect Emissions	N_2O	1 154
1 A 2 e gaseous	Food Processing, Beverages and Tobacco	CO_2	767
1 A 4 c liquid	Agriculture/Forestry/Fisheries	CO_2	759
4 B 1	Cattle	N_2O	731
2 A 2	Lime Production	CO_2	569
1 A 2 f other	Other	CO_2	527
2 B 1	Ammonia Production	CO_2	511
1 A 1 c gaseous	Manufacture of Solid fuels and Other Energy Industries	CO_2	506
1 A 1 b gaseous	Petroleum refining	CO_2	468
1 A 3 e gaseous	Other	CO_2	394
1 A 2 c other	Chemicals	CO_2	392
1 A 2 a liquid	Iron and Steel	CO_2	383

IPCC Category Description		Gas	Emissions 2012 [Gg CO_2e]
1 A 2 d solid	Pulp, Paper and Print	CO_2	348
2 A 7 b	Sinter Production	CO_2	305
1 A 2 f solid	Other	CO_2	288
6 B	WASTEWATER HANDLING	N_2O	266
2 A 3	Limestone and Dolomite Use	CO_2	256
2 F 9	Other Sources of SF6	SF_6	247
4 B 1	Cattle	CH_4	224
1 A 1 a liquid	Public Electricity and Heat Production	CO_2	219
1 A 2 b gaseous	Non-ferrous Metals	CO_2	216
1 A 2 e liquid	Food Processing, Beverages and Tobacco	CO_2	198
5 F 2	Land converted to Other land	CO_2	194
1 A 4 a liquid	Commercial/Institutional	CO_2	189
5 B 2	Land converted to cropland	CO_2	182
1 A 4 b biomass	Residential	CH_4	179
1 A 4 b solid	Residential	CO_2	149
3 D	OTHER	N_2O	146
1 B 2 a	Oil	CO_2	145
1 A 3 c liquid	Railways	CO_2	123
5 E 2	Land converted to Settlements	CO_2	88
2 B 2	Nitric Acid Production	N_2O	53
5 B 1	Cropland remaining cropland	CO_2	43
1 A 2 d liquid	Pulp, Paper and Print	CO_2	41
5 C 2	Land converted to grassland	CO_2	40
2 C 4	SF6 used in Al and Mg Foundries	SF_6	5
1 A 4 a other	Commercial/Institutional	CO_2	2
2 C 3	Aluminium production	PFC	0

The key category with the highest contribution to the national total emissions is *1.A.3.b Road Transportation – diesel oil.* The contribution of *1.A.3.b diesel oil* to the national total emissions in the base year was 6.9%, whereas in 2012 this contribution have increased to 19.7%. 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 diesel oil (CO_2)* is also the most important category in terms of emission trends: Since 1990 emissions increased by 195%.

The second most important source of greenhouse gas emissions in Austria is *2.C.1 Iron and Steel Production*, with a contribution to national total emissions of 6.8% in 2012 compared to 4.5% in the base year.

The key category with the highest contribution to national removals is *5.A.1 Forest land remaining forest land (CO_2)*.

Comparison to last years' submission

Compared to the results of last years' KCA (submission 2013), the following sources have additionally been identified as key:

- *1.B.2.a Oil* (CO_2)
- *1.A.3.c Railways*, liquid (CO_2)
- *5.B.1 Cropland remaining cropland* (CO_2)

5.D.2 Land converted to wetlands was not identified as key any more.

Comparison Tier 1 – Tier 2 KCA (both including and excluding LULUCF)

The following categories have been identified as key additionally to the Tier 1 analysis:

Table 8: comparison results Tier 1 – Tier 2 KCA.

IPCC Category Code	IPCC Category	Greenhouse Gas
1.A.1.a biomass	Public Electricity and Heat Production	N_2O
1.A.3.b diesel oil	Road Transportation	N_2O
1.A.3.b gasoline	Road Transportation	N_2O
1.A.4.b solid	Residential	CH_4
1.B.2.a	Oil	CH_4
4.B.8	Swine	CH_4
4.B.8	Swine	N_2O
4.B.9	Poultry	N_2O
4.D.2	Pasture, Range and Paddock Manure	N_2O
5.D.2	Land converted to wetlands	CO_2
6.B	WASTEWATER HANDLING	CH_4

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 the 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, sector lead, project manager, head of inspection body, managing director – are defined in the QMS.

1.6.1.1 QA/QC Plan

Activities to be conducted by the personnel of the inspection body are written down in quality and technical procedures 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 listed above – quality and technical procedures – form Level 2:

- Level 1: General (the actual 'Quality Manual': general information, description of QMS, general responsibilities, etc.): http://www.umweltbundesamt.at/umweltsituation/luft/emissionsinventur/emi_ueberwachung/
- 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, ...)

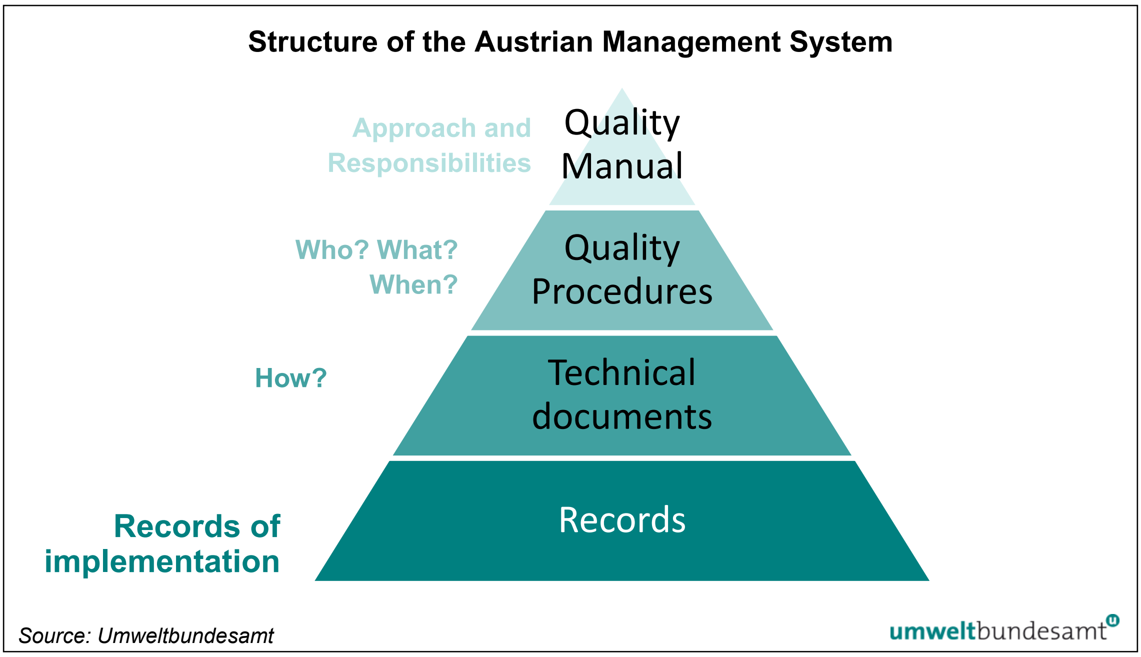

Figure 2: Structure of the Austrian Quality Management System (QMS).

QC Activities

QC activities are performed by the sector experts after inventory work has been finished. Where possible the checks are conducted by the sector expert that has not predominantly prepared the sectoral inventory in the particular year[22]. Additionally, electronic checks (e.g. check for completeness and comparison with last years' 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

QC activities are conducted following QC checklists, covering issues like:

✓ documentation of assumptions
✓ documentation of expert judgements
✓ clear explanation of recalculations
✓ stating of references
✓ plausibility
✓consistency of data
✓ completeness
✓correct transformation/transcription into CFR
✓ information on background tables
✓ consistency of data and information with information in inspection reports
✓ treatment of confidential data

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

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[22] Within the inventory system specific responsibilities for the different emission source/sink categories ('Sector Experts') are defined. There are 8 sectors defined (Energy, Transport, Fugitive Emissions, IP, Solvents, Agriculture, LULUCF and Waste). Two experts form a sector team, whereas one team member is nominated as team leader ('Sector Lead').

Accreditation audits (third party audits)

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

The last audit of the accreditation body took place in May 2013. These audits (obligatory every 15 months) aim 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.

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 have 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 managing director, 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.

Documentation of expert judgements:

- name of the expert and institution/department,
- date,
- basis of judgement (references to relevant studies etc.),
- underlying assumptions.

Expert judgements by an expert of the inventory team or another expert of the Umweltbundesamt have to be made in a written form and documented/archived (as a formal 'note' or in the calculation file). Judgements made by external experts are documented in studies. Relevant literature has to be archived and references to be stated in the internal documentation as well as in the NIR.

1.6.1.5 Focus of QA/QC activities in the year 2013

In May 2013 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 some small changes in the Quality Manual in adaption to the 2012 revised Accreditation Law had to be implemented.

Moreover, in 2013:

- a **risk analysis** was carried out by an external institution to identify and assess potential IT risks, finally confirming the robustness of the approach. Suggestions to further reduce the risks of our approach are planned to be implemented as soon as possible.
- the UNFCCC **In-Country Review** of the 2013 annual submission of Austria took place from Sept. 30 to Oct. 05 2013, further improving the quality of the inventory with respect to completeness and transparency (see Table 291).

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 2000[23].

- 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.

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

- Trust of respondents

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

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 9 (excluding LULUCF) and 10 (including LULUCF) for all categories of the Austrian GHG inventory. Since submission 2012 a complete uncertainty analysis for the whole LULUCF sector is included, as recommended in previous review reports. Table 11 presents the results of the uncertainty analysis Tier 2 approach for all key categories, which were identified in the Key Category Analysis Tier 1 and Tier 2. Uncertainties are presented for each category, and for the level of target year 2011 as well as for the trend in percentage points relative to the total base year (1990) emissions. Table 12 gives the summary results for the Tier 2 uncertainty analysis.

Table 9: 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	√ (E² + F²)	G * D / ∑D	√ (K² + L2)
		%	%	%	%	%
1.A Stationary Combustion - Biomass	CH4	5.0	50.0	50.2	0.13	0.08
1.A Stationary Combustion - Biomass	N2O	5.0	50.0	50.2	0.14	0.08
1.A Stationary Combustion - Gaseous Fuels	CH4	2.0	50.0	50.0	0.00	0.00
1.A Stationary Combustion - Gaseous Fuels	CO2	2.0	0.5	2.1	0.41	0.58
1.A Stationary Combustion - Gaseous Fuels	N2O	2.0	50.0	50.0	0.02	0.01
1.A Stationary Combustion - Liquid Fuels	CH4	0.5	50.0	50.0	0.00	0.00
1.A Stationary Combustion - Liquid Fuels	CO2	0.5	0.5	0.7	0.09	0.10
1.A Stationary Combustion - Liquid Fuels	N2O	0.5	50.0	50.0	0.09	0.01
1.A Stationary Combustion - Other fuels	CH4	10.0	50.0	51.0	0.01	0.00
1.A Stationary Combustion - Other fuels	CO2	10.0	20.0	22.4	0.62	0.55
1.A Stationary Combustion - Other fuels	N2O	10.0	50.0	51.0	0.01	0.01
1.A Stationary Combustion - Solid Fuels	CH4	0.5	50.0	50.0	0.00	0.04
1.A Stationary Combustion - Solid Fuels	CO2	0.5	0.5	0.7	0.08	0.09
1.A Stationary Combustion - Solid Fuels	N2O	0.5	50.0	50.0	0.02	0.01
1.A.3.a Transport - Civil Aviation	CH4	3.0	30.0	30.1	0.00	0.00
1.A.3.a Transport - Civil Aviation	CO2	3.0	3.0	4.2	0.00	0.00
1.A.3.a Transport - Civil Aviation	N2O	3.0	30.0	30.1	0.00	0.00
1.A.3.b Transport - Road Transportation - Diesel	CH4	3.0	30.0	30.1	0.00	0.00
1.A.3.b Transport - Road Transportation - Diesel	CO2	3.0	3.0	4.2	0.84	0.95
1.A.3.b Transport - Road Transportation - Diesel	N2O	3.0	30.0	30.1	0.05	0.03
1.A.3.b Transport - Road Transportation - Gaseous	CO2	3.0	3.0	4.2	0.00	0.00
1.A.3.b Transport - Road Transportation - Gasoline	CH4	3.0	30.0	30.1	0.00	0.02
1.A.3.b Transport - Road Transportation - Gasoline	CO2	3.0	3.0	4.2	0.26	0.30
1.A.3.b Transport - Road Transportation - Gasoline	N2O	3.0	70.0	70.1	0.05	0.07
1.A.3.b Transport - Road Transportation - LPG	CO2	3.0	3.0	4.2	0.00	0.00
1.A.3.c Transport - Railways	CH4	3.0	30.0	30.1	0.00	0.00
1.A.3.c Transport - Railways	CO2	3.0	3.0	4.2	0.01	0.01
1.A.3.c Transport - Railways	N2O	3.0	30.0	30.1	0.01	0.00
1.A.3.d Transport - Navigation	CH4	3.0	30.0	30.1	0.00	0.00
1.A.3.d Transport - Navigation	CO2	3.0	3.0	4.2	0.00	0.00
1.A.3.d Transport - Navigation	N2O	3.0	70.0	70.1	0.00	0.00
1.A.3.e Transport - Other Transportation	CH4	2.0	50.0	50.0	0.00	0.00
1.A.3.e Transport - Other Transportation	CO2	2.0	0.5	2.1	0.01	0.01
1.A.3.e Transport - Other Transportation	N2O	2.0	50.0	50.0	0.00	0.00
1.A.5.b Mobile	CH4	1.0	50.0	50.0	0.00	0.00
1.A.5.b Mobile	CO2	1.0	0.5	1.1	0.00	0.00
1.A.5.b Mobile	N2O	1.0	50.0	50.0	0.00	0.00
1.B.1.a Fugitive Emission - Coal Mining and Handling	CH4	5.0	50.0	50.2	0.00	0.01
1.B.1.b Fugitive Emission - Solid Fuel Transformation	CH4	100.0	100.0	141.4	0.00	0.00
1.B.2.a Fugitive Emission from Oil	CH4	0.5	50.0	50.0	0.08	0.00
1.B.2.a Fugitive Emission from Oil	CO2	0.5	0.5	0.7	0.00	0.00
1.B.2.b Fugitive Emission from Natural Gas	CH4	5.0	10.0	11.2	0.02	0.01
1.B.2.b Fugitive Emission from Natural Gas	CO2	5.0	0.5	5.0	0.01	0.01
2.A.1 Cement Production	CO2	1.1	2.0	2.3	0.05	0.03
2.A.2 Lime Production	CO2	1.6	5.0	5.2	0.04	0.02
2.A.3 Limestone and Dolomite Use	CO2	19.6	2.0	19.7	0.06	0.09
2.A.4 Soda Ash Use	CO2	0.0	0.0	0.0	0.00	0.00
2.A.7.a Glass, Bricks and Ceramics - Bricks and Tiles (decarbonizing)	CO2	2.0	5.0	5.4	0.01	0.00
2.A.7.b Glass, Bricks and Ceramics - Sinter Production	CO2	2.0	5.0	5.4	0.02	0.02
2.A.7.c Glass, Bricks and Ceramics - Glass Production	CO2	2.1	5.0	5.4	0.00	0.00
2.B.1 Chemical Industry - Ammonia Production	CH4	2.0	5.0	5.4	0.00	0.00
2.B.1 Chemical Industry - Ammonia Production	CO2	2.0	0.0	2.0	0.01	0.02
2.B.2 Chemical Industry - Nitric Acid Production	CO2	2.0	0.5	2.1	0.00	0.00
2.B.2 Chemical Industry - Nitric Acid Production	N2O	2.0	5.0	5.4	0.00	0.06
2.B.4 Chemical Industry - Carbide Production	CO2	0.0	0.0	0.0	0.00	0.00
2.B.4 Chemical Industry - Carbide Production	N2O	0.0	0.0	0.0	0.00	0.00
2.B.5 Chemical Industry - Other	CH4	2.0	50.0	50.0	0.01	0.00
2.B.5 Chemical Industry - Other	CO2	2.0	0.5	2.1	0.00	0.00

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	√ (E² + F²)	G * D / ∑D	√ (K² + L2)
		%	%	%	%	%
2.C.1 Metal Production - Iron and Steel Production	CH4	0.5	50.0	50.0	0.00	0.00
2.C.1 Metal Production - Iron and Steel Production	CO2	0.5	0.5	0.7	0.05	0.05
2.C.2 Metal Production - Ferroalloys Production	CO2	2.0	0.5	2.1	0.00	0.00
2.C.3 Metal Production - Aluminium production	CO2	2.0	0.5	2.1	0.00	0.00
2.C.3 Metal Production - Aluminium production	PFC	2.0	50.0	50.0	0.00	0.65
2.C.3 Metal Production - SF6 Used in Aluminium and Magnesium Foun	SF6	0.0	5.0	5.0	0.00	0.02
2.F.1 Refrigeration and Air Conditioning Equipment	HFC	20.0	50.0	53.9	0.93	1.02
2.F.2 Foam Blowing	HFC	20.0	50.0	53.9	0.01	0.01
2.F.3 Fire Extinguishers	HFC	20.0	50.0	53.9	0.01	0.01
2.F.4 Aerosols	HFC	20.0	50.0	53.9	0.01	0.01
2.F.5 Solvents	HFC	20.0	50.0	53.9	0.00	0.00
2.F.7 Semiconductor Manufacture	HFC	5.0	10.0	11.2	0.00	0.00
2.F.7 Semiconductor Manufacture	PFC	5.0	10.0	11.2	0.01	0.00
2.F.7 Semiconductor Manufacture	SF6	5.0	10.0	11.2	0.01	0.01
2.F.8 Electrical equipment	SF6	25.0	50.0	55.9	0.02	0.02
2.F.9 Other Sources of SF6	PFC	25.0	50.0	55.9	0.00	0.00
2.F.9 Other Sources of SF6	SF6	25.0	50.0	55.9	0.17	0.13
3.A Paint Application	CO2	5.0	10.0	11.2	0.01	0.01
3.B Degreasing and Dry Cleaning	CO2	0.0	0.0	0.0	0.00	0.00
3.C Chemical Products, Manufacture and Processing	CO2	0.0	0.0	0.0	0.00	0.00
3.D Other	CO2	5.0	10.0	11.2	0.01	0.01
3.D Other	N2O	5.0	20.0	20.6	0.04	0.03
4.A.1 Cattle	CH4	10.0	20.0	22.4	0.83	0.57
4.A.3 Sheep	CH4	10.0	20.0	22.4	0.02	0.01
4.A.4 Goats	CH4	10.0	30.0	31.6	0.00	0.00
4.A.6 Horses	CH4	10.0	30.0	31.6	0.01	0.01
4.A.8 Swine	CH4	10.0	30.0	31.6	0.04	0.02
4.A.9 Poultry	CH4	10.0	30.0	31.6	0.00	0.00
4.A-10 Other	CH4	10.0	30.0	31.6	0.00	0.00
4.B.1 Cattle	CH4	10.0	50.0	51.0	0.14	0.06
4.B.1 Cattle	N2O	10.0	100.0	100.5	0.92	0.15
4.B.3 Sheep	CH4	10.0	50.0	51.0	0.00	0.00
4.B.3 Sheep	N2O	10.0	100.0	100.5	0.03	0.01
4.B.4 Goats	CH4	10.0	50.0	51.0	0.00	0.00
4.B.4 Goats	N2O	10.0	100.0	100.5	0.01	0.00
4.B.6 Horses	CH4	10.0	50.0	51.0	0.00	0.00
4.B.6 Horses	N2O	10.0	100.0	100.5	0.04	0.02
4.B.8 Swine	CH4	10.0	50.0	51.0	0.05	0.04
4.B.8 Swine	N2O	10.0	100.0	100.5	0.07	0.04
4.B.9 Poultry	CH4	10.0	50.0	51.0	0.01	0.00
4.B.9 Poultry	N2O	10.0	100.0	100.5	0.09	0.03
4.B-10 Other	CH4	10.0	50.0	51.0	0.00	0.00
4.B-10 Other	N2O	10.0	100.0	100.5	0.00	0.00
4.D Agricultural Soils	CH4	5.0	100.0	100.1	0.01	0.00
4.D Agricultural Soils	N2O	5.0	150.0	150.1	5.73	0.93
4.F Field Burning of Agricultural Residues	CH4	100.0	40.0	107.7	0.00	0.00
4.F Field Burning of Agricultural Residues	N2O	100.0	50.0	111.8	0.00	0.00
6. D Other Waste	CH4	15.0	0.0	15.0	0.01	0.01
6. D Other Waste	N2O	15.0	0.0	15.0	0.02	0.03
6.A Solid Waste Disposal on Land	CH4	12.0	25.0	27.7	0.42	0.75
6.B Wastewater Handling	CH4	20.0	50.0	53.9	0.02	0.05
6.B Wastewater Handling	N2O	20.0	50.0	53.9	0.18	0.14
6.C Waste Incineration	CH4	7.0	0.0	7.0	0.00	0.00
6.C Waste Incineration	CO2	7.0	20.0	21.2	0.00	0.01
6.C Waste Incineration	N2O	7.0	0.0	7.0	0.00	0.00
Total Key Categories excluding LULUCF	Gg CO2 e				**6.07**	**2.23**

Table 10: 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	√ (E² + F²)	G * D / ∑D	√ (K² + L2)
		%	%	%	%	%
1.A Stationary Combustion - Biomass	CH4	5.0	50.0	50.2	0.13	0.12
1.A Stationary Combustion - Biomass	N2O	5.0	50.0	50.2	0.15	0.08
1.A Stationary Combustion - Gaseous Fuels	CH4	2.0	50.0	50.0	0.00	0.00
1.A Stationary Combustion - Gaseous Fuels	CO2	2.0	0.5	2.1	0.44	0.67
1.A Stationary Combustion - Gaseous Fuels	N2O	2.0	50.0	50.0	0.03	0.01
1.A Stationary Combustion - Liquid Fuels	CH4	0.5	50.0	50.0	0.00	0.00
1.A Stationary Combustion - Liquid Fuels	CO2	0.5	0.5	0.7	0.09	0.11
1.A Stationary Combustion - Liquid Fuels	N2O	0.5	50.0	50.0	0.10	0.02
1.A Stationary Combustion - Other fuels	CH4	10.0	50.0	51.0	0.01	0.00
1.A Stationary Combustion - Other fuels	CO2	10.0	20.0	22.4	0.65	0.62
1.A Stationary Combustion - Other fuels	N2O	10.0	50.0	51.0	0.01	0.01
1.A Stationary Combustion - Solid Fuels	CH4	0.5	50.0	50.0	0.00	0.05
1.A Stationary Combustion - Solid Fuels	CO2	0.5	0.5	0.7	0.08	0.10
1.A Stationary Combustion - Solid Fuels	N2O	0.5	50.0	50.0	0.03	0.02
1.A.3.a Transport - Civil Aviation	CH4	3.0	30.0	30.1	0.00	0.00
1.A.3.a Transport - Civil Aviation	CO2	3.0	3.0	4.2	0.00	0.00
1.A.3.a Transport - Civil Aviation	N2O	3.0	30.0	30.1	0.00	0.00
1.A.3.b Transport - Road Transportation - Diesel	CH4	3.0	30.0	30.1	0.00	0.00
1.A.3.b Transport - Road Transportation - Diesel	CO2	3.0	3.0	4.2	0.88	1.07
1.A.3.b Transport - Road Transportation - Diesel	N2O	3.0	30.0	30.1	0.05	0.04
1.A.3.b Transport - Road Transportation - Gaseous	CO2	3.0	3.0	4.2	0.00	0.00
1.A.3.b Transport - Road Transportation - Gasoline	CH4	3.0	30.0	30.1	0.00	0.03
1.A.3.b Transport - Road Transportation - Gasoline	CO2	3.0	3.0	4.2	0.28	0.35
1.A.3.b Transport - Road Transportation - Gasoline	N2O	3.0	70.0	70.1	0.05	0.09
1.A.3.b Transport - Road Transportation - LPG	CO2	3.0	3.0	4.2	0.00	0.00
1.A.3.c Transport - Railways	CH4	3.0	30.0	30.1	0.00	0.00
1.A.3.c Transport - Railways	CO2	3.0	3.0	4.2	0.01	0.01
1.A.3.c Transport - Railways	N2O	3.0	30.0	30.1	0.01	0.00
1.A.3.d Transport - Navigation	CH4	3.0	30.0	30.1	0.00	0.00
1.A.3.d Transport - Navigation	CO2	3.0	3.0	4.2	0.00	0.00
1.A.3.d Transport - Navigation	N2O	3.0	70.0	70.1	0.00	0.00
1.A.3.e Transport - Other Transportation	CH4	2.0	50.0	50.0	0.00	0.00
1.A.3.e Transport - Other Transportation	CO2	2.0	0.5	2.1	0.01	0.02
1.A.3.e Transport - Other Transportation	N2O	2.0	50.0	50.0	0.00	0.00
1.A.5.b Mobile	CH4	1.0	50.0	50.0	0.00	0.00
1.A.5.b Mobile	CO2	1.0	0.5	1.1	0.00	0.00
1.A.5.b Mobile	N2O	1.0	50.0	50.0	0.00	0.00
1.B.1.a Fugitive Emission - Coal Mining and Handling	CH4	5.0	50.0	50.2	0.00	0.01
1.B.1.b Fugitive Emission - Solid Fuel Transformation	CH4	100.0	100.0	141.4	0.00	0.00
1.B.2.a Fugitive Emission from Oil	CH4	0.5	50.0	50.0	0.09	0.01
1.B.2.a Fugitive Emission from Oil	CO2	0.5	0.5	0.7	0.00	0.00
1.B.2.b Fugitive Emission from Natural Gas	CH4	5.0	10.0	11.2	0.02	0.01
1.B.2.b Fugitive Emission from Natural Gas	CO2	5.0	0.5	5.0	0.01	0.01
2.A.1 Cement Production	CO2	1.1	2.0	2.3	0.05	0.04
2.A.2 Lime Production	CO2	1.6	5.0	5.2	0.04	0.02
2.A.3 Limestone and Dolomite Use	CO2	19.6	2.0	19.7	0.07	0.10
2.A.4 Soda Ash Use	CO2	0.0	0.0	0.0	0.00	0.00
2.A.7.a Glass, Bricks and Ceramics - Bricks and Tiles (decarbonizing)	CO2	2.0	5.0	5.4	0.01	0.00
2.A.7.b Glass, Bricks and Ceramics - Sinter Production	CO2	2.0	5.0	5.4	0.02	0.02
2.A.7.c Glass, Bricks and Ceramics - Glass Production	CO2	2.1	5.0	5.4	0.00	0.00
2.B.1 Chemical Industry - Ammonia Production	CH4	2.0	5.0	5.4	0.00	0.00
2.B.1 Chemical Industry - Ammonia Production	CO2	2.0	0.0	2.0	0.01	0.02
2.B.2 Chemical Industry - Nitric Acid Production	CO2	2.0	0.5	2.1	0.00	0.00
2.B.2 Chemical Industry - Nitric Acid Production	N2O	2.0	5.0	5.4	0.00	0.07
2.B.4 Chemical Industry - Carbide Production	CO2	0.0	0.0	0.0	0.00	0.00
2.B.4 Chemical Industry - Carbide Production	N2O	0.0	0.0	0.0	0.00	0.00
2.B.5 Chemical Industry - Other	CH4	2.0	50.0	50.0	0.01	0.00
2.B.5 Chemical Industry - Other	CO2	2.0	0.5	2.1	0.00	0.00

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	√ (E² + F²)	G * D / ∑D	√ (K² + L2)
		%	%	%	%	%
2.C.1 Metal Production - Iron and Steel Production	CH4	0.5	50.0	50.0	0.00	0.00
2.C.1 Metal Production - Iron and Steel Production	CO2	0.5	0.5	0.7	0.05	0.06
2.C.2 Metal Production - Ferroalloys Production	CO2	2.0	0.5	2.1	0.00	0.00
2.C.3 Metal Production - Aluminium production	CO2	2.0	0.5	2.1	0.00	0.00
2.C.3 Metal Production - Aluminium production	PFC	2.0	50.0	50.0	0.00	0.81
2.C.3 Metal Production - SF6 Used in Aluminium and Magnesium Foundr	SF6	0.0	5.0	5.0	0.00	0.02
2.F.1 Refrigeration and Air Conditioning Equipment	HFC	20.0	50.0	53.9	0.98	1.17
2.F.2 Foam Blowing	HFC	20.0	50.0	53.9	0.01	0.01
2.F.3 Fire Extinguishers	HFC	20.0	50.0	53.9	0.01	0.01
2.F.4 Aerosols	HFC	20.0	50.0	53.9	0.01	0.01
2.F.5 Solvents	HFC	20.0	50.0	53.9	0.00	0.00
2.F.7 Semiconductor Manufacture	HFC	5.0	10.0	11.2	0.00	0.00
2.F.7 Semiconductor Manufacture	PFC	5.0	10.0	11.2	0.01	0.00
2.F.7 Semiconductor Manufacture	SF6	5.0	10.0	11.2	0.01	0.01
2.F.8 Electrical equipment	SF6	25.0	50.0	55.9	0.02	0.02
2.F.9 Other Sources of SF6	PFC	25.0	50.0	55.9	0.00	0.00
2.F.9 Other Sources of SF6	SF6	25.0	50.0	55.9	0.18	0.15
3.A Paint Application	CO2	5.0	10.0	11.2	0.01	0.01
3.B Degreasing and Dry Cleaning	CO2	0.0	0.0	0.0	0.00	0.00
3.C Chemical Products, Manufacture and Processing	CO2	0.0	0.0	0.0	0.00	0.00
3.D Other	CO2	5.0	10.0	11.2	0.01	0.01
3.D Other	N2O	5.0	20.0	20.6	0.04	0.04
4.A.1 Cattle	CH4	10.0	20.0	22.4	0.88	0.68
4.A.3 Sheep	CH4	10.0	20.0	22.4	0.02	0.01
4.A.4 Goats	CH4	10.0	30.0	31.6	0.00	0.00
4.A.6 Horses	CH4	10.0	30.0	31.6	0.01	0.01
4.A.8 Swine	CH4	10.0	30.0	31.6	0.04	0.03
4.A.9 Poultry	CH4	10.0	30.0	31.6	0.00	0.00
4.A-10 Other	CH4	10.0	30.0	31.6	0.00	0.00
4.B.1 Cattle	CH4	10.0	50.0	51.0	0.15	0.08
4.B.1 Cattle	N2O	10.0	100.0	100.5	0.96	0.23
4.B.3 Sheep	CH4	10.0	50.0	51.0	0.00	0.00
4.B.3 Sheep	N2O	10.0	100.0	100.5	0.03	0.01
4.B.4 Goats	CH4	10.0	50.0	51.0	0.00	0.00
4.B.4 Goats	N2O	10.0	100.0	100.5	0.01	0.00
4.B.6 Horses	CH4	10.0	50.0	51.0	0.00	0.00
4.B.6 Horses	N2O	10.0	100.0	100.5	0.04	0.02
4.B.8 Swine	CH4	10.0	50.0	51.0	0.05	0.05
4.B.8 Swine	N2O	10.0	100.0	100.5	0.07	0.06
4.B.9 Poultry	CH4	10.0	50.0	51.0	0.01	0.01
4.B.9 Poultry	N2O	10.0	100.0	100.5	0.09	0.03
4.B-10 Other	CH4	10.0	50.0	51.0	0.00	0.00
4.B-10 Other	N2O	10.0	100.0	100.5	0.00	0.00
4.D Agricultural Soils	CH4	5.0	100.0	100.1	0.01	0.00
4.D Agricultural Soils	N2O	5.0	150.0	150.1	6.02	1.74
4.F Field Burning of Agricultural Residues	CH4	100.0	40.0	107.7	0.00	0.00
4.F Field Burning of Agricultural Residues	N2O	100.0	50.0	111.8	0.00	0.00
5 Total land use categories	CH4			0.0	0.00	0.00
5 Total land use categories	N2O			396.9	0.13	0.00
5 Total land use categories	CO2			491.9	-24.93	0.00
6. D Other Waste	CH4	15.0	0.0	15.0	0.01	0.02
6. D Other Waste	N2O	15.0	0.0	15.0	0.02	0.03
6.A Solid Waste Disposal on Land	CH4	12.0	25.0	27.7	0.44	0.96
6.B Wastewater Handling	CH4	20.0	50.0	53.9	0.02	0.07
6.B Wastewater Handling	N2O	20.0	50.0	53.9	0.19	0.15
6.C Waste Incineration	CH4	7.0	0.0	7.0	0.00	0.00
6.C Waste Incineration	CO2	7.0	20.0	21.2	0.00	0.01
6.C Waste Incineration	N2O	7.0	0.0	7.0	0.00	0.00
Total Key Categories excluding LULUCF	Gg CO2 e				**25.74**	**2.96**

As can be seen, including the LULUCF sector in the analysis results 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.

Table 11: Tier 2 Uncertainty reporting according IPCC (2000) Table 6.2. – including LULUCF.

IPCC Source category	Gas	Uncertainty in year t emissions as % of emissions in the category		Uncertainty introduced on national total in year 2012	Uncertainty introduced into the trend in total national emissions
		% below (2.5 percentile)	% above (97.5 percentile)	%	%-points
1 A 1 a biomass: Public Electricity and Heat Production	N2O	48	49	0.0	0.0
1 A 1 a gaseous: Public Electricity and Heat Production	CO2	2	2	0.1	0.1
1 A 1 a liquid: Public Electricity and Heat Production	CO2	1	1	0.0	0.0
1 A 1 a other: Public Electricity and Heat Production	CO2	21	22	0.4	0.3
1 A 1 a solid: Public Electricity and Heat Production	CO2	1	1	0.0	0.0
1 A 1 b gaseous: Petroleum refining	CO2	2	2	0.0	0.0
1 A 1 b liquid: Petroleum refining	CO2	1	1	0.0	0.0
1 A 1 c gaseous: Manufacture of Solid fuels and Other Energy Ind	CO2	2	2	0.0	0.0
1 A 2 a gaseous: Iron and Steel	CO2	5	5	0.1	0.1
1 A 2 a liquid: Iron and Steel	CO2	1	1	0.0	0.0
1 A 2 a solid: Iron and Steel	CO2	1	1	0.1	0.1
1 A 2 b gaseous: Non-ferrous Metals	CO2	5	5	0.0	0.0
1 A 2 c gaseous: Chemicals	CO2	5	5	0.1	0.1
1 A 2 c other: Chemicals	CO2	21	23	0.1	0.1
1 A 2 d gaseous: Pulp, Paper and Print	CO2	5	5	0.1	0.1
1 A 2 d liquid: Pulp, Paper and Print	CO2	1	1	0.0	0.0
1 A 2 d solid: Pulp, Paper and Print	CO2	1	1	0.0	0.0
1 A 2 e gaseous: Food Processing, Beverages and Tobacco	CO2	5	5	0.0	0.1
1 A 2 e liquid: Food Processing, Beverages and Tobacco	CO2	1	1	0.0	0.0
1 A 2 f gaseous: Other	CO2	5	5	0.1	0.2
1 A 2 f liquid: Other	CO2	1	1	0.0	0.0
1 A 2 f other: Other	CO2	21	23	0.1	0.1
1 A 2 f solid: Other	CO2	1	1	0.0	0.0
1 A 3 b diesel oil: Road Transportation	CO2	4	4	0.8	0.8
1 A 3 b diesel oil: Road Transportation	N2O	30	30	0.0	0.0
1 A 3 b gasoline: Road Transportation	CO2	4	4	0.3	0.4
1 A 3 b gasoline: Road Transportation	N2O	30	70	0.0	0.1
1 A 3 c liquid: Railways	CO2	4	4	0.0	0.0
1 A 3 e gaseous: Other	CO2	2	2	0.0	0.0
1 A 4 a gaseous: Commercial/Institutional	CO2	5	5	0.1	0.1
1 A 4 a liquid: Commercial/Institutional	CO2	1	1	0.0	0.0
1 A 4 a other: Commercial/Institutional	CO2	21	23	0.0	0.1
1 A 4 b biomass: Residential	CH4	49	51	0.1	0.1
1 A 4 b gaseous: Residential	CO2	5	5	0.2	0.2
1 A 4 b liquid: Residential	CO2	1	1	0.1	0.1
1 A 4 b solid: Residential	CH4	49	49	0.0	0.0
1 A 4 b solid: Residential	CO2	1	1	0.0	0.0
1 A 4 c liquid: Agriculture/Forestry/Fisheries	CO2	1	1	0.0	0.0
1 B 2 a: Oil	CH4	49	49	0.1	0.0
1 B 2 a: Oil	CO2	1	1	0.0	0.0
2 A 1: Cement Production	CO2	2	2	0.0	0.1
2 A 2: Lime Production	CO2	5	5	0.0	0.1
2 A 3: Limestone and Dolomite Use	CO2	19	19	0.1	0.1
2 A 7 b: Sinter Production	CO2	5	5	0.0	0.0
2 B 1: Ammonia Production	CO2	2	2	0.0	0.0
2 B 2: Nitric Acid Production	N2O	5	5	0.0	0.1
2 C 1: Iron and Steel Production	CO2	1	1	0.0	0.0
2 C 3: Aluminium production	PFC	0	0	0.0	0.6
2 C 4: SF6 used in Al and Mg Foundries	SF6	5	5	0.0	0.0
2 F 1: Refrigeration and Air Conditioning Equipment	HFC	53	53	0.9	1.0
2 F 9: Other Sources of SF6	SF6	54	55	0.2	0.2
3 D: OTHER	N2O	20	20	0.0	0.1
4 A 1: Cattle	CH4	20	21	0.8	0.4
4 B 1: Cattle	CH4	50	50	0.1	0.1
4 B 1: Cattle	N2O	50	101	0.7	0.1
4 B 8: Swine	CH4	50	50	0.0	0.0
4 B 8: Swine	N2O	50	102	0.1	0.0
4 B 9: Poultry	N2O	50	102	0.1	0.0
4 D 1: Direct Soil Emissions	N2O	70	203	3.5	0.3
4 D 2: Pasture, Range and Paddock Manure	N2O	70.0	202.8	0.2	0.1
4 D 3: Indirect Emissions	N2O	70.0	202.8	2.2	0.4
5: Forest land remaining forest land	CO2	-482.5	-481.2	23.7	33.9
6 A: SOLID WASTE DISPOSAL ON LAND	CH4	26.5	28.3	0.4	0.9
6 B: WASTEWATER HANDLING	CH4	50.6	55.3	0.0	0.1
6 B: WASTEWATER HANDLING	N2O	50.3	55.3	0.2	0.1

Table 12: Tier 2 Uncertainty reporting according IPCC (2000) Table 6.2. – key results including and excluding LULUCF.

Random uncertainty		excl. LULUCF							Incl. LULUCF
		CO_2	CH_4	N_2O	PFC	HFC	SF_6	Total GHG	Total GHG
1990	Mean value [Tg]	62.02	8.33	6.19	1.02	0.02	0.49	78.07	68.17
	Standard deviation	0.37	0.62	2.65	0.25	0.01	0.04	2.76	9.67
	2s	**1.2%**	**14.9%**	**85.7%**	**48.4%**	**49.4%**	**16.0%**	**7.1%**	**28.4%**
2012	Mean value [Tg]	67.73	5.30	5.21	0.04	1.43	0.33	80.05	76.21
	Standard deviation	0.59	0.38	2.37	0.00	0.39	0.08	2.50	9.80
	2s	**1.7%**	**14.4%**	**90.9%**	**11.2%**	**54.0%**	**47.9%**	**6.3%**	**25.7%**

1.7.2 KP-LULUCF inventory

The assessment of the uncertainties of emissions/removals of the ARD lands was carried out for submission 2014 on basis of the ARD NFI 2011/2013. Results are presented in Chapter 10.3.1.5.

1.8 General assessment of the completeness

1.8.1 GHG inventory

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

Sources and sinks

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

Gases

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

Geographic coverage

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

Notation keys

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

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

IE *(included elsewhere):*

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

NE *(not estimated):*

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

NA *(not applicable):*

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

C (confidential):

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

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

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

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

In the following table transparency and completeness of submission 2014 is compared to the submission 2013. The changes since last submission are due to changes in the reporting on Energy and LULUCF (*5.A*) partly following recommendations from the UNFCCC review. Improvements in transparency (less IE) were implemented in the categories *1.A.1.b* (CH_4 emissions from fuel combustion), *1.B.1.b* (CH_4 emissions from charcoal production reported in 2014 for the first time) as well as throughout sector *5 LULUCF* due to improved reporting on carbon stock changes (biomass, deadwood, organic soils).

Table 13: Transparency and completeness in UNFCCC submissions 2014 and 2013.

Sector	**Submission 2014**				**Submission 2013**			
	IE	**NE**	**Transparency**	**Completeness**	**IE**	**NE**	**Transparency**	**Completeness**
1 Energy	33	0	*91%*	*100%*	36	0	*90%*	*100%*
2 Industrial Processes	26	6	*95%*	*99%*	26	6	*95%*	*99%*
3 Solvents	0	0	*100%*	*100%*	0	0	*100%*	*100%*
4 Agriculture	2	0	*96%*	*100%*	2	0	*96%*	*100%*
5 LULUCF	8	7	*97%*	*96%*	13	7	*95%*	*97%*
6 Waste	0	0	*100%*	*100%*	0	0	*100%*	*100%*
Total	**69**	**13**	***95%***	***99%***	**77**	**13**	***94%***	***99%***
Total number of estimates**			**1 257**				**1 257**	

*** 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"[24] – 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 2012, Austria's total greenhouse gas emissions (without LULUCF) amounted to 80.1 million tons CO_2 equivalents. Compared to the base year, emissions increased by 2.5% (CO_2: +9.2%). The trend is dominated by the trend of the energy sector.

Compared to 2011 emissions decreased by 3.3% (CO_2: −3.7%). The key driver for the emissions decrease between 2011 and 2012 was the decreasing consumption of fossil fuels and the increased use of hydro power for electrical power generation.

Table 14: Summary of Austria's anthropogenic greenhouse gas emissions from 1990–2012 (emissions without LULUCF).

GHG		Total	CO_2	CH_4	N_2O	HFCs	PFCs	SF_6
1990*	[Gg CO_2 equivalent]	**78 086.35**	62 017.75	8 332.12	6 197.92	22.55	1 022.65	493.37
1991		**82 135.09**	65 602.05	8 304.63	6 529.38	24.73	1 030.48	643.82
1992		**75 410.77**	60 100.21	8 022.12	6 134.15	26.51	439.81	687.97
1993		**75 484.11**	60 482.17	7 972.23	5 960.22	237.01	52.57	779.93
1994		**76 345.45**	60 877.09	7 737.86	6 441.00	260.33	58.30	970.88
1995		**79 743.56**	63 924.04	7 651.93	6 606.37	339.64	68.39	1 153.20
1996		**82 754.78**	67 365.30	7 429.43	6 267.87	392.57	65.92	1 233.69
1997		**82 277.81**	67 162.49	7 119.09	6 299.94	460.99	96.48	1 138.81
1998		**81 653.02**	66 743.98	6 978.46	6 418.93	555.40	44.40	911.84
1999		**79 966.28**	65 343.17	6 823.58	6 393.87	632.48	64.19	708.98
2000		**80 276.96**	65 992.86	6 676.68	6 290.90	646.82	67.46	602.25
2001		**84 274.66**	70 029.31	6 545.01	6 176.77	773.86	90.03	659.69
2002		**85 975.56**	71 747.63	6 447.39	6 179.42	874.78	83.46	642.89
2003		**91 984.60**	77 800.99	6 447.66	6 105.65	952.51	102.20	575.58
2004		**91 569.35**	78 229.22	6 277.01	5 410.39	1 020.17	125.49	507.07
2005		**92 580.94**	79 392.94	6 099.43	5 449.04	997.37	125.04	517.12

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

GHG	Total	CO_2	CH_4	N_2O	HFCs	PFCs	SF_6
2006	**89 710.79**	76 633.08	5 978.84	5 482.90	1 004.15	136.94	474.88
2007	**86 967.42**	73 980.07	5 866.55	5 510.22	1 042.65	183.72	384.22
2008	**86 882.03**	73 804.48	5 743.37	5 694.16	1 082.02	167.13	390.87
2009	**80 147.97**	67 567.76	5 642.35	5 417.43	1 134.26	28.64	357.54
2010	**84 807.85**	72 366.12	5 562.12	5 178.53	1 285.65	63.93	351.50
2011	**82 760.84**	70 353.70	5 393.54	5 283.00	1 349.00	60.07	321.53
2012	**80 059.36**	67 733.47	5 306.18	5 221.63	1 431.45	40.46	326.18

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

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

The following Figure 3 depicts the trend of Austria's GHG emissions and also shows Austria's Kyoto Target for 2008–2012. The figure excludes emission sources and sinks from the land use, land use change and forestry sector as reported under the UNFCCC.

It has to be noted that for judging the compliance under the Kyoto Protocol sources and sinks related to Article 3.3 of the Kyoto Protocol (as reported in Chapter 10) have to be considered, and also the use of flexible mechanisms under the Kyoto Protocol has to be accounted.

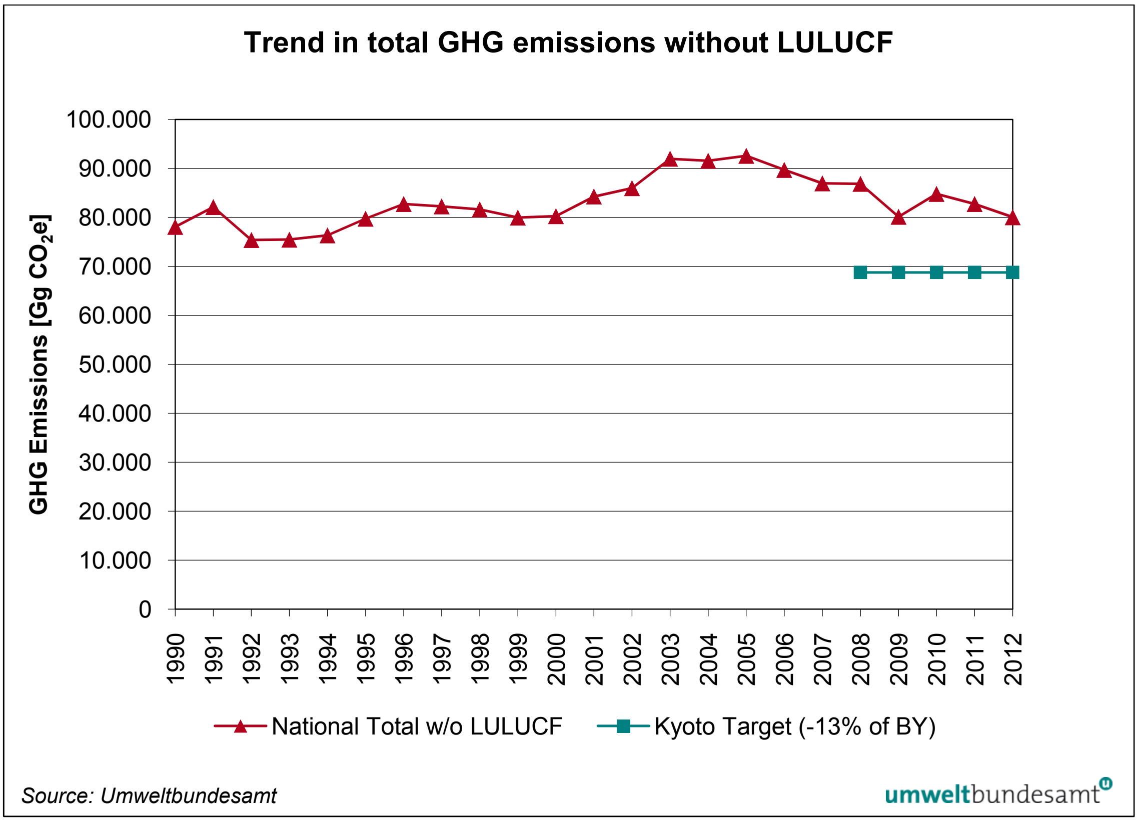

Figure 3: Trend in total GHG emissions 1990–2012 without LULUCF.

2.2 Emission Trends by Gas

The most important GHG in Austria is carbon dioxide (CO_2) with a share of 84.6% in 2012. The CO_2 emissions primarily result from combustion activities. Methane (CH_4), which mainly arises from stock farming and waste disposal, contributes 6.6% to national total GHG emissions, and nitrous oxide with agricultural soils as the main source adds another 6.5%. The remaining 2.2% is due to emissions of fluorinated compounds, which are mostly emitted from the use of these gases as substitutes for ozone depleting substances (ODS) in refrigeration equipment.

Table 15: Austria's greenhouse gas emissions by gas in the base year and in 2012.

GHG	BY 1990	2012	BY 1990	2012
	CO_2 equivalent [Gg]		Share [%]	
Total	**78 086**	**80 059**	**100.0**	**100.0**
CO_2	62 018	67 733	79.4	84.6
CH_4	8 332	5 306	10.7	6.6
N_2O	6 198	5 222	7.9	6.5
F-Gases	1 539	1 798	2.0	2.2

Emissions without LULUCF

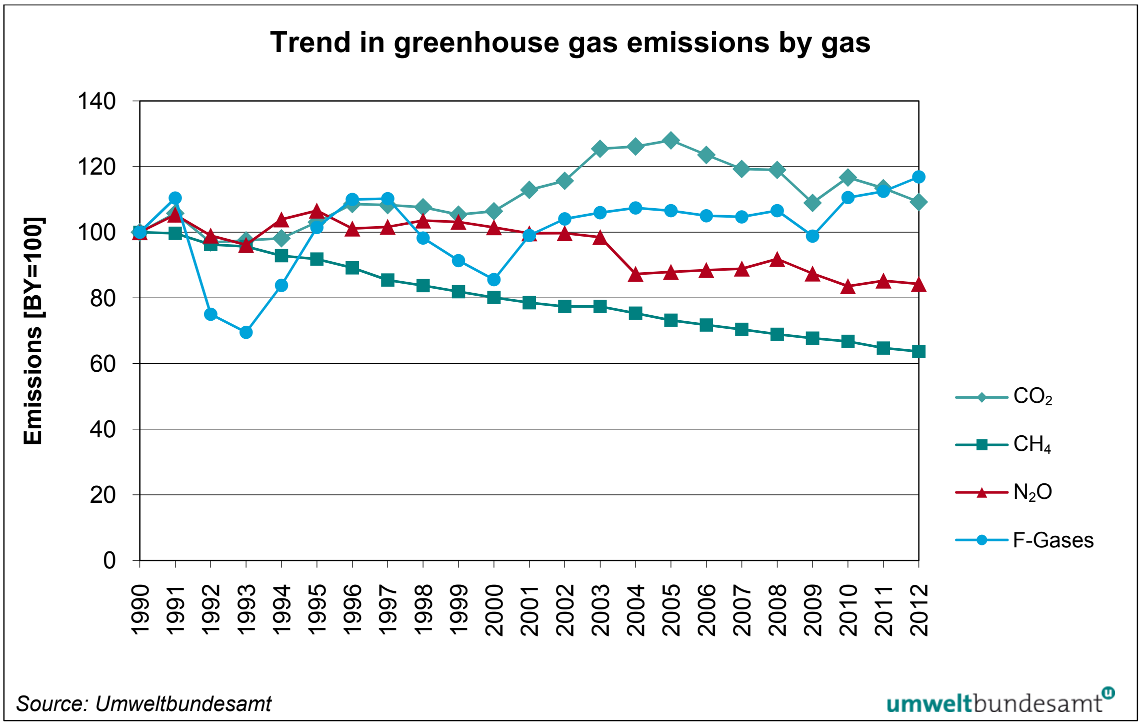

Figure 4: Trend in greenhouse gas emissions 1990–2012 by gas in index form (base year = 100).

CO_2

CO_2 emissions increased by 9.2% from 1990 to 2012. In absolute figures, CO_2 emissions increased from 62 018 to 67 733 Gg during the period from 1990 to 2012 mainly due to higher emissions from transport, which increased by 55.5%.

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

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

CH_4

CH_4 emissions decreased steadily during the period from 1990 to 2012 from 8 332 to 5 306 Gg CO_2 equivalents. In 2012, CH_4 emissions were 36.3% below the level of the base year, mainly due to lower emissions from solid waste disposal sites.

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

N_2O

N_2O emissions in Austria fluctuated between 1990 and 1998, increasing by 3.6% over this period. Since then emissions have shown a decreasing trend, resulting in 5 222 Gg CO_2 equivalents in 2012 compared to 6 198 in the base year (−15.8%). The general decrease is mainly due to lower N_2O emissions from agricultural soils; the strong decrease 2003–2004 was due to emission reduction measures in the chemical industry. Also the decline between 2008 and 2010 is mainly attributable to the chemical industry. Between 2011 and 2012 emissions decreased by 1.2%.

The main source of N_2O emissions are agricultural soils with a share of 58.5% (2012) in national total N_2O emissions. Manure management has a share of 17.6% and fuel combustion, which is another important source of N_2O emissions, has a share of 12.9%.

HFCs

HFC emissions increased remarkably during the period from 1990 to 2012 from 23 to 1 431 Gg CO_2 equivalents. HFCs are used as substitutes for HCFCs (Hydro Chloro Fluoro Carbons; these are ozone depleting substances), the use of which has been banned for most applications.

PFCs

PFC emissions show an inverse trend of HFC emissions. PFC emissions decreased remarkably during the period from 1990 to 2012, from 1 023 to 40 Gg CO_2 equivalents. PFCs were in the base year mainly emitted as by-products of primary aluminium production, which closed down in Austria in 1992; Semiconductor manufacture is the main source of PFC emissions.

SF_6

SF_6 emissions in 1990 amounted to 493 Gg CO_2 equivalents. They increased steadily reaching a maximum of 1 234 Gg CO_2 equivalents in 1996. Since then they have been decreasing. In 2012 SF_6 emissions amounted to 326 Gg CO_2 equivalents, which was 33.9% below the level of the base year (1990).

The main sources of SF_6 emissions are semiconductor manufacture and disposal of noise insulating windows.

2.3 Emission Trends by Source

Table 16 presents a summary of Austria's anthropogenic greenhouse gas emissions by sector.

Table 16: Summary of Austria's anthropogenic greenhouse gas emissions by sector from 1990–2012.

Year	[Gg CO_2 equivalent]	Total	Energy	Industrial processes	Solvents	Agriculture	LULUCF	Waste
1990		**78 086.35**	55 425.27	10 005.29	511.80	8 556.71	-9 877.23	3 587.28
1991		**82 135.09**	59 328.01	10 022.82	465.98	8 746.36	-15 599.76	3 571.93
1992		**75 410.77**	54 400.84	8 844.74	417.65	8 283.60	-10 806.28	3 463.94
1993		**75 484.11**	54 818.29	8 782.55	418.48	8 049.85	-11 253.17	3 414.94
1994		**76 345.45**	54 844.64	9 287.45	403.26	8 555.85	-10 185.16	3 254.24
1995		**79 743.56**	57 703.82	9 800.84	422.45	8 719.98	-11 483.83	3 096.47
1996		**82 754.78**	61 505.05	9 649.57	405.66	8 245.83	-8 454.13	2 948.66
1997		**82 277.81**	60 579.98	10 233.17	424.37	8 223.61	-17 194.31	2 816.67
1998		**81 653.02**	60 567.66	9 725.80	406.32	8 227.18	-15 374.90	2 726.05
1999		**79 966.28**	59 368.36	9 469.35	392.26	8 104.83	-18 291.00	2 631.47
2000		**80 276.96**	59 343.60	10 037.96	425.12	7 912.11	-15 230.97	2 558.17
2001		**84 274.66**	63 473.31	10 006.96	424.82	7 865.46	-17 160.83	2 504.11
2002		**85 975.56**	64 594.65	10 668.71	427.08	7 763.42	-11 095.34	2 521.70
2003		**91 984.60**	70 725.45	10 717.51	418.42	7 557.19	-1 082.82	2 566.02
2004		**91 569.35**	71 143.15	10 151.01	374.23	7 453.77	-6 142.66	2 447.19
2005		**92 580.94**	71 821.10	10 612.62	386.59	7 415.93	-7 625.27	2 344.70
2006		**89 710.79**	68 589.60	10 985.76	415.03	7 451.60	-1 807.49	2 268.81
2007		**86 967.42**	65 477.86	11 425.20	388.34	7 516.97	-750.41	2 159.06
2008		**86 882.03**	64 888.46	11 910.88	367.24	7 652.61	139.85	2 062.84
2009		**80 147.97**	60 548.85	9 738.75	299.16	7 633.61	-3 904.39	1 927.59
2010		**84 807.85**	64 405.46	10 780.73	327.12	7 468.13	-3 892.80	1 826.42
2011		**82 760.84**	62 000.40	11 125.32	319.75	7 578.42	-3 870.97	1 736.95
2012		**80 059.36**	59 691.53	10 877.24	334.56	7 499.03	-3 838.52	1 657.00

Total emissions without LULUCF

The dominant sector regarding GHG emissions in Austria is the sector *Energy*, which caused 74.6% of total greenhouse gas emissions in Austria in 2012 (71.0% in 1990), followed by the Sector *Industrial Processes*, which caused 13.6% (2012) of greenhouse gas emissions. In 2012 emissions from *Energy* are 7.7% and from *Industrial Processes* are 8.7% 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 17: Austria's greenhouse gas emissions by sector in the base year (1990) and in 2012 as well as their share and trend.

GHG	1990	2012	Trend 1990–2012	1990	2012
	Emissions [Gg CO_2e]			Share [%]	
Total	**78 086**	**80 059**	**2.5%**	**100%**	**100%**
1 Energy	55 425	59 692	7.7%	71.0%	74.6%
2 Industry	10 005	10 877	8.7%	12.8%	13.6%
3 Solvent	512	335	-34.6%	0.7%	0.4%
4 Agriculture	8 557	7 499	-12.4%	11.0%	9.4%
5 LULUCF	-9 877	-3 839	-61.1%		
6 Waste	3 587	1 657	-53.8%	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.

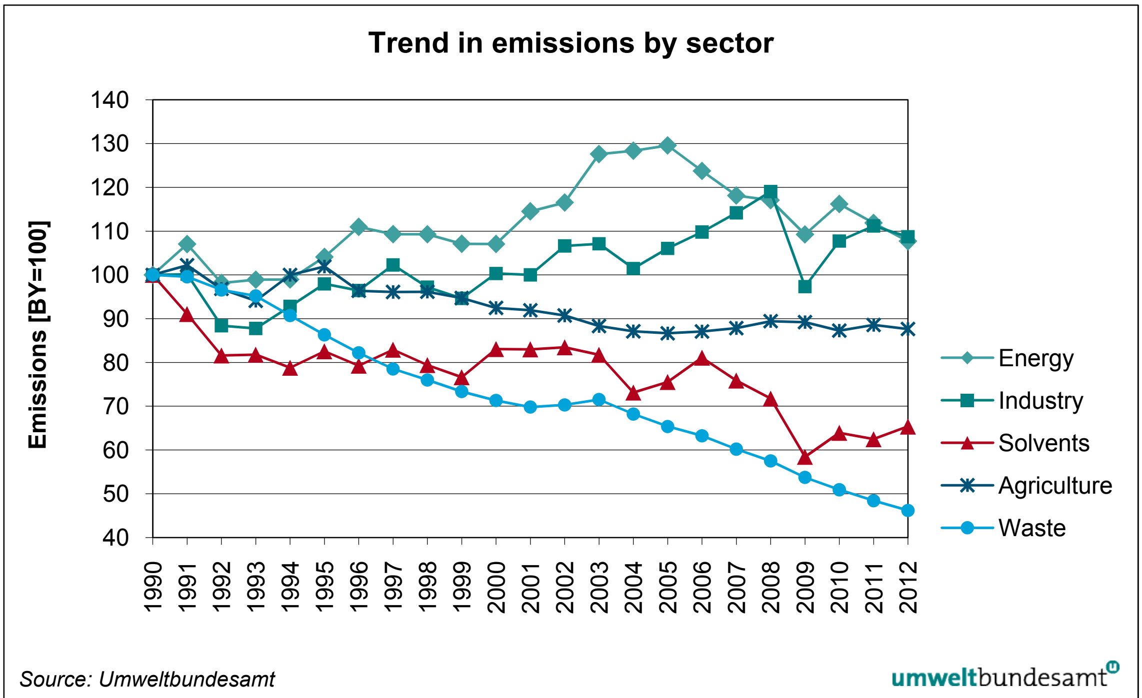

Figure 5: Trend in greenhouse gas emissions 1990–2012 by sector in index form (base year 1990 = 100).

2.3.1 Energy

In 2012 greenhouse gas emissions from the sector *Energy* amounted to 59 692 Gg CO_2 equivalents which correspond to 75% 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.

The overall trend in greenhouse gas emissions from *Energy* shows increasing emissions with a plus of 7.7% from 1990 to 2012. 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 2011 to 2012 emissions from *Energy* decreased by 3.7%. Main drivers for the emission reduction are lower heating oil sales and a reduction of natural gas use for space heating and an increase of electricity production by hydro plants, which goes along with lower electricity production by thermal power plants.

CO_2 contributed 98.1% to the total greenhouse gas emissions from *Energy*, CH_4 0.8% and N_2O 1.1%.

The most important sub-sector of *Energy* in 2012 was transport with a share of 36%, followed by manufacturing industries and construction (26%), energy industries (21%), and other sectors (16%).

Trend 1990–2012 – by subsector

The strong rise in emissions since 1990 from sub-sector transport (+54.2%) is due to an increase of road performance (kilometres driven). In addition to the increase of road performance within Austria, the amount of fuel sold in Austria but driven elsewhere – an effect mainly caused by different fuel prices of neighbouring countries – increased considerably.

The gradual replacement of vehicles by newer, less consuming cars with less specific fuel consumption as well as the increased use of biofuels from 2005 onwards have contributed to the decreasing trend of the last few years. From 2011 to 2012 fuel consumption (gasoline, diesel and alternative fuels) by road transport and mobile off-road vehicles declined by 0.5%, a slight decrease which was mainly due to continued increasing fuel prices in 2012. Specific consumption per vehicle kilometer also declined between 2011 and 2012, by 2% for passenger cars and by 0.2% for heavy duty vehicles.

Energy related emissions from manufacturing industries and construction increased by 22.0% from 1990 to 2012. Fuel consumption increased by 50% in that period, mainly due to increased use of gas and especially biomass. As gas has a lower carbon content, and CO_2 emissions from biomass combustion 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 2012 emissions from sub-sector energy industries were 10.1% below the level of the base year. Emissions from power plants were continuously decreasing since 2005, mainly 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 24.5% (2012), the contribution of hydro and wind power plants to total electricity production increased from 69% to 76% (2012).

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 the subsector other sectors. Emissions in 2012 were 34.1% lower than in 1990. This reduction is mainly attributable to the declining consumption of heating oil and solid fuels and an increase in biomass consumption. Total fuel consumption of this sub sector decreased by 10.4% since 1990.

Fugitive emissions increased by 43.0% since the year 1990. This increase is mainly due to emissions from oil production and natural gas distribution and transmission.

2.3.2 Industrial processes

In 2012 greenhouse gas emissions from *Industrial processes* amounted to 10 877 Gg CO_2 equivalents, which corresponds to 13.6% of the total national emissions.

The overall trend in greenhouse gas emissions from *Industrial processes* shows increasing emissions with an increase of 8.7% from 1990 to 2012. Within this period emissions fluctuated showing a minimum in 1993. Main drivers for the trend in emissions from this sector were (i) the termination of primary aluminium production in 1993, (ii) the introduction of N_2O abatement techniques in the chemical industry in 2004 and in 2009 (which became fully operational in 2010), (iii) increasing metal production resulting in 10.2% higher GHG emissions in 2012 compared to 1990 and (iv) a strong increase of HFC emissions in the period 1992 to 2012 from 23 to 1 431 Gg CO_2 equivalent.

From 2011 to 2012, emissions from this sector decreased by 2.2%, mainly due to decreased production volumes and emissions in major industries such as iron and steel. The largest decreases in emissions were observed in the subcategories metal production (−3.8%) and mineral products (−2.8%).

The most important greenhouse gas of this sector was carbon dioxide with 82.8% of emissions from this category, followed by HFCs with 13.2%, SF_6 with 3.0%, N_2O with 0.5%, PFCs with 0.4% and finally CH_4 with 0.2%.

The most important sub-sectors of the industrial processes sector are metal production and mineral products, which caused 50.4% and 27.1% of the emissions from this sector in 2012.

2.3.3 Solvent and other product use

In 2012 greenhouse gas emissions from *Solvent and other product use* amounted to 335 Gg CO_2 equivalents, which corresponds to 0.4% of the total national emissions.

The overall trend in greenhouse gas emissions from *Solvent and other product use* shows decreasing emissions, with a decrease of 35% from 1990 to 2012. The main driver is a decreasing use of solvents and solvent containing products as a result of legal measures and decreasing N_2O use.

From 2011 to 2012 emissions increased by 4.6% due to an increased use of solvents.

56.5% of these greenhouse gas emissions were indirect CO_2 emissions, 43.5% were contributed by N_2O emissions.

2.3.4 Agriculture

In 2012 emissions from *Agriculture* amounted to 7 499 Gg CO_2 equivalent, which corresponds to 9.4% of the total national emissions.

The overall trend in greenhouse gas emissions from *Agriculture* shows decreasing emissions, with a decrease of 12.4% from 1990 to 2012. 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 2011 to 2012 emissions decreased by 1.0% mainly due to decreased livestock numbers of cattle and swine.

In the Austrian greenhouse gas inventory the sector *Agriculture* is the largest source for both N_2O and CH_4 emissions: In 2012 76% (13 Gg) of total N_2O emissions and 66% (168 Gg) of total CH_4 emissions in Austria originated from this sector. For N_2O this corresponds to 53% of the GHG emissions from agriculture and for methane to 47%.

The most important sub-sectors of *Agriculture* are enteric fermentation, which contributed 43% of total greenhouse gas emissions from the agricultural sector, followed by agricultural soils with a contribution of 41%.

2.3.5 LULUCF

In 2012 net removals from *LULUCF* amounted to 3 839 Gg CO_2 equivalents, which corresponds to 4.8% of total national emissions (without LULUCF) compared to 13% in the base year.[25]

The overall trend in net removals from LULUCF is minus 61% over the observed period (1990–2012). The main driver for this trend is the increase 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).

The most important sub-sector is forest land (5.A) with net removals of 4 487 Gg CO_2 in 2012. CO_2, CH_4 and N_2O emissions arise from the other sub-sectors, with total net emissions amounting to 649 Gg CO_2 equivalents in 2012.

The last available NFI for the estimates in the sector 5.A.1 (forest land remaining forest land) is the NFI 2007/09. For the years after 2008 the mean results for the NFI period 2007/09 are reported as proxy data for this sector.

2.3.6 Waste

In 2012 greenhouse gas emissions from *Waste* amounted to 1 657 Gg CO_2 equivalents, which corresponds to 2.1% of the total national emissions.

The overall trend in greenhouse gas emissions from *Waste* shows decreasing emissions, with a decrease of 54% from 1990 to 2012. 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 (although some exceptions were granted to some Austrian provinces). 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 2011 to 2012 GHG emissions decreased by 4.6% as a result of the declining emissions from waste being deposited in the past.

The most important greenhouse gas is CH_4 with a share of 77.2% in total GHG emissions from this sector in 2012, followed by N_2O with 22.7%, and CO_2 with 0.1%.

The most important sub-sector of *Waste* is solid waste disposal on land, which caused 72% of the emissions from this sector in 2012; the second largest source was waste water handling with 17%.

[25] 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).

2.4 Emission Trends for Indirect Greenhouse Gases and SO_2

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

A detailed description of the methodology used to estimate these emissions is provided in *Austria's Informative Inventory Report (IIR) 2014, Submission under the UNECE/CLRTAP Convention*, which will be published in spring 2014 (UMWELTBUNDESAMT 2014a).

The National total emissions and trends (1990–2012) as well as emission targets[26] 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 18. These reduction targets should be met by 2010 by parties to the UNECE/LRTAP convention who signed this protocol.

Table 18: Total emissions and trends 1990–2012 of indirect GHGs and SO_2 as well as emission targets for air pollutants covered by the Multi-Effect Protocol and CO.

		NO_x	CO	NMVOC	SO_2
1990	Gg	194.74	1 435.60	274.19	74.40
1991		201.95	1 499.70	265.90	71.51
1992		192.31	1 470.72	239.93	55.12
1993		186.92	1 438.82	239.75	53.49
1994		181.03	1 385.50	222.80	47.86
1995		180.94	1 272.49	222.53	47.45
1996		202.94	1 247.21	213.79	44.73
1997		190.90	1 150.11	199.07	40.19
1998		204.80	1 109.13	184.31	35.55
1999		197.63	1 030.66	170.38	33.75
2000		205.18	957.37	175.23	31.69
2001		215.30	918.92	175.48	32.77
2002		221.42	883.15	177.13	31.24
2003		232.97	876.52	175.30	31.98
2004		231.48	838.05	156.76	27.38
2005		235.75	812.58	164.96	27.13
2006		221.48	771.94	174.94	27.83
2007		217.42	720.08	161.26	24.75
2008		204.78	683.06	151.68	22.40
2009		188.98	635.92	123.15	17.03
2010		193.07	640.40	134.82	18.57
2011		182.54	603.63	128.51	18.01
2012		178.26	607.21	135.54	17.23
Trend 1990–2012		***-8.5%***	***-57.7%***	***-50.6%***	***-76.8%***
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

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

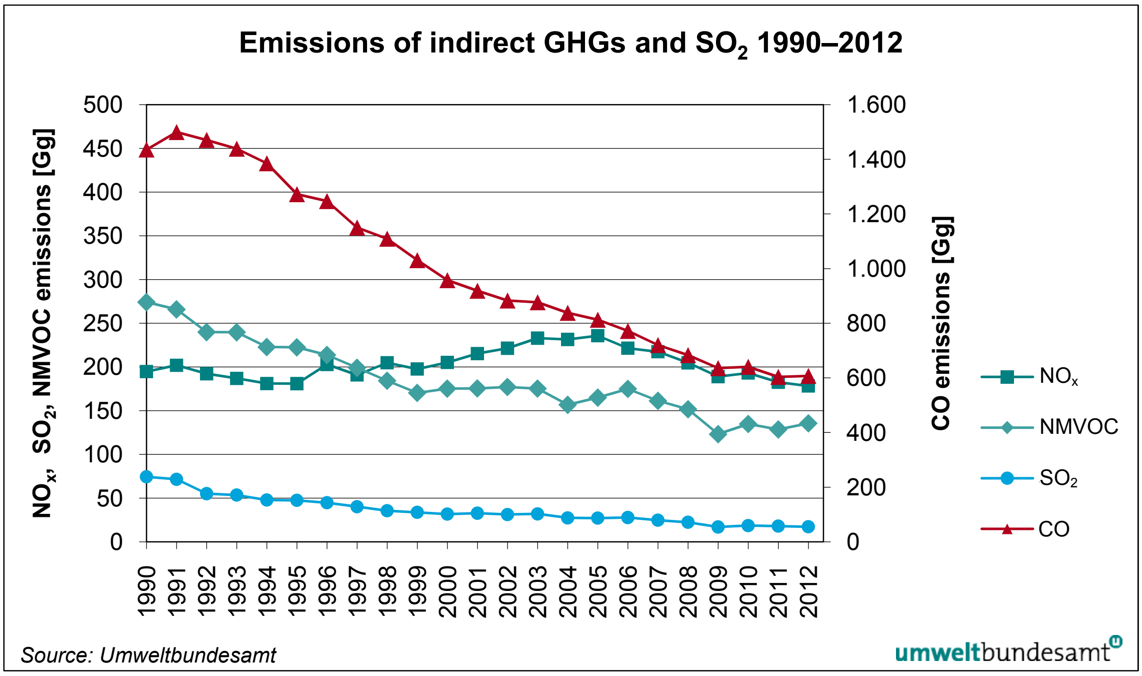

Figure 6: Emissions of indirect GHGs and SO_2 1990–2012.

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

NO_x

NO_x emissions decreased from 195 to 178 Gg during the period from 1990 to 2012. In 2012 the NO_x emissions were 8.5% below the level of 1990.

In 2012 about 96% of NO_x emissions in Austria originated from fossil fuel combustion, with the major part originating from mobile combustion – road transport (57% in national total NO_x emission).

CO

CO emissions decreased from 1 436 to 607 Gg during the period from 1990 to 2012. In 2012 CO emissions were 57.7% below the level of 1990.

In the year 2012, 95% of total CO emissions in Austria originated from fuel combustion activities. The most important sub-source regarding CO emissions is 1.A.4 Other sector (48% in national total CO emission) followed by mobile combustion – road transport (21% in national total CO emission).

NMVOC

NMVOC emissions decreased from 274 to 136 Gg during the period from 1990 to 2012. In 2012 NMVOC emissions were 50.6% below the level of 1990.

The most important emission sources for NMVOC emissions are solvent use and fossil fuel combustion, contributing 58% and 35% respectively of national total NMVOC emissions in 2012.

SO_2

SO_2 emissions decreased from 74 to 17 Gg during the period from 1990 to 2012. In 2012 SO_2 emissions were 76.8% below the level of 1990.

The decrease is mainly due to lower emissions from residential heating (-94%), combustion in the manufacturing industries and construction (-40%) and energy industries (-80%).

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

In 2012 Article 3.3 activities were a net sink in Austria: Net CO_2 removals amounted to 1 506 Gg CO_2.

CO_2 removals from Afforestation/Reforestation (AR) in Austria amounted to 2 052 Gg CO_2. 221 Gg CO_2 resulted from cropland converted to forest land, 645 Gg CO_2 from grassland, 903 Gg CO_2 from other land, 201 Gg CO_2 from settlement and 83 Gg CO_2 from wetland. Emissions from Deforestation (D) activities were approximately 546 Gg CO_2 equivalent (thereof 0.004 Gg N_2O) in 2012. Forest land converted to cropland amounted to 32 Gg CO_2, to grassland 127 Gg CO_2, to other land 187 Gg CO_2, to settlement 149 Gg CO_2 and to wetland 49 Gg CO_2.

Table 19: KP Article 3.3 Reporting 2008-2012.

	Net removals				
	2008	**2009**	**2010**	**2011**	**2012**
	Gg CO_2 equivalent				
Net emissions/removals	-876	-1 450	-1 468	-1 487	-1 506
KP 3.3 Afforestation/Reforestation	-1 948	-2 033	-2 039	-2 045	-2 052
KP 3.3 Deforestation	1 071	583	571	559	546

The emission estimates for the ARD lands were also changed for the first Commitment Period of the Kyoto Protocol on basis of these new activity data and emission factors due to the finalised ARD assessment. Due to these changed input data the annual net removals of ARD activities are on average about 10% higher than in previous submissions.

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 2012 about 74.6% of national total GHGs emissions and 86.4% of national total CO_2 emissions from Austria arose from the energy sector.

3.1.1 Emission Trends

Emissions from the energy sector increased by 7.7% from 55.4 Tg CO_2 equivalents in 1990 to 59.7 Tg CO_2 equivalents in 2012, which is mainly caused by increasing emissions from transport.

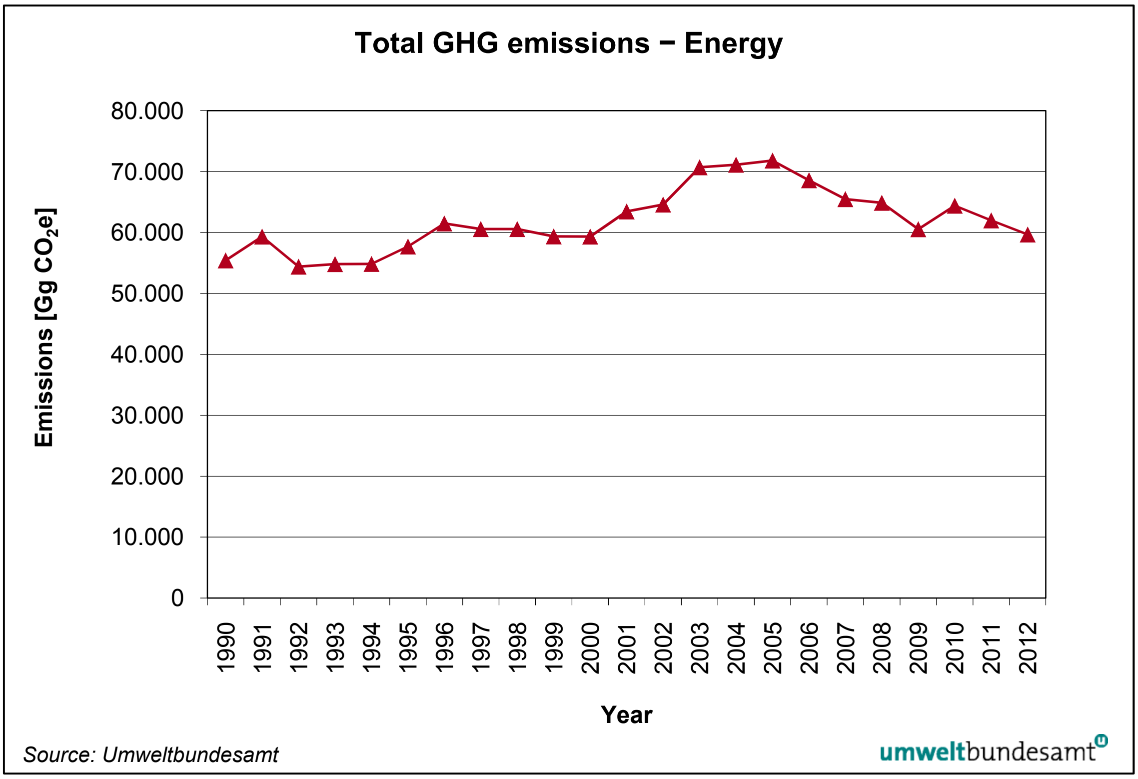

Figure 7: Trend of GHG emissions from 1990–2012 for energy.

Total emissions from energy mainly consist of CO_2 whereas N_2O and CH_4 emissions only make up about 1.1% and 0.8%, respectively. The increase of CO_2 and N_2O emissions is mainly caused by the increasing activity of transport. The decrease of CH_4 emissions mainly occurs in the residential sector due to a shift to more efficient biomass heating. The strong increase of CO_2 emissions from 2002 to 2003 was additionally caused by public electricity plants. Between 2005 and 2012 emissions from public electricity production, manufacturing industries, road transport and the residential/commercial sector decreased. The decrease of residential emissions from 2011 to 2012 is mainly due to low gasoil sales. Emissions from public electricity production mainly decreased due to less natural gas, oil and coal combustion and very high electricity production from hydro plants. Between 2011 and 2012 emissions from road transport decreased due to less fuel sales. Between 2008 and 2009 GHG emissions from *1.A.2 Manufacturing Industries* decreased by almost -11% which is mainly due to the economic crisis and especially due to less steel production which resulted in a reduction of 22% GHG emissions of category *1.A.2.a Iron and Steel*. From 2009 to 2012 emissions of *1.A.2. Manufacturing Industries* increased by +8.2% and reached almost the level of 2008.

Table 20: Emissions of greenhouse gases and their trend from 1990–2012 from IPCC Category 1 Energy.

	CO_2 [Gg]	**CH_4 [Gg]**	**N_2O [Gg]**	**Gg CO_2 equivalent**
1990	54 172	33.23	1.79	54 172
1991	57 963	35.46	2.00	57 963
1992	53 065	34.46	1.97	53 065
1993	53 466	34.29	2.04	53 466
1994	53 538	31.77	2.06	53 538
1995	56 355	32.76	2.13	56 355
1996	60 112	33.30	2.24	60 112
1997	59 300	28.50	2.20	59 300
1998	59 256	28.19	2.32	59 256
1999	58 046	28.36	2.35	58 046
2000	58 033	27.60	2.36	58 033
2001	62 130	27.74	2.45	62 130
2002	63 272	26.42	2.48	63 272
2003	69 378	26.31	2.56	69 378
2004	69 825	25.04	2.55	69 825
2005	70 485	24.42	2.66	70 485
2006	67 302	23.58	2.56	67 302
2007	64 218	23.03	2.50	64 218
2008	63 661	22.49	2.44	63 661
2009	59 375	22.04	2.29	59 375
2010	63 189	23.37	2.34	63 189
2011	60 850	21.91	2.23	60 850
2012	58 534	22.99	2.18	58 534
Trend 1990–2012	***8.1%***	***-30.8%***	***21.4%***	***8.1%***

3.1.1.1 Emission trends by sub categories

The most important sub categories regarding total emissions in the base year were the transport sector (*1.A.3*) and 'other sectors' (*1.A.4*), which is mainly residential heating. GHG emissions from the residential sector decreased since 1990 because of a change in the fuel mix and less heating degree days. A significant increase took place for transport which has the highest share since 1992. The increase of GHG emissions from *1.B fugitive emissions from fuels* is mainly caused by the increase of CH_4 emissions from natural gas distribution, reflecting the increase of the length of natural gas pipelines and the distribution network.

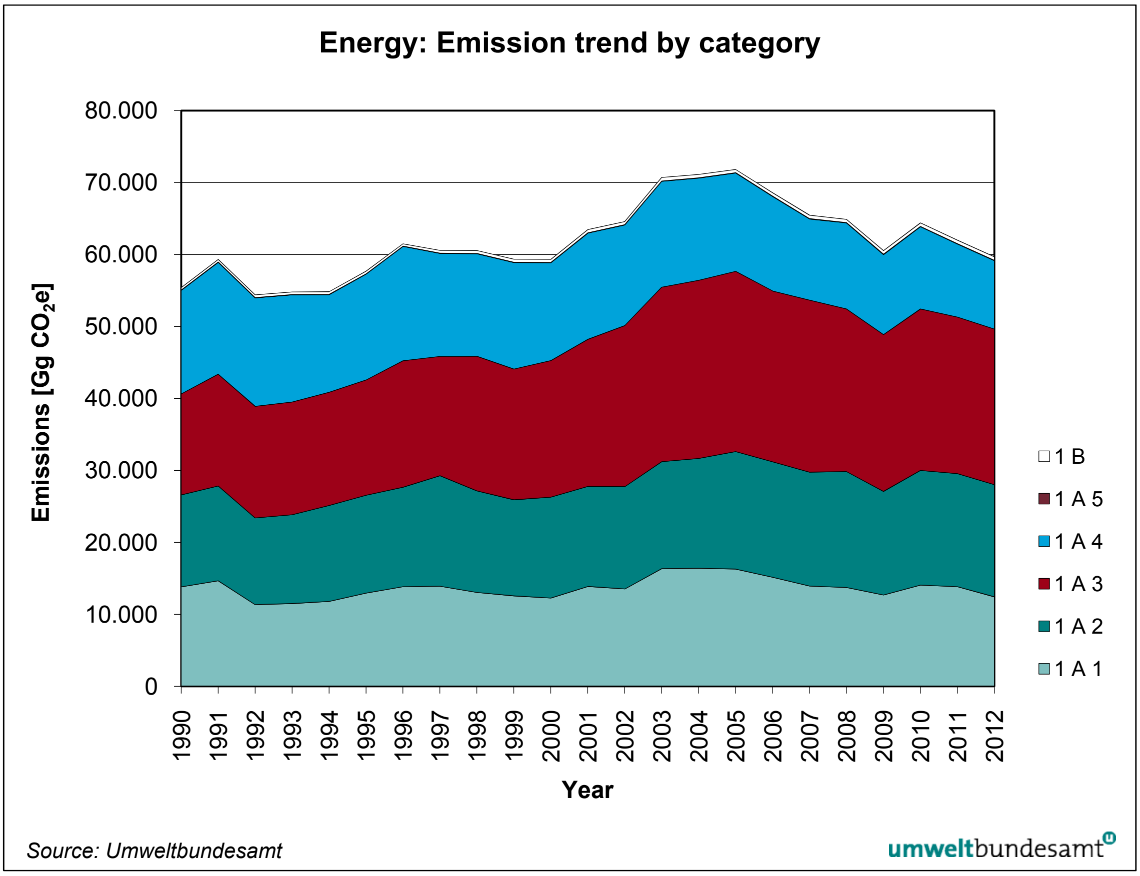

Figure 8: GHG emissions in [Gg CO_2 equivalent] from 1990–2012 from Energy by sub categories.

Table 21: Total GHG emissions in [Gg CO_2 equivalent] from 1990–2012 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	55 425	55 089	13 843	12 774	14 029	14 407	36	337	12	325
1991	59 328	58 975	14 680	13 170	15 533	15 554	38	353	10	343
1992	54 401	54 022	11 361	12 043	15 518	15 065	35	379	9	371
1993	54 818	54 444	11 514	12 348	15 663	14 879	40	375	8	366
1994	54 845	54 471	11 810	13 341	15 727	13 551	43	374	7	367
1995	57 704	57 319	12 972	13 596	16 010	14 707	33	385	6	378
1996	61 505	61 180	13 857	13 821	17 569	15 893	40	325	6	319
1997	60 580	60 210	13 926	15 361	16 577	14 309	38	370	6	364
1998	60 568	60 172	13 059	14 117	18 706	14 247	43	396	6	390
1999	59 368	58 940	12 582	13 353	18 165	14 798	43	428	6	422
2000	59 344	58 918	12 276	14 033	18 965	13 601	42	426	6	419
2001	63 473	63 029	13 890	13 890	20 459	14 748	42	444	6	438
2002	64 595	64 169	13 538	14 223	22 383	13 982	43	426	7	419
2003	70 725	70 230	16 362	14 873	24 243	14 709	44	495	6	489
2004	71 143	70 684	16 406	15 273	24 753	14 209	44	459	2	457
2005	71 821	71 384	16 312	16 328	25 039	13 659	45	438	0.74	437
2006	68 590	68 118	15 171	16 048	23 733	13 121	45	471	0.82	470
2007	65 478	65 000	13 939	15 839	23 888	11 288	46	478	0.75	477
2008	64 888	64 450	13 741	16 107	22 599	11 956	46	439	0.82	438
2009	60 549	60 053	12 707	14 395	21 786	11 118	47	496	0.89	495

	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
2010	64 405	63 930	14 075	15 942	22 439	11 426	47	476	0.77	475
2011	62 000	61 531	13 851	15 723	21 739	10 170	48	469	0.74	469
2012	59 692	59 210	12 447	15 581	21 636	9 498	48	481	0.90	480
Trend 1990–2012	***7.7%***	***7.5%***	***-10.1%***	***22.0%***	***54.2%***	***-34.1%***	***34.9%***	***43.0%***	***-92.3%***	***47.8%***

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 the sectoral/reference approaches and feedstocks/non-energy use of fuels is given in this sector.

Additionally to information provided in this Chapter, Annex 2 includes further information on the underlying activity data used for emissions estimation. The Annex describes the national energy balance (fuels and fuel categories, net calorific values) and the methodology of how activity data are extracted from the energy balance (correspondence of energy balance to SNAP and IPCC categories). Activity data and emission factors used for emissions calculation and information on the last revision of the national energy balance are also presented in Annex 2. For results, methodology and detailed data used for the CO_2 reference approach see Annex 3. National energy balance data are presented in Annex 4.

3.2.1 Comparison of the Sectoral Approach with the Reference Approach

3.2.1.1 Comparison of CO_2 emissions

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

The following figure shows the results for the two approaches for the period 1990–2012. Solid fuels show the most significant deviation.

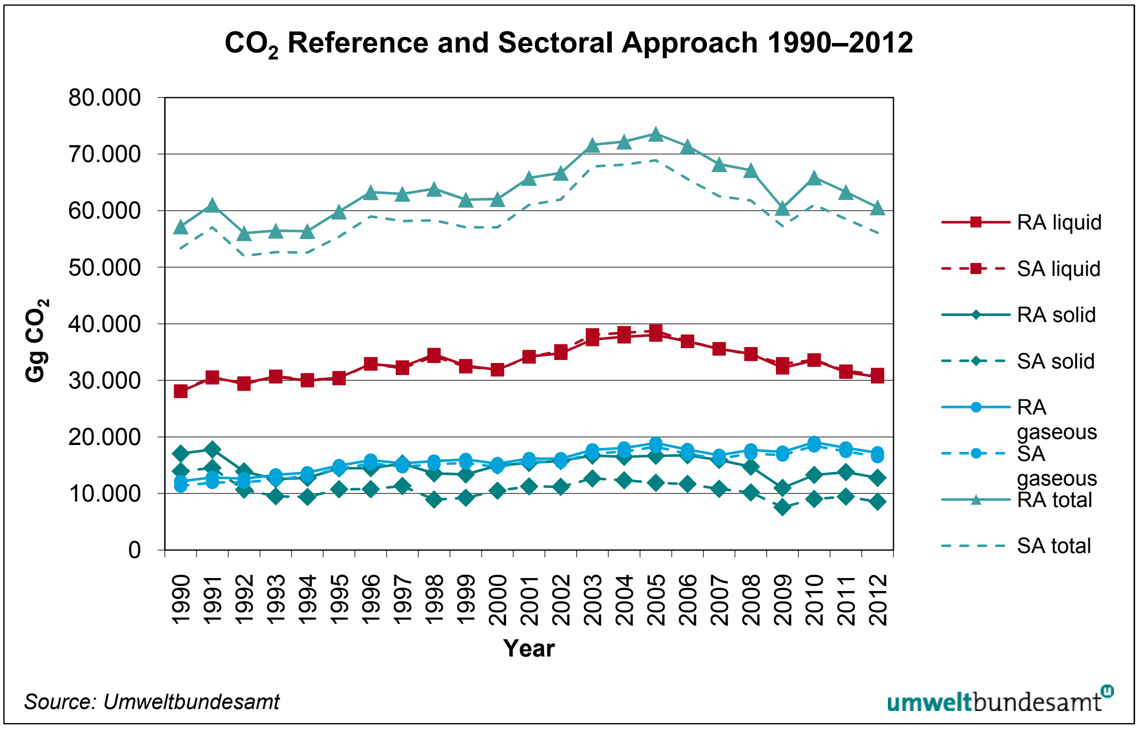

Figure 9: CO_2 Reference and Sectoral Approach 1990 to 2012.

Table 22 presents CO_2 emissions of the sectoral and reference approach.

Table 22: CO_2 emissions of sectoral and reference approach.

Year	Reference Approach				Sectoral Approach *1 A Fuel Combustion*				
	Liquid [Gg CO_2]	Solid [Gg CO_2]	Gaseous [Gg CO_2]	Total [Gg CO_2]	Liquid [Gg CO_2]	Solid [Gg CO_2]	Gaseous [Gg CO_2]	Other [Gg CO_2]	Total [Gg CO_2]
1990	28 037	17 039	12 146	57 222	28 113	13 924	11 301	732	54 070
1991	30 439	17 780	12 841	61 061	30 589	14 518	11 940	805	57 852
1992	29 535	13 887	12 610	56 031	29 322	10 666	12 000	956	52 945
1993	30 620	12 530	13 298	56 448	30 731	9 495	12 453	675	53 354
1994	29 954	12 754	13 679	56 387	30 100	9 379	13 111	820	53 410
1995	30 471	14 448	14 935	59 853	30 309	10 741	14 339	839	56 228
1996	32 896	14 484	15 897	63 277	32 921	10 760	15 287	1 073	60 041
1997	32 374	15 283	15 321	62 978	32 123	11 319	14 720	1 017	59 179
1998	34 581	13 550	15 729	63 860	34 247	8 905	15 144	818	59 114
1999	32 585	13 366	16 004	61 955	32 399	9 239	15 412	825	57 875
2000	31 865	14 922	15 273	62 060	31 880	10 486	14 686	816	57 868
2001	34 213	15 400	16 186	65 799	34 130	11 249	15 632	936	61 947
2002	34 772	15 749	16 160	66 681	35 220	11 173	15 582	1 129	63 105
2003	37 226	16 702	17 721	71 650	38 052	12 663	17 092	1 338	69 145
2004	37 691	16 474	18 042	72 207	38 417	12 319	17 405	1 475	69 615
2005	38 013	16 657	18 925	73 595	38 743	11 889	18 274	1 374	70 279
2006	36 885	16 756	17 769	71 410	36 907	11 679	16 998	1 486	67 070
2007	35 551	15 922	16 757	68 230	35 602	10 808	16 141	1 430	63 981
2008	34 713	14 740	17 708	67 161	34 573	10 180	17 053	1 644	63 449

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]
2009	32 211	10 972	17 328	60 511	32 932	7 579	16 777	1 822	59 110
2010	33 558	13 272	19 053	65 883	33 623	9 021	18 411	1 898	62 952
2011	31 453	13 781	18 059	63 292	31 639	9 438	17 450	2 090	60 617
2012	30 616	12 768	17 198	60 583	31 024	8 547	16 510	2 216	58 297

Table 23 presents the difference of CO_2 emissions in percent between reference and sectoral approach.

Table 23: Difference of CO_2 emissions by type of fuel in percent.

Year	Liquid	Solid	Gaseous	Total
1990	-0.27%	22.37%	7.48%	5.83%
1991	-0.49%	22.47%	7.55%	5.55%
1992	0.72%	30.19%	5.08%	5.83%
1993	-0.36%	31.97%	6.79%	5.80%
1994	-0.48%	35.98%	4.33%	5.57%
1995	0.53%	34.51%	4.15%	6.45%
1996	-0.08%	34.62%	3.99%	5.39%
1997	0.78%	35.03%	4.08%	6.42%
1998	0.98%	52.16%	3.86%	8.03%
1999	0.57%	44.68%	3.84%	7.05%
2000	-0.05%	42.31%	3.99%	7.24%
2001	0.24%	36.90%	3.54%	6.22%
2002	-1.27%	40.96%	3.71%	5.67%
2003	-2.17%	31.90%	3.68%	3.62%
2004	-1.89%	33.73%	3.66%	3.72%
2005	-1.88%	40.11%	3.56%	4.72%
2006	-0.06%	43.47%	4.54%	6.47%
2007	-0.14%	47.32%	3.82%	6.64%
2008	0.40%	44.80%	3.84%	5.85%
2009	-2.19%	44.76%	3.28%	2.37%
2010	-0.19%	47.13%	3.49%	4.66%
2011	-0.59%	46.02%	3.49%	4.41%
2012	-1.31%	49.39%	4.17%	3.92%

Positive numbers indicate that CO_2 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 CO_2 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 *6.C Waste Incineration* for 1990 and 1991.
- *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 -1 to +3%.
- 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 24 presents the differences which can be easily quantified. Positive numbers indicate CO_2 emissions not included in the sectoral approach. Negative numbers indicate CO_2 emissions which are not considered by the reference approach. The remaining differences are mainly due to the use of sector specific emission factors and NCVs for the sectoral approach and the use of 'default fractions of carbon stored' for the reference approach.

Table 24: 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]	Total [Gg CO_2]	Remaining Difference[2]
1990	19	472	2 704	-732	2 463	1.2%
1991	17	498	2 722	-805	2 432	1.3%
1992	15	448	2 458	-956	1 964	2.0%
1993	14	500	2 526	-675	2 365	1.3%
1994	11	476	2 767	-820	2 434	1.0%
1995	13	517	3 136	-839	2 828	1.4%
1996	12	520	2 918	-1 073	2 377	1.4%
1997	10	514	3 316	-1 017	2 823	1.6%
1998	0	506	3 214	-818	2 902	3.0%
1999	2	513	3 077	-825	2 766	2.2%
2000	5	499	3 489	-816	3 177	1.7%
2001	3	455	3 449	-936	2 971	1.4%
2002	5	465	3 882	-1 129	3 222	0.5%
2003	5	504	3 723	-1 338	2 894	-0.5%
2004	4	505	3 652	-1 475	2 686	-0.1%
2005	5	474	4 129	-1 374	3 235	0.1%
2006	5	509	4 208	-1 486	3 235	1.6%
2007	5	447	4 216	-1 430	3 237	1.5%
2008	5	501	4 187	-1 644	3 049	1.0%
2009	5	464	3 243	-1 822	1 890	-1.0%
2010	5	512	3 980	-1 898	2 598	0.3%
2011	5	530	3 988	-2 090	2 432	0.1%
2012	5	511	3 924	-2 216	2 224	-0.2%

1) *Deviation due to losses and statistical differences.*

2) *(RA-SA)/SA. Negative numbers indicate that CO_2 emissions from the reference approach are lower than emissions from the sectoral approach.*

3) *CO_2 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.*

Natural Gas

The following figure shows the quantified difference for natural gas in more detail. The national default CO_2 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 which reflects the usage of plant specific emission factors as reported in the ETS starting in 2005. The maximum of approx. 0.8% difference results for the year 2006.

Quantification of difference between RA and SA for natural gas

	A	B	C	D	E	F	G	H
					Inkl. In RA		Inkl. In RA	
	(RA-SA)/SA	RA	RA-SA-processes	SA	Losses		Non Energy Use 2.B.1	
Year	%	[Mio t CO2]	[Mio t CO2]	[Mio t CO2]	[PJ]	[Mio t CO2]	[PJ]	[Mio t CO2]
1990	0.0%	12.15	0.00	11.30	0.35	0.019	15	0.8
1991	0.0%	12.84	0.00	11.94	0.30	0.017	16	0.9
1992	0.0%	12.61	0.00	12.00	0.27	0.015	11	0.6
1993	0.0%	13.30	0.00	12.45	0.25	0.014	15	0.8
1994	0.0%	13.68	0.00	13.11	0.21	0.011	10	0.6
1995	0.0%	14.93	0.00	14.34	0.24	0.013	11	0.6
1996	0.0%	15.90	0.00	15.29	0.22	0.012	11	0.6
1997	0.0%	15.32	0.00	14.72	0.18	0.010	11	0.6
1998	0.0%	15.73	0.00	15.14	0.00	0.000	11	0.6
1999	0.0%	16.00	0.00	15.41	0.04	0.002	11	0.6
2000	0.0%	15.27	0.00	14.69	0.08	0.005	11	0.6
2001	0.0%	16.19	0.00	15.63	0.06	0.003	10	0.6
2002	0.0%	16.16	0.00	15.58	0.09	0.005	10	0.6
2003	0.0%	17.72	0.00	17.09	0.08	0.005	11	0.6
2004	0.0%	18.04	0.00	17.40	0.08	0.004	11	0.6
2005	0.3%	18.93	0.05	18.27	0.08	0.005	11	0.6
2006	0.8%	17.77	0.13	17.00	0.08	0.005	12	0.6
2007	0.3%	16.76	0.05	16.14	0.08	0.005	10	0.6
2008	0.2%	17.71	0.03	17.05	0.09	0.005	11	0.6
2009	-0.1%	17.33	-0.02	16.78	0.09	0.005	10	0.6
2010	0.1%	19.05	0.01	18.41	0.08	0.005	11	0.6
2011	-0.2%	18.06	-0.03	17.45	0.10	0.005	11	0.6
2012	0.4%	17.20	0.07	16.51	0.21	0.012	11	0.6

Source: 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 2012 remains about 9%.

Quantification of difference between RA and SA for solid fuels

	A	B	C	D	E	F	G	H
					Inkl. In RA		Inkl. In RA	
	(RA-SA)/SA	RA	RA- (SA+ coke + bit.coal)	SA	Coke non energy use		Bit. Coal non energy use	
Year	%	[Mio t CO2]	[Mio t CO2]	[Mio t CO2]	[kt]	[Mio t CO2]	[kt]	[Mio t CO2]
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%	12.8	0.7	9.4	891	2.7	1	0.0
1995	6%	14.4	0.7	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%	13.5	1.8	8.9	944	2.8	1	0.0
1999	15%	13.4	1.3	9.2	931	2.8	1	0.0
2000	12%	14.9	1.3	10.5	1 037	3.1	1	0.0
2001	9%	15.4	1.1	11.2	1 025	3.1	1	0.0
2002	11%	15.7	1.2	11.2	1 117	3.4	2	0.0
2003	7%	16.7	0.8	12.7	1 059	3.2	2	0.0
2004	10%	16.5	1.2	12.3	984	3.0	1	0.0
2005	8%	16.7	0.9	11.9	1 266	3.8	1	0.0
2006	12%	16.8	1.4	11.7	1 196	3.7	1	0.0
2007	12%	15.9	1.3	10.8	1 172	3.6	85	0.2
2008	6%	14.7	0.7	10.2	1 105	3.4	183	0.5
2009	4%	11.0	0.3	7.6	914	2.8	110	0.3
2010	7%	13.3	0.7	9.0	1 046	3.2	137	0.3
2011	9%	13.8	0.9	9.4	995	3.1	151	0.4
2012	9%	12.8	0.8	8.5	1 015	3.1	115	0.3

Source: Umweltbundesamt

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

3.2.1.2 Comparison of energy consumption

Table 25 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 26 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 25: 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	375.46	148.05	203.98	727.49	379.04	139.89	203.98	8.99	731.90
1991	408.94	155.41	215.53	779.88	411.61	146.16	215.53	10.08	783.38
1992	395.78	117.92	216.61	730.30	395.17	108.34	216.61	12.01	732.12
1993	410.80	102.35	224.79	737.94	413.67	96.29	224.79	9.78	744.52
1994	400.48	102.47	236.67	739.62	405.79	95.06	236.67	10.53	748.05
1995	407.81	116.67	258.83	783.31	408.39	108.50	258.83	10.92	786.63
1996	440.81	119.46	275.94	836.21	444.49	109.23	275.94	14.01	843.68
1997	430.55	124.20	265.71	820.46	433.19	114.97	265.71	13.12	826.99
1998	461.35	109.37	273.36	844.08	461.71	90.34	273.36	12.28	837.70
1999	431.70	106.68	278.19	816.57	435.98	92.62	278.19	11.59	818.38
2000	421.54	121.02	262.32	804.89	431.31	105.89	265.10	12.27	814.56
2001	451.45	126.40	282.17	860.02	461.27	113.72	282.17	14.49	871.64
2002	464.29	127.10	281.27	872.66	472.13	112.92	281.27	16.78	883.10
2003	497.48	139.16	308.19	944.82	509.98	128.35	308.51	19.40	966.25
2004	501.91	139.11	313.07	954.10	511.03	125.58	314.16	24.56	975.33
2005	508.46	132.32	328.33	969.11	522.04	122.49	329.95	22.74	997.21
2006	496.92	135.40	307.23	939.55	500.25	120.68	306.92	25.48	953.32
2007	477.25	125.82	290.36	893.43	484.41	111.76	291.44	24.75	912.36
2008	467.90	119.65	306.61	894.16	468.86	105.24	307.89	28.23	910.22
2009	440.72	87.74	298.42	826.87	437.38	77.95	302.89	31.85	850.07
2010	455.92	107.31	328.06	891.29	450.59	92.66	332.39	31.69	907.34
2011	429.56	113.65	312.00	855.21	422.16	97.20	315.05	35.13	869.54
2012	416.92	103.49	297.14	817.54	414.15	87.86	298.10	33.68	833.79

Table 26: Difference of energy consumption by type of fuel in percent.

Year	Liquid	Solid	Gaseous	Total
1990	-0.94%	5.83%	0.00%	-0.60%
1991	-0.65%	6.32%	0.00%	-0.45%
1992	0.15%	8.84%	0.00%	-0.25%
1993	-0.69%	6.30%	0.00%	-0.88%
1994	-1.31%	7.80%	0.00%	-1.13%
1995	-0.14%	7.53%	0.00%	-0.42%
1996	-0.83%	9.37%	0.00%	-0.89%
1997	-0.61%	8.02%	0.00%	-0.79%
1998	-0.08%	21.06%	0.00%	0.76%
1999	-0.98%	15.17%	0.00%	-0.22%
2000	-2.26%	14.29%	-1.05%	-1.19%
2001	-2.13%	11.15%	0.00%	-1.33%
2002	-1.66%	12.55%	0.00%	-1.18%
2003	-2.45%	8.42%	-0.11%	-2.22%
2004	-1.78%	10.78%	-0.35%	-2.18%
2005	-2.60%	8.03%	-0.49%	-2.82%
2006	-0.67%	12.20%	0.10%	-1.44%
2007	-1.48%	12.58%	-0.37%	-2.07%
2008	-0.20%	13.69%	-0.42%	-1.76%
2009	0.76%	12.55%	-1.48%	-2.73%
2010	1.18%	15.81%	-1.30%	-1.77%
2011	1.75%	16.91%	-0.97%	-1.65%
2012	0.67%	17.79%	-0.32%	-1.95%

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.

Recalculations

In this submission the share of biofuels in blended diesel and gasoline is considered in the carbon emission factors from the year 2005 on. This leads to a significant lower difference between the Sectoral and the Reference Approach for liquid fuels. In the previous submission the difference for e.g. the year 2010 was +3.5% which is improved to -0.6%.

In the previous submission the difference due the use of biofuel blended fuels was quantified to explain the difference which is obsolete now.

Coal tar is now included together with coking coal following a review finding (In-Country Review 2013).

3.2.2 International bunker fuels

3.2.2.1 International aviation

In 2012, 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 27: Greenhouse gas emissions and activity from international bunkers-aviation 1990–2012.

Year	CO_2 [Gg]		N_2O [Gg]		CH_4 [Gg]		Activity [TJ]
	int. LTO	int. cruise	int. LTO	Int. cruise	int. LTO	int. cruise	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
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

Year	CO_2 [Gg]		N_2O [Gg]		CH_4 [Gg]		Activity [TJ]
	int. LTO	int. cruise	int. LTO	Int. cruise	int. LTO	int. cruise	int. LTO + int. cruise
	Kerosene						
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	-	29 965
2009	269	1 624	0.012	0.052	0.040	-	26 002
2010	276	1 773	0.012	0.056	0.041	-	28 185
2011	314	1 854	0.014	0.059	0.046	-	29 820
2012	302	1 771	0.014	0.056	0.045	-	28 489
1990-2012	**234%**	**123%**	**141%**	**122%**	**208%**	**-**	**132%**

Methodological Issues

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

3.2.2.2 International navigation

In 2012, the share of international navigation in the total fuel consumption in the navigation sector in Austria amounted to approx. 80%. Greenhouse gas emissions and activity data from navigation assigned to international bunkers are presented in the following table.

Table 28: Greenhouse gas emissions and activity from international bunkers-marine 1990–2012.

Year	CO_2 [Gg]	N_2O [Gg]	CH_4 [Gg]	Activity [TJ]
1990	38.7	0.0019	0.014	523
1991	33.7	0.0017	0.012	455
1992	32.8	0.0016	0.011	443
1993	33.7	0.0017	0.012	455
1994	42.8	0.0021	0.015	578
1995	48.2	0.0023	0.017	652
1996	49.4	0.0024	0.017	668
1997	48.2	0.0023	0.017	652
1998	52.6	0.0025	0.019	712
1999	52.0	0.0025	0.019	705
2000	56.7	0.0027	0.020	769
2001	59.9	0.0028	0.022	813
2002	67.4	0.0031	0.024	914
2003	53.7	0.0024	0.019	729
2004	64.1	0.0028	0.023	870
2005	62.0	0.0027	0.022	840
2006	52.0	0.0023	0.019	701
2007	55.4	0.0024	0.020	746
2008	50.6	0.0022	0.018	682
2009	42.3	0.0018	0.016	568
2010	50.5	0.0021	0.018	679

Year	CO_2 [Gg]	N_2O [Gg]	CH_4 [Gg]	Activity [TJ]
2011	44.4	0.0018	0.016	593
2012	45.6	0.0019	0.016	609
1990–2012	**18%**	**-4%**	**17%**	**16%**

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 Austria uses a bottom-up method to calculate the international fuel consumption in navigation which is made up of freight transport activities on the River Danube. As domestic navigation on the River Danube is navigation between Danube harbors located within Austria, international navigation is navigation across national boundaries and transit navigation, expressed in

tons x kilometer → (GWh/tkm*tkm; CO_2/tkm*tkm, etc.)

As inland tkm on the Danube are used to calculate bottom-up domestic navigation, tkm from import, export and transit-activities on the Danube are used to calculate the international share of navigation on the Danube.

Statistical data (tkm) for freight activities (split up into inland, import, export and transit tkm) on the River Danube were obtained from (STATISTIK AUSTRIA 2013). For detailed methodological issues concerning factors like kg diesel/tkm and emissions factors see the results of the model GEORG as described in *1.A.2 f.*

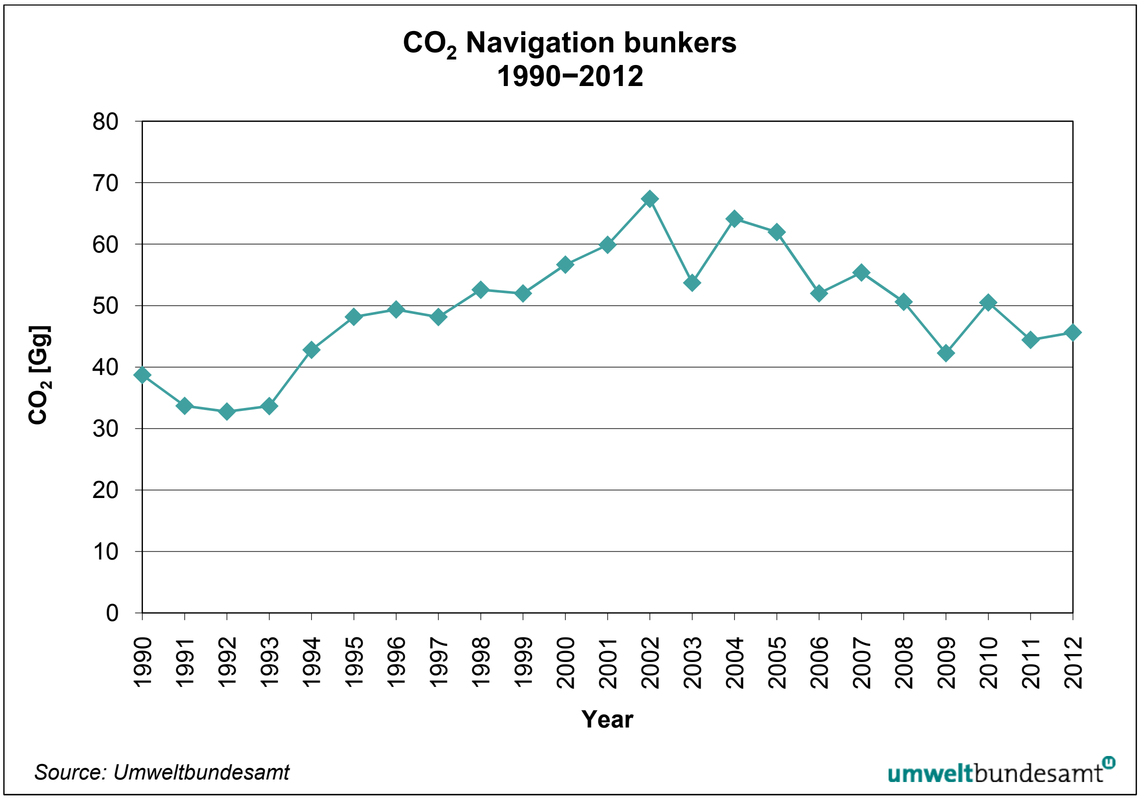

Figure 12: CO_2 emissions from navigation bunkers.

3.2.3 Feedstocks and non-energy use of fuels

Non-energy use of fuels is considered in the national energy balance. Below explanations for the reported non-energy use is provided together with information on where CO_2 emissions due to the manufacture, use and disposal of carbon containing products are considered.

For fraction of carbon stored the IPCC default values are applied for all fuels except for coke oven coke, of which the amount of carbon stored in steel was calculated.

3.2.3.1 Lubricants

manufacture: emissions are assumed to be included in total emissions from category *1.A.1.b* petroleum refinery.

use: emissions from the use of motor oil are included in CO_2 emissions from transport. VOC emissions from lubricants used in rolling mills are considered in category *2.C.1*. It is assumed that other uses of lubricants do not result in VOC or CO_2 emissions due to the low vapour pressure of lubricants.

disposal: emissions from incineration of lubricants (waste oil) are either included in categories *1.A.1.a* and *1.A.2* if waste oil is used as fuels or in category *6.C* respectively if energy is not recovered.

3.2.3.2 Bitumen

manufacture: emissions from the production of bitumen are assumed to be included in total emissions of category *1.A.1.b* petroleum refinery.

use: indirect CO_2 emissions from the use of bitumen for road paving and roofing that should be reported in categories *2.A.5* and *2.A.6* are included in sector *3 solvent and other product use*.

disposal: CO_2 emissions from the disposal from bitumen are assumed to be negligible. Recycling is not considered.

3.2.3.3 Natural Gas

manufacture: emissions from the use of natural gas as a feedstock in ammonia production are accounted for in the industrial processes sector (category *2.B.1*).

use/disposal: not applicable, no CO_2 emissions result from the use or disposal of ammonia.

3.2.3.4 Coke oven coke

manufacture: emissions from the production of coke are considered in category *1.A.2.a*.

use: CO_2 emissions from coke used in iron and steel industry are reported under *2.C*.

disposal: not applicable

3.2.3.5 Other bituminous coal

In [IEA JQ 2013] 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

3.2.3.6 Other oil products

manufacture: emissions from the production of ethylene and propylene are included in total emissions of category *1.A.1.b petroleum refinery*. CO_2 emissions from solvent use are considered in sector *3 solvent and other product use*.

use: CO_2 emissions from solvent use are considered in sector *3*.

disposal: emissions from the disposal of plastics in landfills are considered in *6.A* and from the use of plastic waste as a fuel in *1.A.2*; emissions from the incineration of plastic in waste without energy recovery is included in *6.C*; emissions from incineration of plastics in waste with energy recovery are considered in *1.A.1.a* and *1.A.2*.

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

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

3.2.5 Country-specific issues

With regard to country-specific issues it can be referred to Chapter 3.2.9, where point source emissions as well as the CO_2 emission trading system (ETS) are considered.

3.2.6 Source Category Description

Transport

In 2012 the most important source of GHGs was transport, with a share of 27.0% in national total GHG emissions. 14.3% of national GHG emissions were released by passenger cars, 2.0% by light duty vehicles, 9.8% 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 0.02% 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 19.5% in 2012 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 2012 with a share of 15.5% total GHG emissions of was energy industries, were fossil fuels are used for electrical power and district heating production. In the year 2012 overall gross public electricity production was 63 384 GWh[27]

[27] Source: IEA Questionnaire November/2013 by STATISTIK AUSTRIA.

of which 46 503 GWh (73%) were generated by hydro plants, 14 080 GWh (22%) by thermal power plants and 2 801 GWh (4%) by solar, geothermal and wind power plants. Industrial auto producers generated 9 232 GWh of electricity in the year 2012. 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 oil refinery industry which consists of only one plant in Austria which is also included in this category (sub-category *1.A.1.b Petroleum refining*). The crude oil input of the oil refinery was 8.3 Mt in 2012.

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 11.9% in 2012 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 a large 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 2012.

3.2.7 Key Categories

The methodology and results of the key category analysis is presented in Chapter 1.5. Table 29 presents the key source categories of *1.A Fuel Combustion Activities*.

Table 29: 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 2012; 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
1.A.2.a gaseous	Iron and Steel	CO_2	LA; TA
1.A.2.a liquid	Iron and Steel	CO_2	LA
1.A.2.a solid	Iron and Steel	CO_2	LA; TA
1.A.2.b gaseous	Non-ferrous Metals	CO_2	LA 2012 TA
1.A.2.c gaseous	Chemicals	CO_2	LA; TA
1.A.2.c other	Chemicals	CO_2	LA 2012; TA
1.A.2.d gaseous	Pulp, Paper and Print	CO_2	LA; TA
1.A.2.d liquid	Pulp, Paper and Print	CO_2	LA 1990; TA
1.A.2.d solid	Pulp, Paper and Print	CO_2	LA
1.A.2.e gaseous	Food Processing, Beverages and Tobacco	CO_2	LA; TA

IPCC Category	Category Name	GHG	Keysource Assessment
1.A.2.e liquid	Food Processing, Beverages and Tobacco	CO_2	LA; TA
1.A.2.f gaseous	Other	CO_2	LA; TA
1.A.2.f liquid	Other	CO_2	LA; TA
1.A.2.f other	Other	CO_2	LA 2012; TA
1.A.2.f solid	Other	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; TA
1.A.4.a gaseous	Commercial/Institutional	CO_2	LA; TA
1.A.4.a liquid	Commercial/Institutional	CO_2	LA; TA
1.A.4.a other	Commercial/Institutional	CO_2	LA 1990; TA
1.A.4.b biomass	Residential	CH_4	LA 1990; TA
1.A.4.b gaseous	Residential	CO_2	LA; TA
1.A.4.b liquid	Residential	CO_2	LA; TA
1.A.4.b solid	Residential	CO_2	LA 1990; TA
1.A.4.c liquid	Agriculture/Forestry/Fisheries	CO_2	LA; TA

LA = Level Assessment (if not further specified – for the years 1990 and 2012)

TA = Trend Assessment 2012

3.2.8 Completeness

Table 30 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 30: Overview of subcategories of Category 1.A Fuel Combustion: transformation into SNAP Codes and status of estimation.

IPCC Category	SNAP	Status		
		CO_2	CH_4	N_2O
1.A.1.a Public Electricity and Heat Production	**0101 Public power 0102 District heating plants**			
1.A.1.a Liquid Fuels		✓	✓	✓
1.A.1.a Solid Fuels		✓	✓	✓
1.A.1.a Gaseous Fuels		✓	✓	✓
1.A.1.a Biomass		✓	✓	✓
1.A.1.a Other Fuels		✓	✓	✓
1.A.1.b Petroleum refining	**0103 Petroleum refining plants**			
1.A.1.b Liquid Fuels		✓	✓	✓
1.A.1.b Solid Fuels		NO	NO	NO
1.A.1.b Gaseous Fuels		✓	✓	✓
1.A.1.b Biomass		NO	NO	NO

IPCC Category	SNAP	Status		
		CO_2	CH_4	N_2O
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
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		✓	✓	✓

IPCC Category	SNAP	Status		
		CO_2	CH_4	N_2O
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		✓	✓	✓
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		✓	IE(1)	IE(1)
1.A.3.b Biomass		✓	IE(1)	IE(1)
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 Residual Oil		NO	NO	NO
1.A.3.d Gas/Diesel oil		✓	✓	✓
1.A.3.d Gasoline		✓	✓	✓
1.A.3.d Solid fuelsl		NO	NO	NO
1.A.3.d Gaseous		NO	NO	NO
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

IPCC Category	SNAP	Status		
		CO_2	CH_4	N_2O
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
1.A.4.c Agriculture/Forestry/Fisheries	**0203 Plants in agriculture, forestry and aquaculture** **0806 Other Mobile Sources and Machinery-Agriculture** **0807 Other Mobile Sources and Machinery-Forestry**			
1.A.4.c Liquid Fuels		✓	✓	✓
1.A.4.c Solid Fuels		✓	✓	✓
1.A.4.c Gaseous Fuels		✓	✓	✓
1.A.4.c Biomass		✓	✓	✓
1.A.4.c Other Fuels		NO	NO	NO
1.A.5 Other	**0801 Other Mobile Sources and Machinery-Military**			
1.A.5 Liquid Fuels		✓	✓	✓
1.A.5 Solid Fuels		NO	NO	NO
1.A.5 Gaseous Fuels		NO	NO	NO
1.A.5 Biomass		NO	NO	NO
1.A.5 Other Fuels		NO	NO	NO
Marine Bunkers	**080404 International sea traffic (international bunkers)**			
Gasoline		NO	NO	NO
Gas/Diesel oil		✓	✓	✓
Residual Fuel Oil		NO	NO	NO
Lubricants		NO	NO	NO
Coal		NO	NO	NO
Other Fuels		NO	NO	NO
Aviation Bunkers	**080502 International airport traffic (LTO cycles – < 1 000 m)** **080504 International cruise traffic (> 1 000 m)**			
Jet Kerosene		✓	✓	✓
Gasoline		NO	NO	NO
Multilateral Operations		NO	NO	NO

(1) CH_4 and N_2O emissions from CNG, LPG and biomass are included in gasoline and diesel (liquid fuels)

3.2.9 Methodological Issues

3.2.9.1 Choice of Method

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

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

Tier 2 methodology

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

- *1.A.1.a Public Electricity and Heat Production, plants >= 50 MW_{th}:* CO_2, CH_4, N_2O, NMVOC;
- *1.A.1.a Public Electricity and Heat Production, plants < 50 MW_{th}:* All Pollutants;
- *1.A.1.b Petroleum Refining:* CO_2, CH_4, N_2O;
- *1.A.1.c Manufacture of Solid Fuels and Other Energy Industries:* All Pollutants;
- *1.A.2 Manufacturing Industries and Construction – Stationary sources:* All Pollutants;
- *1.A.3.c Railways:* All Pollutants;
- *1.A.3.d Navigation:* All Pollutants;
- *1.A.3.e Other Transportation – Pipeline compressors:* All Pollutants;
- *1.A.4 Other Sectors – Stationary sources:* All Pollutants;

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

Activity data are taken from official energy statistics.

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

Emissions factors are country specific, fuel and technology dependent.

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

Tier 3 methodology

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

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

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

Emissions factors are fuel and technology dependent.

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

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

Consideration of point source emissions

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

- *1.A.1.a Public Electricity and Heat Production (55 boilers):* CO, SO_2, NO_x;
- *1.A.1.b Petroleum Refining (1 plant):* SO_2, NO_x, CO, VOC („IE": reported under 1 B);
- *1.A.2.a Iron and Steel (2 integrated iron & steel plants):* CO_2, CO, VOC, SO_2, NO_x;
- *1.A.2.f Other – Cement production (10 plants):* CO_2, SO_2, NO_x, CO, VOC.

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

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

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

- Refineries,
- Iron and steel manufacturing industries,
- Non metallic mineral industries (cement, glass, lime, bricks and tiles, other ceramic materials),
- Pulp 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;
- CO_2 emission factor of fuel or process material;
- Share of non fossil CO_2 in case of „non-traded fuels".

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

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

Direct CO_2 measurements have not been submitted.

The ETS reports include data about „traded-fuels" (e.g. different types of coal and fuel oils, natural gas) as well as „non-traded fuels" (e.g. industrial wastes, biomass). For each of the „traded fuels" a national default NCV and a national default CO_2 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:
  $Activity_{category,\ fuel} = (Energy\_Balance\_Activity_{category,\ fuel} - \Sigma i(ETS\_Activity_{plant\ i,\ fuel})) \times Energy\_Balance\_NCV_{fuel} + \Sigma i(ETS\_Activity_{plant\ i,\ fuel} \times ETS\_NCV_{plant\ i,\ fuel})$.
- ETS CO_2 emissions are considered by fuel. The remaining CO_2 emissions are calculated by remaining activity data and „national default" emission factors:
  $CO_{2category,\ fuel} = (Energy\_Balance\_Activity_{category,\ fuel} - \Sigma i(ETS\_Activity_{plant\ i,\ fuel})) \times Energy\_Balance\_NCV_{fuel} \times Default\_EF_{fuel} + \Sigma i(ETS\_CO_{2plant\ i,\ fuel})$.

Choice of emission factors for stationary sources

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

Emission factors may vary over time for the following reasons:

- The chemical characteristics of a fuel category varies, e.g. sulphur content in residual oil, carbon content of coal, CH_4 content of natural gas.
- The mix of fuels in the fuel category changes over time. If the different fuels of a fuel category have different calorific values and their share in the fuel category changes, the calorific value of the fuel category might change over time.
- The technical equipment of a combustion plant, which burns a specific fuel, changes over time.

References for CO_2 and CH_4 emission factors are national studies (BMWA-EB 1990, 1996, 2003, UMWELTBUNDESAMT 2001a, UMWELTBUNDESAMT 2004a). N_2O emission factors are also taken from national studies (STANZEL et al. 1995) and (BMUJF 1994). Detailed figures are included in the relevant chapters.

CO_2 emission factors for stationary sources per fuel type

Natural Gas (fossil)

For all stationary sources of natural gas combustion a CO_2 emission factor of 55.4 t CO_2/TJ (UMWELTBUNDESAMT 2001a) has been applied.

Liquid fuels (fossil)

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

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

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

Refinery Gas: The CO_2 emission factor is based on plant specific measurements.

Solid fuels (fossil)

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

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

Municipal Solid Waste, MSW (partly fossil)

The fossil carbon content for MSW is taken from (ABFALLWIRTSCHAFT 2003). A fraction analysis of the typical wet MSW for Vienna[28] was performed by the local waste authority of Vienna (MA 48) in 1997/1998.

The fossil and non fossil carbon content of each fraction is taken from (ÖKOINSTITUT 2002). This leads to a fossil share of 45% of the overall carbon content of 261 kg C/t $MSW_{wet\ matter}$. The CO_2 emission factor is converted into t CO_2/TJ by means of a heating value of 9.8 GJ/t. The heating value is a personal information of STATISTIK AUSTRIA to the Umweltbundesamt and consistent with the energy balance (IEA JQ 2013). 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 3.2.11.6.

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

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

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

Sewage Sludge (non fossil)

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

Black Liquor (non fossil)

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

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

Biogas reported by (IEA JQ 2013) is used for energy recovery in all subcategories of Category *1 A.* A default carbon content of 30.6 t C/TJ for biogas is taken from (IPCC Guidelines 1997).

CO_2 emissions reported by the ETS

The following Table 31 shows certificated CO_2 emissions from the ETS (UMWELTBUNDESAMT 2014b) 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. pyrolisis material).

Table 31: 2005–2012 CO_2 emissions [Gg] as reported by the ETS.

	Category	2005	2006	2007	2008	2009	2010	2011	2012
Total ETS[1)]		33 373	32 381	31 745	32 078	27 359	30 855	30 550	28 334
1.A	FUEL COMBUSTION ACTIVITIES	25 297	23 996	22 820	22 801	19 871	22 477	21 868	19 953
1.A.1.a	Public Electricity and Heat Production	11 482	10 374	9 037	8 973	7 825	9 335	8 772	6 975
1.A.1.b	Petroleum refining	2 827	2 830	2 868	2 806	2 809	2 724	2 768	2 836
1.A.1.c	Manufacture of Solid fuels and Other Energy Industries	43	50	52	47	54	47	42	43
1.A.2.a	Iron and Steel	5 686	5 525	5 580	5 765	4 446	5 544	5 517	5 423
1.A.2.b	Non-ferrous Metals	–	–	–	–	–	–	–	
1.A.2.c	Chemicals	665	623	592	611	631	654	620	628

	Category	2005	2006	2007	2008	2009	2010	2011	2012
1.A.2.d	Pulp, Paper and Print	2 245	2 153	2 150	2 128	1 999	2 044	2 027	1 966
1.A.2.e	Food Processing, Beverages and Tobacco	316	278	283	295	304	352	349	333
1.A.2.f	Other	2 010	2 139	2 239	2 157	1 786	1 762	1 760	1 736
1.A.4.a	Commercial/Institutional	22	23	19	19	17	15	13	13
2.	INDUSTRIAL PROCESSES	8 093	8 451	8 978	9 319	7 474	8 380	8 685	8 382
2.A.1	Cement Production	1 797	1 954	2 131	2 133	1 799	1 622	1 666	1 673
2.A.2	Lime Production	579	570	596	621	507	574	605	569
2.A.3	Limestone and Dolomite Use	247	253	268	269	211	287	261	251
2.A.7.a	Bricks and Tiles (decarbonizing)	128	130	130	110	94	81	99	93
2.A.7.b	Sinter Production	310	312	329	332	244	314	345	305
2.A.7.c	Glass Production	35	37	40	44	41	40	36	37
2.C.1.a	Steel	763	778	826	820	614	792	817	806
2.C.1.b	Pig Iron	4 188	4 368	4 600	4 934	3 924	4 623	4 808	4 602
2.C.1.e.1	Electric furnace steel plant	45	49	58	57	42	47	49	46

[1)] *Source: UMWELTBUNDESAMT (2014b). These data do not include N_2O emissions from nitric acid production.*

CO_2 emission factors reported within the ETS

Table 32 and Table 33 show the implied CO_2 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 CO_2 emissions are rounded to the nearest ton whereas reported fuel consumption is not rounded.

Table 32: 2012 CO_2 implied emission factors calculated from ETS data. Coal, Petrol Coke, Waste and Natural Gas.

SNAP	102A Hard Coal	105A Brown Coal	107A Coke Oven Coke	110A Petrol Coke	115A Ind. Waste	301A Natural Gas
Weighted average	**92.44**	**97.71**	**105.89**	**105.89**	**86.20**	**55.11**
010101 Public Power plants >= 300 MW_{th}	92.91	-	-	-	-	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	-	53.58
010504 Other Energy Industries – Gas Turbines	-	-	-	-	-	55.40
020103 Commercial plants < 50 MW_{th}	-	-	-	-	-	55.40
0301 Industry – Steel	-	-	-	-	-	55.40

SNAP	102A Hard Coal	105A Brown Coal	107A Coke Oven Coke	110A Petrol Coke	115A Ind. Waste	301A Natural Gas
0301 Industry – Non ferrous metals	-	-	-	-	-	-
0301 Industry – Chemicals	96.96	-	-	-	82.92	55.40
0301 Industry – Pulp and Paper	88.08	-	-	-	116.27	55.40
0301 Industry – Food and Beverages	98.31	-	104.00	-	45.75	55.40
03010 Industry – Other	-	-	-	-	86.28	55.40
030311 Cement kilns	92.85	97.40	-	89.89	87.32	55.40
030312 Lime kilns	-	97.50	-	99.36	82.71	55.40
030317 Glass	-	-	-	-	-	55.40
030319 Bricks and Tiles	94.10	102.04	104.01	100.99	129.01	55.40
030323 Dolomite Treatment	-	-	-	94.33	-	55.40
030326 Integrated Iron & Steel works	91.40	-	105.91	-	83.03	55.12

Table 33: 2012 CO_2 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	**77.64**	**78.00**	**79.81**	**74.99**	**73.82**	**80.59**	**64.02**
010101 Public Power plants >= 300 MW_{th}	76.98	-	79.52	76.25	73.72	-	-
010102 Public Power plants >= 50 MW_{th} < 300 MW_{th}	-	-	-	-	-	-	-
010103 Public Power plants <= 50 MW_{th}	-	-	-	-	77.70	-	-
010201 Public District Heating plants >= 300 MW_{th}	-	-	80.00	75.00	78.16	-	-
010202 Public District Heating plants >= 50 MW_{th} < 300 MW_{th}	76.99	78.00	79.45	73.83	94.21	-	-
010203 Public District Heating plants < 50 MW_{th}	77.01	-	80.01	74.95	-	-	64.03
010301 Refinery	-	-	-	-	-	81.08	-
010504 Other Energy Industries – Gas Turbines	-	-	-	-	-	-	-
020103 Commercial plants < 50 MW_{th}	-	-	-	75.87	49.40	-	-
0301 Industry – Steel	-	-	-	-	-	-	-
0301 Industry – Non ferrous metals	-	-	-	-	-	-	-
0301 Industry – Chemicals	-	-	79.54	75.26	72.03	68.42	-
0301 Industry – Pulp and Paper	77.89	-	78.67	74.97	76.58	-	-
0301 Industry – Food and Beverages	-	-	-	79.72	71.06	-	-
03010 Industry – Other	77.99	-	-	75.25	74.41	-	-
030311 Cement kilns	77.97	-	78.01	74.96	-	-	-
030312 Lime kilns	-	-	77.96	75.95	-	-	-
030317 Glass	78.00	-	-	-	61.91	-	-
030319 Bricks and Tiles	77.90	-	78.00	75.02	0.00	-	64.02
030323 Dolomite Treatment	79.56	-	-	-	63.44	99.92	64.27
030326 Integrated Iron & Steel works	75.62	-	79.98	-	-	-	-

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 2013) 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 corresponding IPCC categories as described in Chapter 3.2.3.

3.2.10 1.A.1 Energy Industries

3.2.10.1 1.A.1.a Public Electricity and Heat Production

Key Sources: CO_2 from 1.A.1.a gaseous, liquid, solid and other fuels

Category *1.A.1.a Public Electricity and Heat Production* covers emissions from fuel combustion in public power and heat plants. The share in total GHG emissions from sector *1.A* is 19.8% for the year 1990 and 15.4% for the year 2012. The increased CH_4 emissions are due to increased natural gas and biomass combustion in plants smaller 50 MW_{th} (see tables in Annex 2).

Methodology

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

For the years 2005–2012 CO_2 emissions from plants having a total boiler capacity of >= 20 MW_{th} are taken from ETS reports and CO_2 emissions from plants < 20 MW_{th} are calculated by means of national default emission factors and remaining fuel consumption of the energy balance. Coal consumption is fully covered by the ETS. The general methodology is described in Chapter 3.2.3.

Emission factors

National emission factors for CO_2 and CH_4 are taken from (BMWA-EB, 1990, 1996, (UMWELTBUNDESAMT 2001a) and (GEMIS, 2002). N_2O emission factors are taken from a national study (STANZEL et al. 1995). The selected emissions factors for 2012 as well as the national default emission factors are listed in the following table. The CO_2 emission factor for municipal solid waste is taken from (ABFALLWIRTSCHAFT 2003).

Table 34: Emission factors of Category 1.A.1.a for the year 2012.

Fuel	**Default CO_2 [t/TJ]**	**CH_4 [kg/TJ]**	**N_2O [kg/TJ]**
Light Fuel Oil in plants ≥ 50 MW_{th}	77.00	1.00	1.00
Light Fuel Oil in plants ≤ 50 MW_{th}	78.00	0.80	0.60
Medium Fuel Oil	78.00	1.00	1.00
Heavy Fuel Oil in plants ≥ 50 MW_{th}	80.00	0.60–1.00	1.80
Heavy Fuel Oil in plants ≤ 50 MW_{th}	78.00	2.00	1.00
Gasoil	75.00	1.20	1.00
Diesel oil	75.00	0.20	0.60
Liquified Petroleum Gas	64.00	1.50	1.00
Hard coal in power and CHP plants	95.00	0.10	0.50
Hard coal in district heating plants.	93.00	0.30	5.00
Lignite and brown coal in power and CHP plants ≥ 50 MW_{th}	110.00	0.10	0.50
Lignite and brown coal in district heating plants ≥ 50 MW_{th}	108.00	0.20	2.00
Lignite, brown coal and brown coal briquettes in plants < 50 MW_{th}	97.00	7.00	1.40
Natural Gas in power and CHP plants ≥ 50 MW_{th}	55.40	0.18	0.50
Natural Gas in district heating plants ≥ 50 MW_{th}	55.40	1.50	1.00
Natural Gas in plants ≤ 50 MW_{th}	55.40	1.50	0.10
Fuel Wood	100.00[1)]	21.00	3.00
Wood Waste	110.00[1)]	2.00	4.00
Sewage Sludge	110.00[1)]	12.00	1.40
Biogas, Sewage Sludge Gas, Landfill Gas	112.00[1)]	1.50	1.00
Municipal Solid $Waste_{wet}$	48.88[2)]	12.00	1.40
Industrial Waste	104.17[2)]	12.00	1.40

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

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

Activity data

Total fuel consumption of Category *1.A.1.a* is taken from (IEA JQ 2013) 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 19 TWh electricity and 78 PJ district heat production from fuel combustion. In the year 2012 electricity production from hydro plants reached a historic maximum of 46.5 TWh and contributed to 73% of total production.

Table 35: Public gross electricity and heat production.

Year	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
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	60 606	42 400	16 188	2	49	1 967	63 209
2010	61 731	40 478	19 099	1	89	2 064	78 344
2011	56 356	36 805	17 442	1	174	1 934	72 617
2012	63 384	46 503	14 080	1	337	2 463	72 203

[1)] *including pumped storage; Source: STATISTIK AUSTRIA 2013*

As shown in Table 36 electricity supply increased by 12 405 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. The year 2011 shows an historical maximum of net imports which contribute to 12% of total electricity supply.

Table 36: Electricity supply, gross production imports, exports and net imports [GWh].

Year	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

Year	Electricity [GWh]				
	Supply[1)]	Gross production[2)]	Imports	Exports	Net Imports
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	64 112	69 088	19 542	18 762	780
2010	67 247	71 128	19 898	17 567	2 331
2011	67 224	65 811	24 972	16 777	8 195
2012	68 155	72 616	23 264	20 454	2 810

Source: Statistik Austria

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

2) *Public and autoproducer gross production*

Recalculations

Recalculations of activity data are following the revisions of the energy balance as described in Annex 2. Natural gas consumption has been revised from the year 2005 on which leads to −174 Gg of CO_2 emissions in 2011. Liquid fuel (residual fuel oil) consumption has been revised from the year 2009 on which leads to +46 Gg of CO_2 emissions in 2011.

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_{th}.

3.2.10.2 1.A.1.b Petroleum Refining

Key Sources: CO_2 from 1.A.1.b gaseous and liquid fuels

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

The share in total GHG emissions from sector *1.A* is 4.4% for the year 1990 and 4.8% for the year 2012. Crude oil input was 8 megatons in 1990 and 8.3 megatons in 2012.

Methodology

The IPCC Tier 2 bottom up methodology is used. Activity data is multiplied by emission factors. For calculation of CO_2 emissions plant specific emission factors are used. For calculation of N_2O and CH_4 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 37: Carbon content per fuel group for petroleum refining.

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

For 1990 to 2001 CO_2 emissions are calculated by multiplying activity data from the energy balance by the emission factors in Table 37. CO_2 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 CO_2 emissions are disaggregated to the IEA fuel types (see column „Associated IEA-fuels") by using default emission factors for industrial boilers, subtracting the calculated CO_2 emissions from total CO_2 emissions, and associating remaining CO_2 emissions to refinery gas. The resulting IEF for refinery gas is presented in Table 38. The IEF fluctuations reflect changes in refinery gas composition.

Table 38: Implied emission factors for refinery gas.

Year	t CO_2/TJ
1990	51.6
1991	50.7
1992	51.0
1993	48.9
1994	50.3
1995	52.0
1996	51.6
1997	50.7
1998	50.9
1999	56.5
2000	51.6
2001	51.9
2002	74.0
2003	76.1
2004	95.1
2005	63.9
2006	53.7
2007	49.1
2008	54.4
2009	88.6
2010	69.8
2011	71.5
2012	66.9

N_2O and CH_4 emissions are calculated by multiplying fuel consumption by the emission factors presented in Table 39 (they are selected according to chapter 3.2.9).

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 39: Emission factors of Category 1.A.1.b.

Fuel	CO_2 [t/TJ]	N_2O [kg/TJ]	CH_4 [kg/TJ]
Residual Fuel Oil	80.00	0.60	2.00
Gas oil	75.00	0.60	1.20
Diesel	78.00	0.60	0.20
Other Oil Products	78.00	0.60	0.20
LPG	64.00	1.00	1.50
Petrol Coke	100.88	3.00	2.00
Refinery gas 2012	66.90	0.10	0.20
Natural Gas	55.40	0.10	1.50

Activity data

Fuel consumption is taken from (IEA JQ 2013) 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 40: Refinery input/output mass balance.

Material flow [kt]	1990	1995	2000	2005	2006	2007	2008	2009	2010	2011	2012
Total Input	**9 062**	**9 244**	**8 887**	**9 338**	**9 088**	**9 189**	**9 438**	**9 096**	**8 449**	**9 133**	**9 178**
Crude oil	7 952	8 619	8 240	8 743	8 472	8 496	8 710	8 286	7 719	8 170	8 349
NGL	41	43	107	43	47	184	80	130	134	194	123
Feedstocks	1 069	582	540	526	470	348	406	461	317	505	395
Biofuel (blending)	0	0	0	27	99	161	242	219	279	264	311
Total Output	**8 881**	**8 931**	**8 562**	**9 067**	**8 815**	**8 850**	**9 005**	**9 038**	**8 210**	**9 129**	**9 098**
Fuel oil	1 913	1 502	979	1 045	915	844	738	989	815	822	983
Gas oil	1 239	1 454	1 062	997	1 004	612	991	835	761	738	688
Diesel	1 531	1 920	2 662	2 931	2 780	2 976	3 108	3 164	2 741	3 367	3 275
Other Kerosene	31	8	1	1	1	1	3	3	3	0	16
Aviation kerosene	291	420	544	592	526	604	472	313	476	615	616
Aviation gasoline	0	0	0	0	0	0	0	0	0	0	0
Motör gasoline	2 631	2 271	1 815	1 798	1 615	1 704	1 684	1 739	1 519	1 614	1 635
White spirit	0	5	0	0	0	0	0	64	70	65	0

Material flow [kt]	1990	1995	2000	2005	2006	2007	2008	2009	2010	2011	2012
Bitumen	269	254	343	466	392	411	444	420	292	376	366
Other petroluem products	499	667	763	718	1 035	1 095	978	983	991	867	1 069
LPG	47	60	34	143	91	113	138	137	87	101	67
Refinery gas	373	305	312	309	390	417	383	324	392	381	311
Petroleum Coke	57	66	48	66	65	73	66	67	62	183	70
Input-Output	**180**	**313**	**325**	**272**	**273**	**339**	**434**	**58**	**239**	**4**	**80**

Recalculations

Recalculations of activity data are following the revisions of the energy balance as described in Annex 2.

The share of natural gas used for hydrogen generation (non-energy use) is now allocated within 1.A.1.b. In the previous submissions this quantity was considered in category 1.A.2.f. By keeping the figure for the total CO_2 emissions (from the verified EU-ETS data) this leads to a lower consumption of liquid fuels (refinery gas) and a slightly change of N_2O emissions (about −1 Mg in 2011). Emissions of CH_4 were reported as included elsewhere in the previous submission. Following a recommendation of the UNFCCC review CH_4 emissions from fuel combustion are now reported within this category which is +0.05 Gg of CH_4 in 2011.

Planned improvements

No improvements are planned.

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

Key Source: CO_2 from 1.A.1.c gaseous fuels

Category *1.A.1.c Manufacture of Solid Fuels and Other Energy Industries* enfolds emissions from fuel combustion in the oil and gas extraction sector (reported by companies as 'own use'), compressors used for natural gas storage tanks and fuel use of gas processing facilities („gas refineries"). For 1990 to 1995 transformation losses/own use in gas works are included too. The share in sector *1.A* overall GHG emissions is 0.9% for the year 1990 and 0.9% for the year 2012.

Methodology

CORINAIR simple methodology is applied.

For 2005 to 2012 CO_2 emissions and activity data of natural gas storage compressors are taken from ETS data.

Emission factors

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

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

Table 41: Emission factors of Category 1.A.1.c.

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

Activity data

Fuel consumption is taken from (IEA JQ 2013) 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 2013) 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 2013).

Recalculations

The change of natural gas activity data from 2005 on is following the revision of the energy balance as described in Annex 2. The consequence in GHG emissions is −79 Gg CO_2 in the year 2011.

3.2.11 1.A.2 Manufacturing Industries and Construction

3.2.11.1 1.A.2.a Iron and Steel

Key Sources: CO_2 from 1.A.2.a gaseous, solid and liquid fuels

Category *1.A.2.a Iron and Steel* enfolds emissions from fuel combustion in iron and steel industry. CO_2 emissions from ore reduction in blast furnaces are included in category *2.C.1.b Pig Iron*. The share in total GHG emissions from Sector 1.A is 9% for the year 1990 and 9.9% for the year 2012.

Methodology

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

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

CO_2, NMVOC, CO, NO_X and SO_2 emissions are reported by the two Austrian iron and steel plants together with their coal, fuel oil and natural gas fuel consumption. For liquid fuels, natural gas and coke oven coke CO_2 emission factors taken from (BMWA-EB 1996) are applied. The remaining CO_2 emissions are allocated to the reported coke oven gas consumption. The methodology to divide the reported fuel consumption into energy related and process related consumption is performed with the information provided in (IEA JQ 2013).

The complex carbon fluxes in iron and steel plants cannot be well modelled within the energy balance which leads to a fluctuation of implied CO_2 emission factors for *1.A.2.a* solid fuels over time. CO_2 emissions 2005 to 2012 are reported from plant operators. The emissions declaration includes emissions from natural gas consumption not included in the ETS.

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

CH_4 emissions are calculated under the assumption that the ratio of CH_4 emissions to the reported NMVOC emissions is equal to the ratio of CH_4 and NMVOC emissions if calculated with the CORINAIR simple method. For the year 2007 this ratio is 362/267; the plant reported 267 t NMVOC and by applying the ratio obtained from the CORINAIR simple methodology, total CH_4 emissions were estimated to be 80 t. In a last step CH_4 emissions were allocated to the different fuel types.

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

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

Mass balance of integrated iron and steel plant

The following Figure 13 shows a flow chart of a integrated iron and steel plant representing the mass balance which is used for reporting under the ETS. The grey shaded area illustrates the most important facilities and the interior fluxes between them, although the real conditions are even more complex. The outside parts of the figure shows the carbon containing inputs and outputs of fuels and materials as reported under the ETS. The fuel Input and the internal transformation processes between fuels (e.g. coke oven coke, blast furnace gas, coke oven gas, blast furnace gas, waste gas from basic oxygen furnaces) are reported in the energy balance. CO_2 emissions from reducing agents (non energy use of coke oven coke, waste oil, plastics waste, tar) which are used in the blast furnace as well as the net CO_2 emissions from carbon containing material input such as iron ore, scrap and electrodes as well as output material such as steel and pig iron are reported under CRF category *2.C.1.* CO_2 emissions from additions which are used in the blast furnace such as limestone, magnesite and dolomite are reported under CRF category *2.A.3.* CO_2 Emissions from other fuel input such as hard coal, residual fuel oil and natural gas as well as a the final energy consumption of coke oven coke are reported under CRF category *1.A.2.a*.

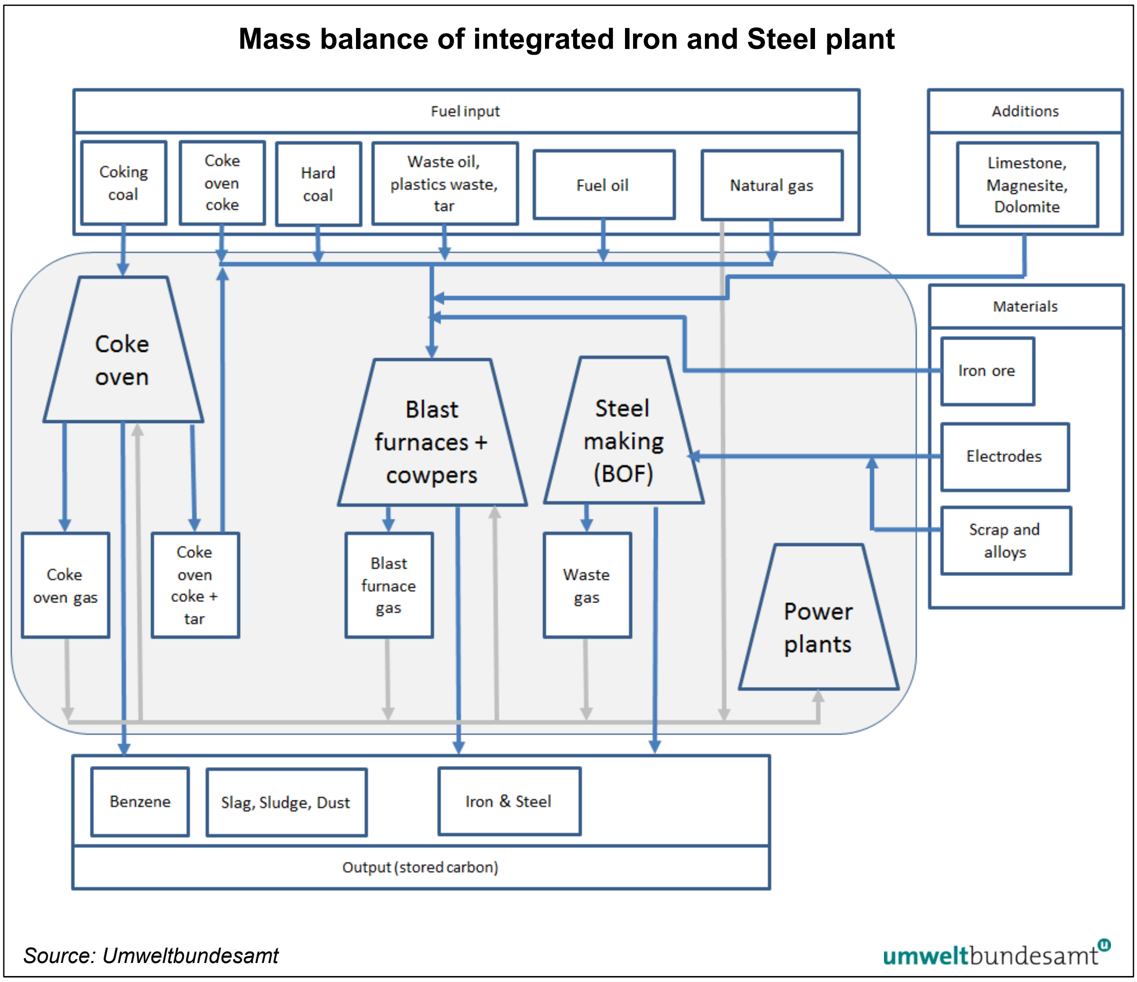

Figure 13: Mass balance of integrated Iron and Steel plant.

Emissions

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

Table 42: Greenhouse gas emissions from Category 1.A.2.a by sub sources.

Year	other sources			Integrated steel plants		
	CO_2 [Gg]	CH_4 [Gg]	N_2O [Gg]	CO_2 [Gg]	CH_4 [Gg]	N_2O [Gg]
1990	191	0.005	0.001	4 753	0.020	0.041
1991	250	0.007	0.001	4 365	0.016	0.041
1992	202	0.005	0.001	3 730	0.014	0.035
1993	222	0.006	0.002	3 969	0.016	0.036
1994	234	0.006	0.002	4 207	0.020	0.039
1995	291	0.007	0.002	4 483	0.019	0.045
1996	445	0.012	0.003	4 221	0.019	0.040
1997	465	0.012	0.002	4 822	0.022	0.046
1998	424	0.011	0.002	4 291	0.022	0.046
1999	316	0.008	0.001	4 547	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	5 115	0.027	0.052
2003	368	0.010	0.001	5 260	0.068	0.053
2004	300	0.008	0.001	5 555	0.081	0.054
2005	448	0.012	0.002	6 001	0.089	0.057
2006	495	0.013	0.002	5 849	0.095	0.060
2007	379	0.011	0.001	5 837	0.090	0.062
2008	393	0.010	0.002	5 796	0.081	0.059
2009	350	0.009	0.001	4 471	0.078	0.046
2010	343	0.009	0.001	5 582	0.074	0.057
2011	367	0.010	0.001	5 573	0.085	0.055
2012	379	0.010	0.001	5 479	0.084	0.053

Emission factors

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

The selected and calculated emission factors for 2012 are presented in Table 43 and

Table 44.

Table 43: Emission factors of Category 1.A.2.a for area sources.

Fuel	CO_2 [t/TJ]	CH_4 [kg/TJ]	N_2O [kg/TJ]
Light Fuel Oil	78.00	0.20	0.60
Heavy Fuel Oil	78.00	2.00	1.00
Gas oil	75.00	1.20	1.00
Petroleum	78.00	0.20	0.60

Fuel	CO_2 [t/TJ]	CH_4 [kg/TJ]	N_2O [kg/TJ]
LPG	64.00	1.50	1.00
Hard Coal	94.00	5.00	1.40
Lignite and brown coal	97.00	7.00	1.40
Coke	104.00	2.00	1.40
Natural Gas	55.40	1.50	0.10
Wood Waste	110.00[1)]	2.00	4.00

1) *Reported as CO_2 emissions from biomass.*

Table 44: Emission factors of Category 1.A.2.a for point sources.

Fuel	CO_2 [t/TJ]	CH_4 [kg/TJ] (2012)	N_2O [kg/TJ]
Heavy Fuel Oil	78.00	1.64	1.00
Coke	104.00	1.64	1.40
Coke Oven Gas	94.60	-	1.00
Natural Gas	55.40	1.23	0.10

Fugitive emissions and losses

An analysis of ETS data shows that the amount of carbon stored in slag, dust, sludge and steel was 76 kt CO_2 equivalents in 2012 (2011: 71 kt, 2010: 66 kt, 2009: 55 kt, 2008: 91 kt). This amount should be considered in the quantification of the difference between the sectoral and the reference approach.

Activity data

Total fuel consumption is taken from (IEA JQ 2013) as presented in Annex 4.

Point source activity data are reported by plant operators which are widely consistent with (IEA JQ 2013).

Recalculations

The update of activity data according to the revised energy balance as described in Annex 2 resulted in a shift of +95 Gg CO_2 from category *2.C.1* for the year 2011 to category 1.A.2.a (following the revision of the energy balance regarding the non-energy use of coke oven coke used in blast furnaces). The revision of natural gas consumption since the year 2005 results in +95 Gg CO_2 emissions in the year 2011.

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

Key Source: CO_2 from 1.A.2.b gaseous 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 2012.

Methodology

CORINAIR simple methodology is applied. Fuel consumption is taken from (IEA JQ 2013) as described in Annex 4.

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

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

The emission factors for 2012 are presented in the following table.

Table 45: Emission factors of Category 1.A.2.b

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

Activity data

Fuel consumption is taken from (IEA JQ 2013) as presented in Annex 4.

Recalculations

Changes of activity data are based on a revision of the energy balance 2005 to 2011 as described in Annex 2 and result in +273 Gg CO_2 emissions in the year 2011.

3.2.11.3 1.A.2.c Chemicals

Key Sources: CO_2 from 1.A.2.c gaseous, solid and liquid 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 3% for the year 2012. 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 2012 CO_2 ETS data are considered.

CO_2 emissions from industrial waste: Table 46 shows the composition of the implied emissions factor 2000–2012 for industrial waste. One plant with a capacity of 150 kt solid waste/year is considered with a NCV of 10 TJ/kt waste and a CO_2 emission factor of 104.17 t/TJ. From 2005 on ETS data is considered with plant specific emissions and energy consumption. The remaining energy use (other waste) is considered with a CO_2 emission factor of 52.09 t/TJ. 'Other waste' is considered as 50% waste gas (with a high share of hydrogen) and chemical reaction heat (which is not relevant for GHG emissions). Therefore an emission factor of 50% of the default emission factor is selected.

Table 46: Composition of 1.A.2.c Chemical industries – industrial waste – CO_2 IEF for the years 2000 to 2012.

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	6 904	1 500	104.17	299	84.88	5 105	52.09	64.82
2009	5 602	1 500	104.17	271	76.38	3 832	52.09	67.20
2010	6 460	1 500	104.17	276	77.47	4 684	52.09	65.26
2011	6 550	1 500	104.17	210	75.10	4 840	52.09	64.75
2012	5 872	1 500	104.17	259	82.92	4 113	52.09	66.75

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

Emission factors

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

Table 47: Emission factors of Category 1.A.2.c for 2012.

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

Fuel	CO_2 [t/TJ]	CH_4 [kg/TJ]	N_2O [kg/TJ]
Black Liquor	110.00[1)]	2.00	1.40
Biogas	112.00[1)]	1.50	1.00
Industrial Waste	66.75[3)]	12.00	1.40

1) Reported as CO_2 emissions from biomass

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

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

Activity data

Fuel consumption is taken from (IEA JQ 2013) as presented in Annex 4.

Recalculations

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

These recalculations due to revision of the energy balance mainly affect CO_2 emissions from liquid fuels (+35 Gg CO_2 in 2011), natural gas (-376 Gg CO_2 in 2011) and other fuels (+90 Gg CO_2 in 2011) which results in an overall increase of +500 kt CO_2 in 2011.

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

Key Source: CO_2 from 1.A.2.d gaseous, solid and liquid fuels

Category *1.A.2.d Pulp, Paper and Print* enfolds emissions from fuel combustion in pulp, paper and print industry. The share in total GHG emissions from sector *1.A* is 4.1% for the year 1990 and 3.4% for the year 2012.

Methodology

The CORINAIR simple methodology is applied. For the years 2005 to 2012 CO_2 ETS data are considered.

CO_2 emissions from industrial waste: The following Table 48 shows the composition of the implied emissions factor 2000–2012 for industrial waste. From 2005 on ETS data is considered with plant specific emissions and energy consumption. From 1990 to 2004 energy consumption of the energy balance is taken and considered with a CO_2 emission factor of 104.17 t/TJ. In general ETS data shows slightly higher energy consumption (in terms of TJ) than current energy statistics, therefore ETS data is used from 2005 on.

Table 48: Composition of 1.A.2.d Pulp, Paper and Print – industrial waste – CO_2 IEF for the years 2000 to 2012.

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	101	88.78	88.78	8.92
2009	139	96	91.72	91.72	8.79
2010	169	79	100.85	100.85	7.93
2011	188	91	87.79	87.79	7.99
2012	121	60	116.27	116.27	6.98

Emission factors

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

Emission factors for 2012 are presented in the following table.

Table 49: Emission factors of Category 1.A.2.d.

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

1) *Reported as CO_2 emissions from biomass*

2) *Including sewage sludge from paper mills*

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

Activity data

Fuel consumption is taken from (IEA JQ 2013) 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 2011 is +181 Gg CO_2 from natural gas.

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

Key Source: CO_2 from 1.A.2.e gaseous, solid and liquid 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 1.7% for the year 2012.

Methodology

CORINAIR simple methodology is applied. For the years 2005 to 2013 CO_2 ETS data are considered.

Emission factors

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

Emission factors for 2012 are presented in the following table.

Table 50: Emission factors of Category 1.A.2.e.

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

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

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

Activity data

Fuel consumption is taken from (IEA JQ 2013) as presented in Annex 4.

Recalculations

Changes of activity data are based on a revision of the energy balance as described in Annex 2. The most important recalculation for the year 2011 is +92 Gg CO_2 from natural gas.

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

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

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

The share in total GHG emissions from Sector *1.A* is 6.7% for the year 1990 and 7.9% for the year 2012. N_2O emissions mainly arise from mobile machinery (1990: 66%; 2012: 53%).

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

In the following the methodology of estimating emissions from stationary sources of category *1.A.2.f Other* is described. The share in total GHG emissions from sector *1.A* is 6.2% for the year 1990 and 5.9% for the year 2012.

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 2012 clinker production was falling by 20% from 4 Mt to 3.2 Mt.

Methodology

Information about CO_2 emissions due to fuel combustion for cement production is taken from four studies of the Austrian cement industry (HACKL & MAUSCHITZ, 1995, 1997, 2001, 2003, 2007) and (MAUSCHITZ 2004, 2009, 2010, 2011, 2012, 2013). 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 2012.

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

CO_2 emissions 1990 to 2003

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

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

CO_2 emissions 2004 to 2012 are taken from the ETS allocation plan survey and ETS data.

CH_4 and N_2O emissions are calculated with the simple CORINAIR methodology.

Activity data

Calculated thermal energy intake of cement kilns is between 3.46 GJ/t clinker in 1990 and 3.7 GJ/t clinker in 2012.

Hard Coal, Brown Coal, Petrol Coke and Industrial Waste

In (IEA JQ 2013) the category *Non-metallic Mineral Products* enfolds fuel consumption of NACE Division 26. As within this NACE division, industrial branches other than cement industry do not use coal and industrial waste for fuel combustion, 100% of those fuels are allocated to the cement industry. The same is for 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 CO_2 IEFs of industrial waste which is used as a fuel in cement kilns. After 2005 the share of waste which contains 100% biomass has been taken from ETS data. The overall IEF is between 79.25 an 85.86 t CO_2/TJ which is reasonable because most of the waste origins from oil products. From 1990 to 2004 the mass of fractions with 100% biomass is not 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 51: Industrial waste used as fuel in cement kilns 1990–2012.

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	62.41	–	–

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				
2000	–	170	20.94	55.38	–	–
2001	–	218	20.85	48.03	–	–
2002	–	239	20.78	58.09	–	–
2003	–	254	21.91	70.57	–	–
2004	–	257	22.07	57.72	–	–
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	147	226	22.57	81.67	24.50	106.17
2009	146	219	23.19	81.29	28.36	109.65
2010	129	227	22.19	83.20	23.71	106.91
2011	136	240	21.53	85.13	28.98	114.11
2012	152	263	20.92	87.29	34.93	122.22

[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 2013).

Activity data 2005–2012

For the years 2005–2012 ETS data are taken which covers 100% of cement plants.

Emission factors

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

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

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

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

Methodology

The CORINAIR simple methodology is applied. For 2005 to 2012 ETS data is considered for glass, magnesia, bricks & tiles and lime manufacturing plants. Fuel use of lime kilns which are operated by sugar industries is reported under category 1.A.2.e food processing, Beverages and Tobacco.

Activity data

Fuel consumption is taken from (IEA JQ 2013) 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 2013) 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 2013).

Emission factors

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

The emission factors for 2012 are presented in the following table.

Table 52: Emission factors of Category 1.A.2.f stationary sources.

Fuel	CO_2 [t/TJ]	CH_4 [kg/TJ]	N_2O [kg/TJ]
Hard Coal	94.00	5.00	1.40
Lignite and brown coal	97.00	7.00	1.40
Brown Coal Briquettes	97.00	7.00	1.40
Coke	104.00	2.00	1.40
Light Fuel Oil	78.00	0.20	0.60
Medium Fuel Oil	78.00	2.00	1.00
Heavy Fuel Oil	78.00	2.00	1.00
Gas oil	75.00	1.20	1.00
Diesel	75.00	0.20	0.60
Petroleum	78.00	0.20	0.60
LPG	64.00	1.50	1.00
Gas Works Gas	64.00	0.20	1.00
Petrol Coke	100.88	0.00	0.00
Natural Gas	55.40	1.50	0.10
Fuel Wood	100.00[1)]	2.00	4.00
Wood Waste	110.00[1)]	2.00	4.00
Black Liquor	110.00[1)]	2.00	1.40
Biogas	112.00[1)]	1.50	1.00
Sewage Sludge Gas	112.00[1)]	1.50	1.00
Landfill Gas	112.00[1)]	1.50	1.00
Industrial Waste –unspecified	104.17[2)]	12.00	1.40
Industrial Waste – Cement industry	87.29[3)]	12.00	1.40

1) *Reported as CO_2 emissions from biomass*

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

3) *Implied emission factor.*

Recalculations

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

Recalculations 2011 mainly affect CO_2 emissions from natural gas (+24 Gg CO_2), liquid fuels (−49 Gg CO_2) and solid fuels (−56 Gg CO_2).

See also recalculations-chapter of category *1.A.1.b*.

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

In the following chapter the methodology of estimating emissions from mobile sources of *1.A.2.f Other* is described. The share in total GHG emissions from sector *1.A* is 0.5% for the year 1990 and 2.0% for the year 2012. All GHG emissions originate from liquid fossil fuel combustion.

Table 53: Greenhouse gas emissions from Category 1.A.2.f mobile sources 1990–2012.

Year	CO_2 [Gg]	CH_4 [Gg]	N_2O [Gg]	Gg CO_2 equivalent
1990	256	0.01	0.09	284
1991	289	0.02	0.10	321
1992	306	0.02	0.11	340
1993	322	0.02	0.11	358
1994	338	0.02	0.12	376
1995	358	0.02	0.13	399
1996	446	0.02	0.17	498
1997	420	0.02	0.16	471
1998	494	0.02	0.19	555
1999	471	0.02	0.19	530
2000	551	0.02	0.22	620
2001	518	0.02	0.21	583
2002	504	0.02	0.20	567
2003	537	0.02	0.21	602
2004	591	0.02	0.20	655
2005	809	0.02	0.23	882
2006	975	0.03	0.24	1 051
2007	1 051	0.03	0.23	1 124
2008	1 151	0.03	0.23	1 223
2009	1 108	0.03	0.21	1 174
2010	1 070	0.02	0.19	1 130
2011	1 072	0.02	0.19	1 131
2012	1 113	0.02	0.18	1 170
Trend 1990–2012	**335%**	**84%**	**103%**	**312%**

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 fuel consumption and national emissions are calculated (bottom-up). Calculated fuel consumption of off-road traffic is then summed up with total fuel consumption of inland road transport and is compared with total fuel sold in Austria according to the national energy balance. The difference is allocated to fuel export (for details concerning fuel export see *1.A.3.b*). The emissions reported for Austria also include the emissions from the fuel exports assuming that the fuel export fleet (mainly travelling on highways) is similar to the Austrian fleet on highways.

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. leaders, diggers, etc.) were taken from:

- Statistik Austria (fuel statistics),
- Questionnaire to vehicle and machinery users (PISCHINGER 2000),
- Interviews with experts and expert judgment
  validating the questionnaire results (PISCHINGER 2000) and
- Information from vehicle and machinery manufacturers (PISCHINGER 2000).

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

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 below.

Table 54: Implied emission factors and activities for industrial off-road traffic 1990–2012.

Year	Activity	Implied Emission Factors		
	TJ	CO_2 t/TJ	CH_4 kg/TJ	N_2O kg/TJ
1990	3 456	74.02	3.92	26.06
1991	3 907	74.02	3.90	26.09
1992	4 137	74.02	3.89	26.11
1993	4 350	74.02	3.89	26.13
1994	4 565	74.02	3.83	26.46
1995	4 844	73.85	3.71	26.98
1996	6 036	73.85	3.55	27.87
1997	5 690	73.85	3.45	28.52
1998	6 691	73.85	3.36	29.04
1999	6 397	73.67	3.30	29.33
2000	7 478	73.67	3.25	29.61
2001	7 029	73.67	3.23	29.77
2002	6 841	73.67	3.19	29.59
2003	7 292	73.67	2.98	28.26
2004	8 021	73.67	2.66	25.38
2005	10 965	73.75	2.24	21.42
2006	13 153	74.15	2.02	18.53
2007	14 164	74.20	1.87	16.38
2008	15 511	74.21	1.76	14.85
2009	14 894	74.41	1.75	14.04
2010	14 373	74.41	1.72	13.47
2011	14 311	74.93	1.71	13.10
2012	14 858	74.92	1.67	12.29

In 2012, the total avoided fossil CO_2 emissions from the use of biofuels amounted to 1 669 Gg in Austria. 5% of these emissions are attached to mobile off-road sources in the industry sector. For more details about the use of biofuels see chapter *1.A.3.b Road Transport*.

Emission Factors

The following emission factors for four categories of engine types (average motor capacity) depending on the year of construction are used in the GEORG model. They represent emissions according to the engine power output and also fuel consumption.

Table 55: Emission factors for diesel engines > 80 kW.

Year	CO_2	CH_4	N_2O
	[g/kwh]		
1993	875.09	0.04	0.32
2001	829.97	0.03	0.35
2003	813.85	0.01	0.22
2006	846.74	0.01	0.12
2011	846.74	0.01	0.08

Table 56: Emission factors for diesel engines < 80 kW.

Year	CO_2	CH_4	N_2O
	[g/kwh]		
1993	898.62	0.047	0.32
2001	846.41	0.036	0.35
2003	864.85	0.029	0.22
2006	864.85	0.016	0.12
2011	864.85	0.016	0.08

Table 57: Emission factors for 4-stroke-petrol engines.

Year	CO_2	CH_4	N_2O
	[g/kwh]		
1993	1 769.1	0.80	0.04
2001	1 702.6	0.64	0.04
2003	1 480.0	0.61	0.04
2006	1 480.0	0.59	0.04
2011	1 480.0	0.55	0.03

Table 58: Emission factors for 2-stroke-petrol engines.

Year	CO_2	CH_4	N_2O
	[g/kwh]		
1993	2 330.1	2.50	0.015
2001	2 117.7	1.76	0.015
2003	2 059.4	1.66	0.015
2006	1 576.5	0.51	0.014
2011	1 520.2	0.51	0.012

Recalculations

Revisions of the national energy balance between 2009 and 2011 resulted in minor adjustments of the sectoral diesel consumption data applied in the national off-road model GEORG. Emissions from the off-road construction industry were recalculated due to a posteriori statistical change in the construction production index for the year 2011 resulting in slightly increased GHG emissions (+0.4% in 2011) (HAUSBERGER & SCHWINGSHACKL 2013).

3.2.12 1.A.3 Transport

3.2.12.1 1.A.3.a Civil Aviation

Key Source: No

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

Greenhouse gas emissions from national aviation are very low in comparison to total emissions from the transport sector and amounted to 0.3% in 2012. 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.

Table 59: CO_2, N_2O and CH_4 emissions from 1.A.3.a Civil Aviation by subcategories 1990–2012.

Year	CO_2			N_2O			CH_4		
	dom. LTO	dom. LTO	dom. cruise	dom. LTO	dom. LTO	dom. cruise	dom. LTO	dom. LTO	dom. cruise
	Kerosene [Gg]	Gasoline [Gg]	Kerosene [Gg]	Kerosene [Gg]	Gasoline [Gg]	Kerosene [Gg]	Kerosene [Gg]	Gasoline [Gg]	Kerosene [Gg]
1990	10.0	7.8	14.2	0.0006	0.0002	0.0005	0.0022	0.0001	-
1991	10.8	8.1	18.7	0.0007	0.0002	0.0006	0.0021	0.0001	-
1992	11.6	8.3	23.2	0.0007	0.0002	0.0007	0.0021	0.0001	-
1993	12.4	8.6	27.6	0.0008	0.0002	0.0009	0.0020	0.0001	-
1994	13.2	8.8	32.1	0.0008	0.0002	0.0010	0.0019	0.0001	-
1995	14.0	7.1	36.6	0.0009	0.0002	0.0012	0.0018	0.0000	-
1996	16.2	6.8	40.6	0.0010	0.0002	0.0013	0.0029	0.0000	-
1997	18.4	7.6	44.5	0.0011	0.0002	0.0014	0.0039	0.0001	-
1998	20.6	8.2	48.5	0.0012	0.0002	0.0015	0.0050	0.0001	-
1999	21.1	8.7	51.3	0.0012	0.0002	0.0016	0.0052	0.0001	-
2000	19.3	6.4	41.6	0.0023	0.0002	0.0013	0.0048	0.0000	-
2001	15.8	5.9	38.4	0.0020	0.0002	0.0012	0.0039	0.0000	-
2002	16.4	7.5	38.2	0.0021	0.0002	0.0012	0.0041	0.0001	-
2003	16.1	8.2	38.3	0.0020	0.0002	0.0012	0.0040	0.0001	-
2004	17.2	7.6	39.5	0.0020	0.0002	0.0013	0.0043	0.0001	-
2005	16.4	8.8	41.6	0.0020	0.0002	0.0013	0.0041	0.0001	-
2006	19.6	9.0	43.2	0.0021	0.0002	0.0014	0.0049	0.0001	-
2007	20.0	9.0	44.7	0.0021	0.0002	0.0014	0.0050	0.0001	-
2008	22.2	9.3	39.3	0.0021	0.0003	0.0012	0.0055	0.0001	-
2009	20.4	10.3	36.8	0.0021	0.0003	0.0012	0.0051	0.0001	-
2010	19.4	9.2	34.9	0.0021	0.0003	0.0011	0.0048	0.0001	-
2011	16.8	13.9	31.2	0.0016	0.0004	0.0010	0.0042	0.0001	-
2012	16.9	8.0	29.7	0.0016	0.0002	0.0009	0.0042	0.0001	-

Methodological Issues

IFR – Instrument Flight Rules

For the years 1990–1999 a country-specific methodology was applied. The calculations are based on a study commissioned by the Umweltbundesamt finished in 2002 (KALIVODA et al. 2002). This methodology is consistent with the very detailed CORINAIR Tier 3b methodology (advanced version based on (MEET 1999): air traffic movement data[29] (flight distance and destination per aircraft type) and aircraft/engine performances data were used for the calculation.

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

VFR – Visual Flight Rules

CORINAIR, simple methodology was applied.

Activity Data

Fuel consumption (kerosene and gasoline) for *1.A.3.a. Civil Aviation* is presented below.

[29] This data is also used for the split between national and international aviation.

Table 60: Activity data 1.A.3.a Civil Aviation by subcategories 1990–2012.

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
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	127	480
2011	231	191	429
2012	233	110	409

IFR 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 from 2000 onwards 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 2008[30], 2009, 2010, 2011, 2012, 2013) and by Austro Control (AUSTRO CONTROL 2007[31], 2008, 2009, 2010, 2011, 2012, 2013). Moreover, for the calculation of passenger kilometres and ton kilometres input data was taken from the Austrian transport statistics (STATISTIK AUSTRIA 2013). The total amount of jet kerosene and gasoline was taken from the energy balance (STATISTIK AUSTRIA 2000–2013).

VFR flights

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

Table 61: Number of national IFR LTO cycles and fuel consumption as obtained from the MEET model 1990–2012.

Year	Activity			national
	nat. LTO Kerosene [Mg]	VFR Gasoline [Mg]	dom. 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
2011	5 323	4 397	9 893	16 185
2012	5 366	2 540	9 435	16 405

[30] for the years 2000–2007

[31] for the years 2000–2006

Emission Factors

CO_2

IFR/VFR

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

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

N_2O

IFR

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

VFR

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

CH_4

National/international cruise

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

National/international LTO

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

Quality Assurance and Quality Control (QA/QC)

Time series consistency

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

To demonstrate that the deviation between the two methodologies is acceptable, 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).

Table 62: Methodology dependent calculation of fuel consumption from 1.A.3.a Civil Aviation in 2000.

Year 2000	**Fuel**				
	dom. LTO	**dom. LTO**	**dom. cruise**	**int. LTO**	**int. cruise**
	Gasoline [Mg]	**Kerosene [Mg]**			
CORINAIR Tier 3b methodology	2 039	6 868	17 161	61 641	470 082
CORINAIR Tier 3a methodology	2 039	6 109	13 178	66 708	471 058
Deviation	0.0%	-11.0%	-23.2%	8.2%	0.2%

To show that there is no underestimation of domestic aviation emissions domestic fuel consumption is then multiplied with the default CO_2 emission factor of 3 150 kg CO_2/Mg fuel (CORINAIR, KALIVODA et al. 2002). Total reported CO_2 emissions for domestic aviation in the year 2000 are consistent with the CORINAIR Tier 3a methodology (new method), whereas the CORINAIR Tier 3b methodology (old method) deviates by 22%.

Table 63: Methodology dependent calculation of CO_2 from 1.A.3.a Civil Aviation in 2000.

	dom LTO	**dom. LTO**	**dom. cruise**	**dom. Total**	**Deviation**
	Gasoline	**Kerosene**			
2000	**[kt CO_2]**	**[kt CO_2]**		**[kt CO_2]**	**%**
OLI2013 (1990–2012)	6,4	19,3	41,6	67,24	
CORINAIR CO_2 default EF Tier 3b methodology	6,4	21,6	54,1	82,11	22,1
CORINAIR CO_2 default EF Tier 3a methodology	6,4	19,2	41,5	67,18	-0,1

Since there is no systematic deviation between the two models' results, Austria has decided not to replace the more accurate data applied for the period 1990–1999 (FCCC/ARR/2011/AUT§46).

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.

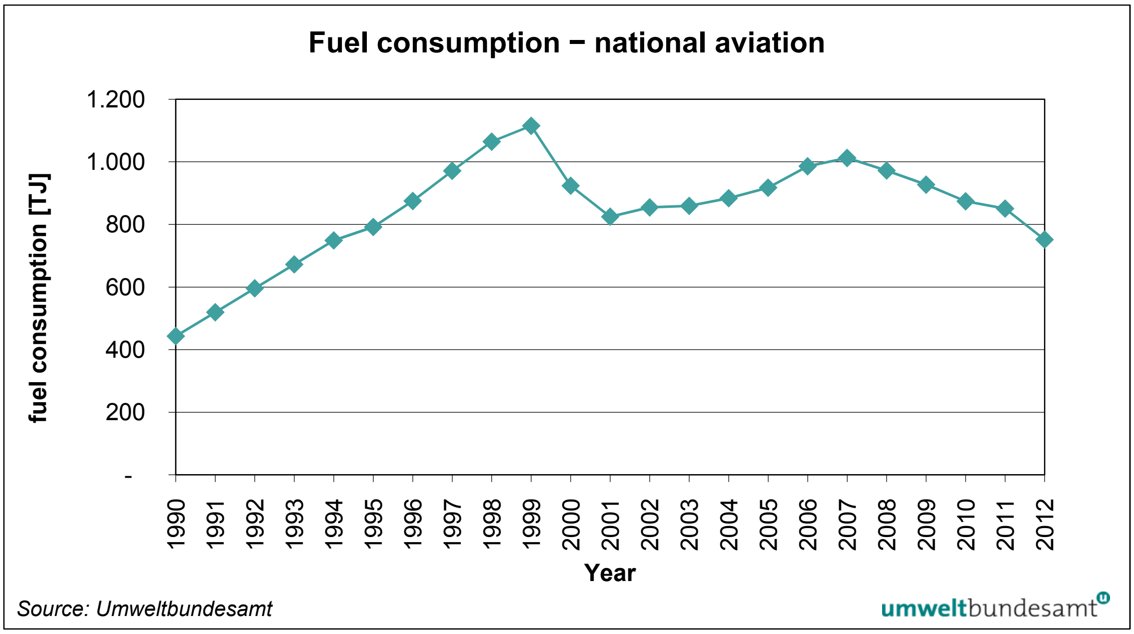

Figure 14: Activity data national aviation (1.A.3.a) 1990–2012.

Harmonization CRF and IEA data

In 2013 the ERT detected inconsistencies of fuel consumption data of domestic aviation and domestic navigation between the CRF tables and the IEA data (ICR 2013). In response to that it was explained that Austria uses a bottom-up approach to estimate fuel consumption whilst IEA relies on top-down approach based on fuel consumption statistics reported by Statistics Austria

After having discussed this issue with Statistics Austria an Explanatory Note (30/09/2013) has been compiled by Statistics Austria declaring that a regular adoption of inventory data for the split between national and international fuel consumption in civil aviation and navigation in the national statistics will be adopted in the future, as far as the data can be submitted in time (early November). As this cannot be guaranteed due to late data delivery for the bottom-up calculation in the inventory Statistics Austria may have to use a simple extrapolation of the previous years' data and send the current split to the IEA the following year. It is common practice to not report revised data to the IEA after the regular submission date at the end of October, i.e. outside the regular reporting deadlines.

The inconsistency for 2011 is therefore removed with this years' submission of the energy statistics (of data 1990–2012) to the IEA.

Completeness

In response to a question raised by the ERT (ICR 2013) it was explained that emissions of ground activities at domestic airports are also included, even if they are not separately reported under *1.A.3.a Aviation*. This can be assured as Austria reports emissions from **total fuel sold** from the energy balance.

The approach in the Austrian inventory is as follows: After calculating fuel consumption for inland road transport and off-road transport using a bottom-up approach (GLOBEMI, GEORG), the sum of this fuel used is compared with the total fuel sold from the national energy balance (for details see *1.A.3.b Road Transport*). The difference is then allocated to fuel export, which includes fuel consumption for ground activities at airports and harbours as well, including fuel consumption by unregistered vehicles. As the fuel consumption reported under fuel export is included in the national totals[32], an underestimation of emissions can be excluded.

Recalculations

No recalculations have been made in this years' submission.

3.2.12.2 1.A.3.b Road Transport

Key Source: Yes (CO_2: diesel/gasoline)

Road Transport showed a strong increase in emissions since 1990 (+55%) mainly due to an increase of road performance (kilometres driven) in passenger and freight transport. In addition to the increase of road performance within Austria, the amount of fuel sold in Austria but driven elsewhere – an effect mainly caused by higher fuel prices in neighbouring countries compared to Austria – has increased considerably since 1990. In 2012 GHG emissions from road transport decreased by 0.5% compared to 2011, mainly due to a slight decrease in fossil fuel consumption.

The gradual replacement of vehicles by newer, less consuming cars with less specific fuel consumption as well as the increased use of biofuels from 2005 onwards have contributed to the decreasing trend of the last few years.

Table 64: Greenhouse gas emissions from Category 1.A.3.b Road Transport 1990–2012.

Year	CO_2 [Gg]	CH_4 [Gg]	N_2O [Gg]	Gg CO_2 equivalent
1990	13 323	3.05	0.56	13 560
1991	14 794	3.37	0.67	15 074
1992	14 770	3.36	0.71	15 061
1993	14 908	3.36	0.75	15 210
1994	14 955	3.28	0.80	15 272
1995	15 229	3.06	0.82	15 546
1996	16 788	2.75	0.85	17 108
1997	15 801	2.45	0.83	16 110
1998	17 778	2.39	0.93	18 115
1999	17 161	2.08	0.90	17 484
2000	18 067	1.89	0.93	18 394
2001	19 409	1.77	0.95	19 742
2002	21 516	1.74	1.03	21 873
2003	23 271	1.64	1.07	23 638
2004	23 788	1.47	1.05	24 144
2005	24 072	1.31	1.02	24 415
2006	22 685	1.13	0.94	23 000
2007	22 884	0.99	0.89	23 180
2008	21 512	0.83	0.79	21 775

[32] GHG emissions from fuel export are included in 1.A.3.b, and are presented separately in Table 66 (Chapter 3.2.12.2)

Year	CO_2 [Gg]	CH_4 [Gg]	N_2O [Gg]	Gg CO_2 equivalent
2009	20 886	0.74	0.73	21 129
2010	21 657	0.68	0.69	21 886
2011	20 920	0.61	0.64	21 130
2012	20 835	0.59	0.60	21 035
Trend 1990–2012	**56%**	**-81%**	**8%**	**55%**

In 2012, 53% of the total greenhouse gas emissions from *1.A.3 Transport* are caused by passenger cars (petrol and diesel) and 36% 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 24%.

Table 65: GHG emissions from Road Transport differentiated by means of transportation 1990–2012.

Year	Passenger cars		light duty vehicles	heavy duty vehicles	moped	motorcycle
	petrol	diesel				
	[Gg CO_2e]	[Gg CO_2e]	[Gg CO_2e]	[Gg CO_2e]	[Gg CO_2e]	[Gg CO_2e]
1990	7 438	1 403	1 309	3 319	31	34
1991	8 269	1 671	1 352	3 689	29	37
1992	7 927	1 759	1 394	3 883	27	41
1993	7 627	1 888	1 417	4 178	26	45
1994	7 374	2 108	1 471	4 213	25	50
1995	7 141	2 356	1 492	4 444	24	57
1996	6 597	2 576	1 510	6 296	23	63
1997	6 253	2 859	1 545	5 327	22	70
1998	6 591	3 356	1 589	6 442	22	78
1999	6 115	3 557	1 640	6 025	21	86
2000	5 918	3 904	1 688	6 729	20	91
2001	5 984	4 466	1 700	7 432	20	95
2002	6 488	5 423	1 696	8 083	19	100
2003	6 655	6 294	1 715	8 780	18	104
2004	6 477	6 882	1 740	8 859	18	107
2005	6 271	7 263	1 787	8 904	18	110
2006	6 002	7 252	1 808	7 741	17	113
2007	5 862	7 510	1 822	7 784	17	117
2008	5 255	7 240	1 742	7 326	17	119
2009	5 234	7 070	1 657	6 951	17	124
2010	5 144	6 940	1 646	7 937	16	127
2011	4 938	6 682	1 628	7 662	16	132
2012	4 795	6 571	1 594	7 843	15	138
Trend 1990–2012	**-36%**	**368%**	**22%**	**136%**	**-50%**	**303%**

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 & SCHWINGSHACKL 2013).

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/or
   - total gasoline and diesel consumption of the area under consideration,
   - average km per vehicle and year.

Following data is calculated:

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

Figure 15 shows a schematic picture of the methodology of GLOBEMI.

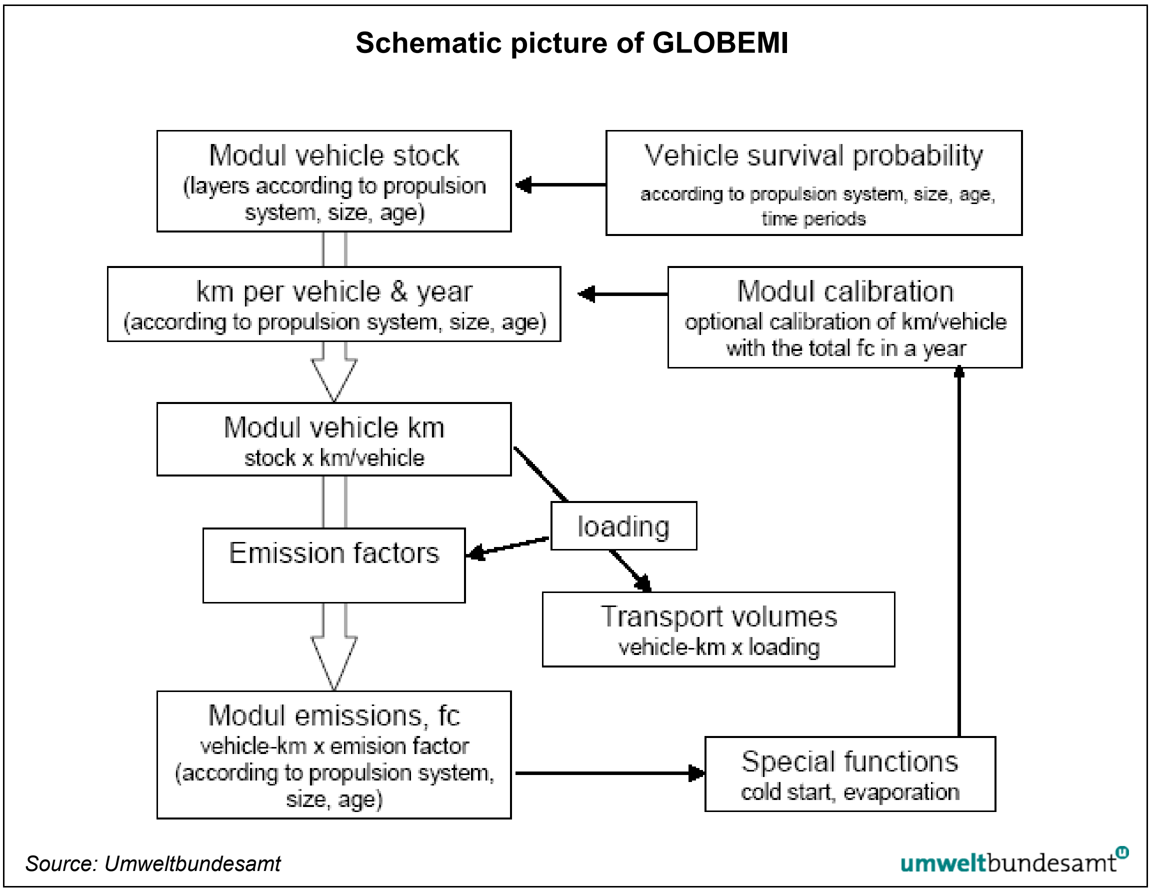

Figure 15: Schematic picture of the GLOBEMI model.

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.

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

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)

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

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

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

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

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

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

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

7) Summation over all vehicle categories

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

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

Activity Data

From 2011 to 2012 fuel consumption (gasoline, diesel and alternative fuels) by road transport and mobile off-road vehicles declined by 0.5%, a slight decrease which was mainly due to continued increasing fuel prices in 2012. Specific consumption per vehicle kilometer also declined between 2011 and 2012, by 2% for passenger cars and by 0.2% for heavy duty vehicles.

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.

The total annual road performance (millage driven per year) in Austria which is used in GLOBEMI 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.

Top down Methodology – Fuel sold

Based on the GLOBEMI model fuel consumption and emissions for road transport are calculated with a bottom-up approach. Calculated fuel consumption of road transport is then summed up with calculated fuel consumption of off road traffic and is compared with national total fuel sold.

The difference between the fuel consumption calculated in the bottom-up methodology for road traffic plus off-road transport within Austria and total fuel sales in Austria (obtained from national statistics; STATISTIK AUSTRIA 2000–2013) is allocated to fuel export (fuel sold in Austria but consumed abroad).

The emissions reported for Austria also include the emissions from the fuel exports.

Fuel export

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% 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 two national studies (MOLITOR et al. 2004; MOLITOR et al. 2009).

The following table shows the GHG emissions from inland road transport and fuel export.

Table 66: GHG emissions from fuel export and inland road transport 1990–2012.

Year		**Passenger cars**	**Light duty vehicles**	**Heavy duty vehicles**	**Mopeds and motorcycles**
	fuel export	**inland**	**inland**	**inland**	**inland**
		Gg CO_2 equivalent			
1990	925	8 832	1 309	2 404	65
1991	1 908	9 143	1 352	2 578	65
1992	1 456	9 456	1 394	2 657	68
1993	1 313	9 650	1 417	2 731	71
1994	878	10 028	1 471	2 790	75
1995	935	10 140	1 492	2 867	81
1996	2 263	10 297	1 510	2 908	86
1997	1 082	10 409	1 545	2 948	92
1998	2 838	10 544	1 589	3 006	99
1999	1 936	10 709	1 640	3 052	107
2000	2 697	10 726	1 688	3 129	111
2001	3 997	10 717	1 700	3 168	115
2002	5 989	10 752	1 696	3 254	119
2003	7 608	10 738	1 715	3 383	122
2004	8 048	10 721	1 740	3 449	124
2005	8 317	10 643	1 787	3 477	127
2006	7 152	10 356	1 808	3 487	131
2007	7 218	10 353	1 822	3 585	134
2008	6 062	10 332	1 742	3 427	136
2009	6 049	9 969	1 657	3 237	140
2010	6 799	9 874	1 646	3 349	144
2011	6 052	9 807	1 628	3 422	148
2012	6 248	9 586	1 594	3 376	154
1990–2012	**576%**	**9%**	**22%**	**40%**	**136%**

In 2012 the share of fuel export in *1.A.3.b* amounted to 30% or 6 248 Gg CO_2 equivalents of which 28% are attributed to passenger road transport and 72% to road freight transport. It is assumed that the fuel export fleet (mainly travelling on highways) is similar to the Austrian fleet on highways, which means that no different efficiency rates are assumed for the fuel export fleet.

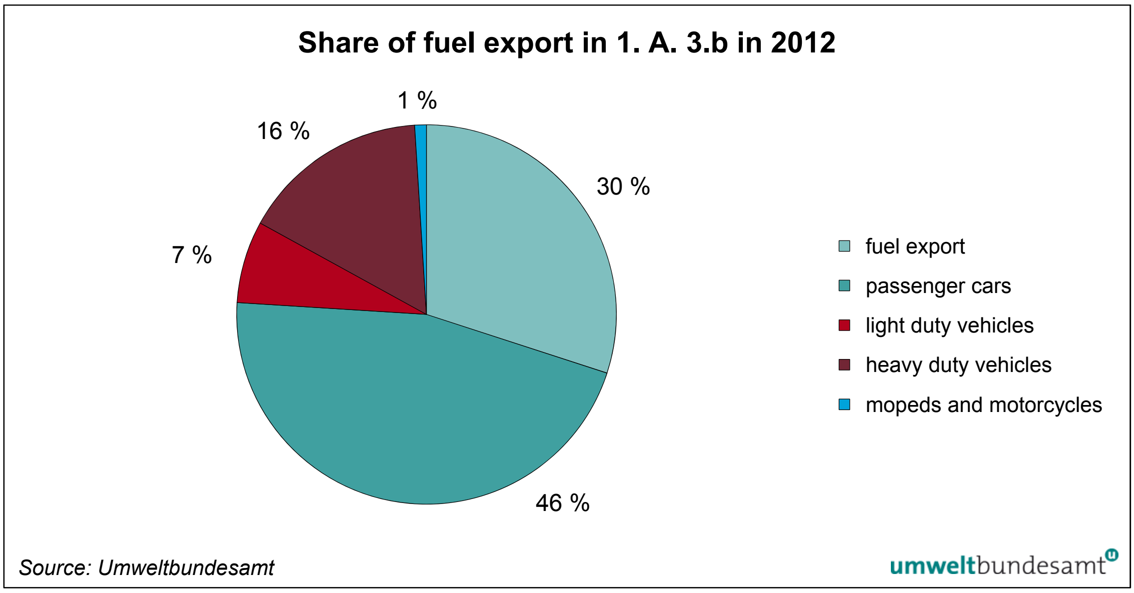

Figure 16: Share of fuel export in 1.A.3.b in 2012.

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. In 2012 the energetic substitution by biofuels amounted to 6.77% in the road transport sector.[33] 2005, the first year of blending biofuels, the substitution amounted to only 0.8% (UMWELTBUNDESAMT 2006b, BMLFUW 2013a).

For the year 2012 a consumption of 498 761 tons of biodiesel (for blending with diesel) and 105 715 tons of bioethanol (for blending with gasoline) are used as input data in the calculation models based on (BMLFUW 2013a).[34] Following amounts are used in pure form: 16 191 tons of plant oil; 337 tons of bioethanol in E85; 57 823 tons of biodiesel.

Table 67: Use of biofuels in absolute figures 2005–2012.

Year	pure	blended		biofuels total
	biofuel pure [tons]	biodiesel [tons]	bioethanol [tons]	[tons]
2005	17 000	75 000	0	**92 000**
2006	52 500	288 000	0	**340 500**
2007	89 209	298 828	20 391	**408 428**
2008	121 276	304 291	84 910	**510 477**
2009	133 690	405 909	99 424	**639 023**
2010	92 377	427 000	105 883	**625 260**
2011	101 824	422 072	102 755	**626 650**
2012	74 351	440 938	105 378	**621 299**

[33] The required substitution target – 5.75%, measured by energy content – was significantly outperformed in 2011 (with 6.75%).

[34] Models: GLOBEMI and GEORG (see *1.A.2.f*)

The following table shows the amounts of substituted CO_2 emissions in the road transport sector from 2005 onwards (the first year of blending biofuels in Austria).

Table 68: Substitution of CO_2 emissions in 1.A.3.b Road Transport by the use of biofuels in absolute figures 2005–2012.

Year	**passenger cars**	**light duty vehicles**	**heavy duty vehicles**
	[Gg CO_2]	**[Gg CO_2]**	**[Gg CO_2]**
2005	102	21	112
2006	365	82	380
2007	471	94	427
2008	672	107	457
2009	839	134	573
2010	798	123	602
2011	788	126	603
2012	778	122	607
Trend 2005–2012	**665%**	**485%**	**441%**

Emission Factors

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 3.2 (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.

Moreover, specific CO_2 emission factors of new passenger cars according to the national CO_2 monitoring data for the Austrian fleet has been implemented (BMLFUW 2012b).

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 69: Implied emission factors of passenger cars 1990–2012.

Year	Activity	Implied Emission Factors		
		CO_2	CH_4	N_2O
	TJ	t/TJ	kg/TJ	kg/TJ
1990	116 480	74.5	18.9	3.9
1991	130 744	74.5	19.7	4.3
1992	127 195	74.5	20.4	4.7
1993	124 786	74.5	21.1	5.0
1994	124 160	74.5	20.9	5.5
1995	124 427	74.4	19.4	5.6
1996	120 204	74.5	17.6	5.7
1997	119 531	74.4	15.7	5.8
1998	130 515	74.4	14.1	5.9
1999	127 107	74.3	12.4	5.9
2000	129 160	74.3	10.8	5.9
2001	137 650	74.3	9.5	5.7
2002	157 114	74.3	8.2	5.5
2003	171 080	74.3	7.1	5.2
2004	176 773	74.3	6.0	4.9
2005	179 057	74.4	5.1	4.7
2006	176 367	74.1	4.3	4.4
2007	178 053	74.1	3.6	4.1
2008	166 434	74.3	3.1	3.9
2009	162 210	75.1	2.7	3.7
2010	159 834	74.9	2.4	3.5
2011	153 183	75.3	2.2	3.3
2012	149 918	75.3	2.0	3.2

The catalytic converter of former generation (EURO 1) had a higher N_2O-niveau than the catalysts of the newer generation (as of EURO 2). Therefore, since 2001 (implementation of EURO 2) the implied emission factor of N_2O is decreasing steadily. The decrease of the IEF for CH_4 is also due to the increasing share of vehicles with catalytic converters and improved combustion technologies.

Table 70: Implied emission factors of light duty vehicles 1990–2012.

Year	Activity	Implied Emission Factors		
		CO_2	CH_4	N_2O
	TJ	t/TJ	kg/TJ	kg/TJ
1990	17 454	74.1	13.9	1.8
1991	18 037	74.1	12.9	1.8
1992	18 604	74.1	11.9	1.9
1993	18 906	74.1	11.2	1.9
1994	19 649	74.1	9.9	1.9
1995	19 973	73.9	8.7	1.9
1996	20 217	73.9	7.7	1.9
1997	20 703	73.9	6.7	1.8
1998	21 303	73.9	5.8	1.8
1999	22 041	73.7	4.9	1.8
2000	22 697	73.7	4.2	1.7
2001	22 875	73.7	3.7	1.7
2002	22 832	73.7	3.2	1.6
2003	23 091	73.7	2.7	1.6
2004	23 441	73.7	2.2	1.6
2005	24 043	73.8	2.0	1.6
2006	24 245	74.1	1.8	1.6
2007	24 411	74.1	1.4	1.6
2008	23 334	74.2	1.1	1.6
2009	22 103	74.4	0.9	1.7
2010	21 964	74.4	0.7	1.7
2011	21 576	74.9	0.6	1.7
2012	21 126	74.9	0.5	1.8

Table 71: Implied emission factors of heavy duty vehicles 1990–2012.

Year	Activity	Implied Emission Factors		
		CO_2	CH_4	N_2O
	TJ	t/TJ	kg/TJ	kg/TJ
1990	44 517	74.0	2.2	1.6
1991	49 490	74.0	2.1	1.5
1992	52 103	74.0	2.0	1.5
1993	56 065	74.0	1.9	1.5
1994	56 547	74.0	1.8	1.5
1995	59 788	73.8	1.8	1.4
1996	84 728	73.8	1.6	1.4
1997	71 697	73.8	1.5	1.4
1998	86 714	73.8	1.4	1.4
1999	81 286	73.7	1.3	1.3
2000	90 802	73.7	1.2	1.3
2001	100 302	73.7	1.2	1.3
2002	109 119	73.7	1.1	1.2
2003	118 542	73.7	1.1	1.2
2004	119 628	73.7	1.1	1.2
2005	120 114	73.7	1.0	1.2
2006	103 861	74.2	1.1	1.2
2007	104 368	74.2	1.0	1.1
2008	98 233	74.2	1.0	1.1
2009	93 002	74.4	1.1	1.0
2010	106 219	74.4	1.0	0.9
2011	101 855	74.9	1.0	0.9
2012	104 293	74.9	1.2	0.8

Table 72: Implied emission factors of mopeds 1990–2012.

Year	Activity	Implied Emission Factors		
		CO_2	CH_4	N_2O
	TJ	t/TJ	kg/TJ	kg/TJ
1990	277	74.3	1 753.2	0.7
1991	259	74.3	1 736.9	0.7
1992	248	74.3	1 681.5	0.7
1993	237	74.3	1 635.9	0.6
1994	229	74.3	1 575.0	0.6
1995	223	74.3	1 510.4	0.6
1996	219	74.2	1 445.2	0.6
1997	215	74.2	1 381.8	0.5
1998	213	74.1	1 308.8	0.5
1999	209	74.1	1 249.9	-
2000	203	74.1	1 207.9	-
2001	199	74.1	1 160.4	-
2002	193	74.1	1 121.1	-
2003	190	74.0	1 069.9	-
2004	186	74.1	1 025.8	-
2005	187	74.2	961.2	-
2006	191	73.0	882.8	-
2007	192	73.0	825.2	-
2008	189	73.1	785.3	-
2009	184	74.7	750.9	-
2010	182	74.3	707.4	-
2011	179	74.3	667.8	-
2012	177	74.3	626.5	-

Table 73: Implied emission factors of motorcycles 1990–2012.

Year	Activity	Implied Emission Factors		
		CO_2	CH_4	N_2O
	TJ	t/TJ	kg/TJ	kg/TJ
1990	456	74.3	35.3	0.9
1991	486	74.3	34.9	0.8
1992	541	74.3	34.4	0.7
1993	599	74.3	33.7	0.8
1994	670	74.3	33.2	0.9
1995	760	74.3	32.5	0.8
1996	843	74.2	31.9	0.8
1997	926	74.2	31.4	0.9
1998	1 036	74.1	30.9	0.9
1999	1 147	74.1	30.4	0.9
2000	1 212	74.1	29.8	0.8
2001	1 273	74.1	29.2	0.9
2002	1 335	74.1	28.6	0.9
2003	1 386	74.0	27.9	0.9
2004	1 424	74.1	27.2	0.8
2005	1 460	74.2	26.7	0.9
2006	1 533	73.0	25.4	0.8
2007	1 588	73.0	24.7	0.8
2008	1 616	73.1	24.4	0.8
2009	1 637	74.7	24.1	0.9
2010	1 697	74.3	23.3	0.8
2011	1 765	74.3	22.6	0.8
2012	1 842	74.3	21.7	0.8

Quality Assurance and Quality Control (QA/QC)

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

- ✓ Are the correct values used (check for transcription errors)?
- ✓ Check of plausibility of input data (time-series order of magnitude)!
- ✓ Is the data set complete for the whole time series?
- ✓ Check of calculation units!
- ✓ Check of plausibility of results (time-series order of magnitude)!
- ✓ Are all references clearly made?
- ✓ Are all assumptions documented?

Uncertainty Assessment

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

- The uncertainty of activity data (total fuel sold) for road transport is considered to be low (3%), and also the uncertainty of CO_2 emission factors is estimated to be 3%.

- N_2O emission factors are determined in vehicle emission tests, mostly carried out on test benches. Therefore emission factors are prone to uncertainties for the following reasons:
  - test driving cycles cannot fully reflect real driving behaviour,
  - uncertainties of test equipment and emission measurement equipment,
  - emission factor varies over time because of chemical characteristics of the fuels,
  - the influence of aging and maintenance of the vehicle stock.

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

Recalculations

Update/Improvement of activity data

In the national energy balance the levels for liquefied petroleum gas (LPG) and compressed natural gas (CNG) were changed retrospectively for the years 2009, 2010 and 2011. LPG activity data were revised downwards, CNG activity data slightly upwards. Necessary changes in the inventory transport model[35] caused slightly revised emission data for individual years. In total, activity data for LPG and CNG shows a reduced fuel use. This, however, has no significant effect on overall emissions due to the small absolute quantities of LPG and CNG used in sector transport.

Update of methodology and emission factors

Road transport emission factors applied in the previous submission were based on the preliminary HBEFA V3.1 update (Handbook Emission Factors for Road Transport), whereas in this submission EFs were obtained from the final version V3.2 of the HBEFA. The official release of HBEFA V3.2 is expected by the end of 2014.

The use of updated EFs for Euro 5 and Euro 6 vehicles resulted in significantly lower emissions from light duty vehicles due to reduced fuel consumption data for EURO 5 (EURO 6 shows a smaller reduction) whereas emissions from heavy duty vehicles increased due to increased fuel consumption data for EURO 5 (EURO 6 had to be raised by a higher extent).

Overall revisions of the sector road transport show a slight increase of GHG emissions (0.1 % for 2011).

Planned improvements

As recommended by the ERT during the ICR 2013 (ARR 2013 para 34), Austria plans to report CH_4 and N_2O emissions from biomass and fossil parts separately. As the CH_4 and N_2O EF used are based on measurements, a revision of the modelling approach may not be an adequate method and alternative ways for splitting emissions in CRF Table 1.A(a) have to be considered.

3.2.12.3 1.A.3.c Railways

Key Source: No

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

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[35] HAUSBERGER, S. & SCHWINGSHACKL, M. (2013): Straßenverkehrsemissionen und Emissionen sonstiger mobiler Quellen Österreichs für die Jahre 1990 bis 2012 (OLI2013); erstellt im Auftrag der Umweltbundesamt GmbH, Graz, 2013.

Table 74: Greenhouse gas emissions from Category 1.A.3.c Railways 1990–2012.

Year	CO_2 [Gg]	CH_4 [Gg]	N_2O [Gg}
1990	178	0.01	0.06
1991	163	0.01	0.06
1992	162	0.01	0.05
1993	158	0.01	0.05
1994	159	0.01	0.05
1995	149	0.01	0.05
1996	134	0.01	0.05
1997	133	0.01	0.05
1998	131	0.01	0.05
1999	135	0.01	0.05
2000	135	0.01	0.05
2001	130	0.01	0.05
2002	141	0.01	0.05
2003	141	0.01	0.05
2004	140	0.01	0.05
2005	161	0.01	0.06
2006	156	0.01	0.06
2007	155	0.01	0.06
2008	153	0.01	0.06
2009	141	0.01	0.05
2010	142	0.01	0.05
2011	120	0.01	0.05
2012	124	0.01	0.05
Trend 1990–2012	**-30%**	**-33%**	**-15%**

Methodological Issues

The applied methodology is described in the subchapter on mobile sources of *1.A.2.f*.

Activity Data & Emission Factors

Activities used for estimating the emissions and the implied emission factors of *1.A.3.c Railways* are presented below. Details concerning emission factors for mobile off-road sources are described in the subchapter on mobile sources of *1.A.2.f*.

Table 75: Emission factors and activity data for railway 1990–2012.

Year	Activity	Implied Emission Factors		
		CO_2	CH_4	N_2O
	TJ	t/TJ	kg/TJ	kg/TJ
1990	2 385	74.6	3.8	25.2
1991	2 187	74.6	3.8	25.3
1992	2 169	74.7	3.7	25.3
1993	2 115	74.6	3.7	25.3
1994	2 134	74.6	3.7	25.5
1995	1 995	74.5	3.7	25.5
1996	1 804	74.6	3.7	25.5
1997	1 795	74.2	3.6	25.9
1998	1 769	74.2	3.6	26.1
1999	1 830	74.0	3.5	26.2
2000	1 826	74.0	3.5	26.3
2001	1 758	73.9	3.5	26.6
2002	1 902	73.9	3.4	26.6
2003	1 908	73.9	3.3	26.5
2004	1 899	73.7	3.2	26.5
2005	2 178	73.8	3.2	26.5
2006	2 107	74.2	3.3	27.2
2007	2 082	74.3	3.2	27.0
2008	2 064	74.3	3.2	26.7
2009	1 892	74.5	3.4	28.2
2010	1 911	74.5	3.3	27.4
2011	1 602	75.0	3.8	32.1
2012	1 650	75.0	3.6	30.8

Recalculations

Revised diesel consumption of railways in the national energy balance, for 2009, 2010 and 2011 resulted in reduced GHG emissions from railways (e.g. -19% in 2011).

3.2.12.4 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 76: Greenhouse gas emissions from Category 1.A.3.d Navigation 1990–2012.

Year	CO_2 [Gg]	CH_4 [Gg]	N_2O [Gg]
1990	14.1	0.007	0.002
1991	14.3	0.007	0.002
1992	14.2	0.007	0.002
1993	13.7	0.007	0.002
1994	13.4	0.007	0.002
1995	13.5	0.007	0.002
1996	13.5	0.007	0.002
1997	14.2	0.007	0.002
1998	14.3	0.007	0.002
1999	13.6	0.006	0.002
2000	14.0	0.006	0.002
2001	13.4	0.006	0.002
2002	12.7	0.006	0.002
2003	12.4	0.006	0.001
2004	14.7	0.006	0.002
2005	14.4	0.006	0.002
2006	13.6	0.005	0.002
2007	13.6	0.005	0.002
2008	12.0	0.005	0.002
2009	11.1	0.005	0.001
2010	11.2	0.004	0.001
2011	11.4	0.004	0.001
2012	11.5	0.004	0.001
Trend 1990–2012	**-18%**	**-45%**	**-20%**

Methodological Issues

Austria uses the bottom-up model GEORG to calculate the national fuel consumption in navigation which is made up of freight transport activities on the River Danube and passenger transport on rivers and lakes in Austria. Passenger transport is conducted with passenger ships, private motor boats and sailing boats. The inland navigation fleet (stock) was obtained from registration statistics from provincial governments, the average yearly operating time as well as the average fuel consumption per hour from questionnaires to fleet operators and/or manufacturers' data. Statistical data (Tkm) for freight activities on the River Danube were obtained from (STATISTIK AUSTRIA 2000–2013). Additionally fuel consumption for working boats is taken into account in the national fuel consumption of navigation. For detailed methodological issues of the model GEORG see *1.A.2 f.*

Up to 2009 Austria had reported emissions from water-borne navigation on the River Danube entirely as domestic navigation under category *1.A.3.d* thus reporting zero emissions for international navigation and overestimating national navigation.

Following the recommendations by the ERT (ARR 2009 last), Austria presented in the **2010 submission** a disaggregation between domestic and international navigation, based on the following approach:

Fuel sold in Austria along the River Danube (in 2011, there were 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. This approach probably resulted in some overestimation of international navigation as it did not account for national navigation along the Danube.

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

tons x kilometer → (GWh/tkm*tkm; CO_2/tkm*tkm, etc.)

The applied methodology for estimating emissions of international navigation is described in subchapter 3.2.2.1 International bunker fuels.

Activity Data & Emission Factors

Activities used for estimating the emissions and the implied emission factors of *1.A.3.d Navigation* are presented below. Details concerning emission factors for mobile off-road sources are described in the subchapter on mobile sources of *1.A.2.f*.

Table 77: Emission factors and activity data for the sector Navigation 1990–2012.

Year	Activity	Implied Emission Factors		
		CO_2	CH_4	N_2O
	TJ	T/TJ	kg/TJ	kg/TJ
1990	190	74.2	38.2	9.5
1991	193	74.2	37.6	9.8
1992	192	74.2	37.6	9.7
1993	184	74.2	38.9	9.1
1994	181	74.2	39.1	8.9
1995	182	74.1	38.2	9.1
1996	182	74.1	37.5	9.3
1997	192	74.1	35.0	10.3
1998	194	74.0	34.1	10.6
1999	184	74.0	34.9	9.9
2000	189	74.0	33.5	10.5
2001	181	74.0	34.2	9.9
2002	172	74.0	35.1	9.2
2003	167	74.0	35.2	8.8
2004	198	73.9	29.3	11.6
2005	194	74.0	28.7	11.5
2006	185	73.4	28.7	10.9
2007	185	73.4	27.5	11.1
2008	163	73.4	29.5	9.5
2009	149	74.7	30.7	8.6
2010	150	74.4	29.2	8.8
2011	153	74.5	27.5	9.2
2012	155	74.5	26.0	9.3

Quality Assurance and Quality Control (QA/QC)

Harmonization CRF and IEA data

In 2013 the ERT detected inconsistencies of fuel consumption data of domestic aviation and domestic navigation between the CRF tables and the IEA data (ICR 2013). In response to that it was explained that Austria uses a bottom-up approach to estimate fuel consumption whilst IEA relies on top-down approach based on fuel consumption statistics reported by Statistics Austria

After having discussed this issue with Statistics Austria an Explanatory Note (30/09/2013) has been compiled by Statistics Austria declaring that a regular adoption of inventory data for the split between national and international fuel consumption in civil aviation and navigation in the national statistics will be adopted in the future, as far as the data can be submitted in time (early November). As this cannot be guaranteed due to late data delivery for the bottom-up calculation in the inventory Statistics Austria may have to use a simple extrapolation of the previous years' data and send the current split to the IEA the following year. It is common practice to not report revised data to the IEA after the regular submission date at the end of October, i.e. outside the regular reporting deadlines.

The inconsistency for 2011 is therefore removed with this years' submission of the energy statistics (of data 1990-2012) to the IEA.

Completeness

In response to a question raised by the ERT (ICR 2013) it was explained that emissions of ground activities at domestic harbours are also included, even if they are not separately reported under *1.A.3.d Navigation*. This can be assured as Austria reports emissions from **total fuel sold** from the energy balance.

The approach in the Austrian inventory is as follows: After calculating fuel consumption for inland road transport and off-road transport using a bottom-up approach (GLOBEMI, GEORG), the sum of this fuel used is compared with the total fuel sold from the national energy balance (for details see *1.A.3.b Road Transport*). The difference is then allocated to fuel export, which includes fuel consumption for ground activities at airports and harbours as well, including fuel consumption by unregistered vehicles. As the fuel consumption reported under fuel export is included in the national totals[36], an underestimation of emissions can be excluded.

Recalculations

Revisions of the national energy balance between 2009 and 2011 resulted in minor changes of the sectorial diesel consumption data applied in the national off-road model GEORG (HAUSBERGER & SCHWINGSHACKL 2013).

[36] GHG emissions from fuel export are included in 1.A.3.b and are presented separately in Table 66 (Chapter 3.2.12.2)

3.2.12.5 1.A.3.e Other Transportation – Pipeline Compressors

Key Source: Yes (CO_2: gaseous)

Category *1.A.3.e Other Transportation* enfolds emissions from pipeline transport by gas turbine driven compressors. The share in total GHG emissions from sector *1.A* is 0.4% for the year 1990 and 0.7% for the year 2012. 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 2013) as presented in Annex 4.

Emission factors

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

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

Table 78: Emission factors of Category 1.A.3.e for all years.

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

Recalculations

Changes of activity data are based on a revision of the energy balance as described in Annex 2 and result in +4 Gg CO_2 emissions in 2011.

3.2.13 1.A.4 Other sectors

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

The share in total GHG emissions from sector *1.A* is 26.2% for the year 1990 and 16% for the year 2012.

1.A.4 Other sectors – stationary sources

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

Category *1.A.4 Other Sectors* includes emissions from stationary fuel combustion in the small combustion sector. Emissions from public district heating plants are included in category *1.A.1.a Public Electricity and Heat Production* or the respective sub categories of *1.A.2 Manufacturing Industries and Construction* if district heat is sold by industry. Information about type of heatings is collected by micro census surveys and according to the energy statistics supplier. A clear distinction between „real" public district heating or micro heating networks which serve several buildings under the same ownership 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 14.5% for the year 2012.

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.c Agriculture/Forestry/Fishing

There is no information about the structure of devices within these categories. Therefore it is assumed that the whole fuel consumption reported in (IEA JQ 2013) 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, 2008, 2010 and 2012 by STATISTIK AUSTRIA. The calculated shares are used to subdivide total final energy consumption to the several technologies. For the years in between the shares are interpolated. Because the newest census data is always reconsidered to improve previous years census data evaluation this implies a periodic recalculation in time series.

Emission factors

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

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

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

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

Table 79: Share of CH_4 and NMVOC on VOC for small combustion devices.

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

The selected emission factors for 2012 are presented in the following table.

Table 80: Emission factors of Category 1.A.4 conventional boilers for the year 2012.

Fuel	CO_2 [t/TJ]	CH_4 [kg/TJ]		N_2O [kg/TJ]	
		CH and AH	Stove	CH and AH	Stove
Hard Coal	93.00	90.00	110.00	2.00	1.00
Hard Coal Briquettes	93.00	90.00	110.00	2.00	1.00
Lignite and brown coal	108.00	90.00	110.00	4.00	1.00
Brown Coal Briquettes	97.00	90.00	110.00	4.00	4.00
Coke	92.00	90.00	110.00	2.00	2.00
Peat	106.00	–	90.00	–	1.00
Light Fuel Oil	77.00	0.25	–	0.60	–
Medium Fuel Oil	78.00	2.00	–	1.00	–
Heavy Fuel Oil	78.00	2.00	–	1.00	–
Gas oil	75.00	0.20	0.50	1.00	1.00
Petroleum	78.00	0.20	–	0.60	–
LPG	64.00	1.50	–	1.00	–
Gas Works Gas	64.00	0.20	–	1.00	–
Natural Gas	55.40	0.80	0.80	1.00	1.00
Fuel Wood	100.00[1)]	139.97[3)] 138.76[3)]	179.20[3)]	3–5	7.00
Wood Waste	110.00[1)]	17.51[3)]	179.20[3)]	3–7	7.00
Char coal	112.00[1)]		200.00		1.00
Landfill Gas	112.00[1)]	1.50	–	1.00	–
Industrial Waste	104.17[2)]	12.00	–	1.40	–

[1)] *reported as CO_2 emissions from biomass*

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

[3)] *Implied emission factor*

Because no measurements are available, CH_4 emission factors for new biomass heatings (Table 81) are derived from conventional boiler emission factors with the ratio of conventional boiler and new biomass heatings NMVOC emission factors:

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

Table 81: Emission factors of Category 1.A.4 new biomass boilers.

Fuel	CO_2 [t/TJ]	CH_4 [kg/TJ]		N_2O [kg/TJ]	
		CH/AH	Stove	CH and AH	Stove
Fuel Wood	100.00[1)]	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 CO_2 emissions from biomass.*

Activity data

Total fuel consumption for each of the sub categories of *1.A.4* is taken from (IEA JQ 2013) as presented in Annex 4.

Since (IEA JQ 2013) 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 2013).

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

Table 82: Share of 1.A.4.b heating type on fuel category for the year 2012.

	Central Heating	Appartement Heating	Stove
Hard Coal Brown Coal Brown Coal Briquettes Coke	75%	5%	20%
Gas oil	95%	3%	2%
Residual Fuel Oil, Gas Works Gas, LPG, Petroleum	100%	–	–
Natural Gas	49%	47%	4%
Fuel Wood	81%	5%	14%
Wood Chips, Pellets, other solid biomass	95%	3%	1%

The following table shows biomass boiler sales from 2000 which are considered with lower CO, NMVOC and CH_4 emissions than equipment installed before 2000. The estimated accumulated consumption in 2011 is 47 PJ which is 75% 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 83: Number of biomass boiler sales 2000–2012 and fuel consumption estimate.

Year	Pellet boilers	Pellet stoves	Wood chip boilers	Log wood boilers
2000	3 466	0	0	0
2001	4 932	0	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
2011	10 400	2 700	3 744	6 328
2012	11 971	4 000	3 573	6 328
Accumulated total number	**97 465**	**31 584**	**43 584**	**70 991**
Avg. estimated yearly consumption per boiler or stove [GJ]	203	48	331	236
Total estimated consumption of new boilers 2012 [TJ]	19 795	1 516	14 414	16 721

Figure 17 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 2012.

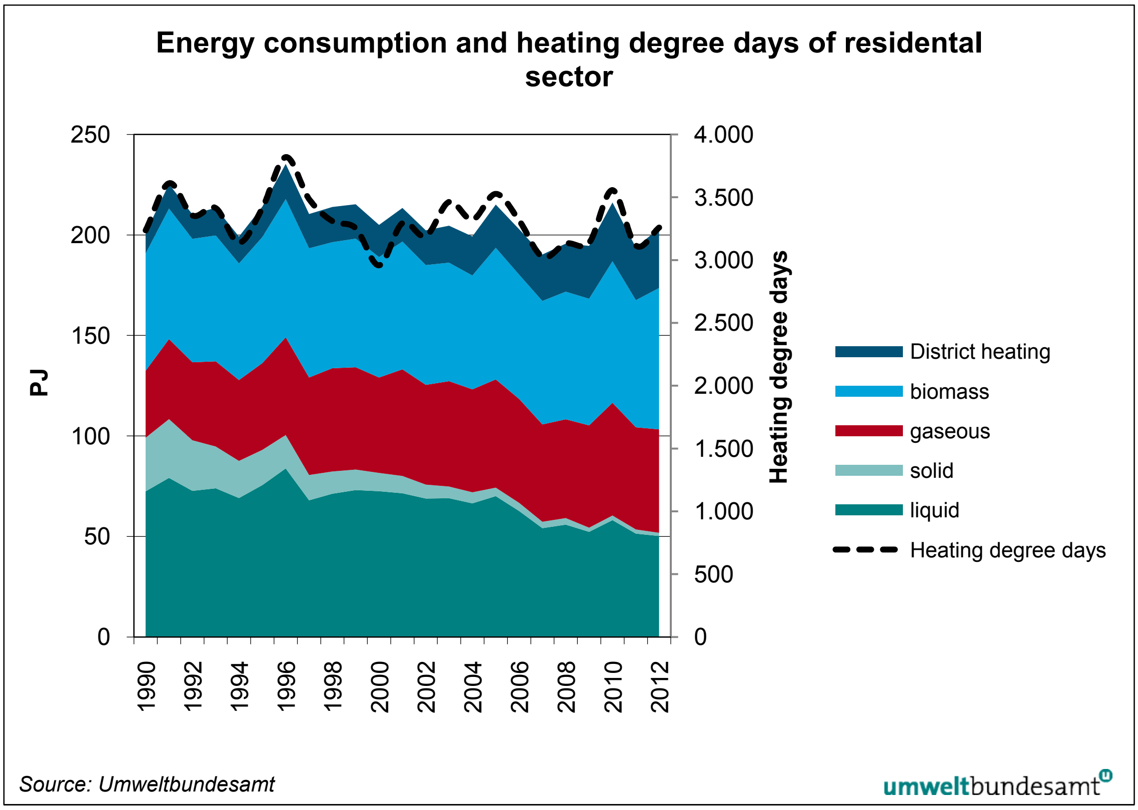

Figure 17: Energy consumption [PJ] of residential sector by type of fuel and number of heating degree days 1990–2012.

Recalculations

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

Recalculations due to the revised energy balance affect activity data 2005 to 2011 which mainly implies changes in *1.A.4.a* CO_2 emissions for natural gas 2009 (+308 Gg CO_2) to 2011 (-377 Gg CO_2) and liquid fuels in 2009 (+127 Gg CO_2) to 2011 (-178 Gg CO_2)

Following the recommendation to the In Country Review 2013 charcoal use has been included in the emission estimates.

Improvements and change in methodology

The 2012 census data has been considered for calculation of the heating type shares. For the year 2011 the interpolated shares between the years 2010 and 2012 are used.

1.A.4 Other sectors – mobile sources

1.A.4.b Household and Gardening

Key Source: No

In addition to vehicles used in household and gardening this category contains ski slope machineries and snow vehicles.

Table 84: Greenhouse gas emissions from mobile sources of Household and Gardening 1990–2012.

Year	CO_2 [Gg]	CH_4 [Gg]	N_2O [Gg]
1990	144	0.06	0.02
1991	145	0.07	0.02
1992	146	0.07	0.02
1993	147	0.07	0.02
1994	146	0.06	0.02
1995	146	0.06	0.03
1996	145	0.06	0.03
1997	143	0.06	0.03
1998	142	0.06	0.03
1999	142	0.05	0.03
2000	142	0.05	0.03
2001	142	0.05	0.03
2002	142	0.05	0.03
2003	141	0.05	0.03
2004	140	0.05	0.02
2005	138	0.05	0.02
2006	134	0.04	0.02
2007	132	0.04	0.02
2008	128	0.04	0.02
2009	125	0.03	0.02
2010	124	0.03	0.02
2011	123	0.03	0.01
2012	123	0.03	0.01
Trend 1990–2012	-15%	-59%	-43%

Methodological Issues

The applied methodology is described in the subchapter on mobile sources of *1.A.2.f.*

Activity Data & Emission Factors

Activities used for estimating the emissions and the implied emission factors of *1.A.4.b Household and gardening – mobile sources* are presented below.

Table 85: Emission factors and activity data for mobile sources of Household and Gardening 1990–2012.

Year	Activity	Implied Emission Factors		
		CO_2	CH_4	N_2O
	TJ	T/TJ	kg/TJ	kg/TJ
1990	1 947	74.2	33.3	12.2
1991	1 951	74.2	33.3	12.2
1992	1 969	74.2	33.2	12.3
1993	1 979	74.2	33.1	12.3
1994	1 968	74.1	32.7	12.4
1995	1 977	74.1	31.6	12.7
1996	1 956	74.0	30.8	12.8
1997	1 938	74.0	30.0	12.9
1998	1 921	74.0	29.2	13.1
1999	1 919	73.9	28.3	13.1
2000	1 919	73.9	27.5	13.3
2001	1 922	73.9	26.9	13.4
2002	1 918	73.9	26.5	13.4
2003	1 912	73.9	26.3	13.2
2004	1 900	73.9	25.5	12.8
2005	1 864	74.0	24.3	12.5
2006	1 828	73.5	23.1	12.1
2007	1 794	73.5	21.7	11.6
2008	1 742	73.6	20.5	11.1
2009	1 680	74.6	19.4	10.7
2010	1 667	74.4	18.0	9.8
2011	1 650	74.6	16.9	9.1
2012	1 644	74.6	16.1	8.2

1.A.4.c Agriculture and Forestry

Key Source: Yes (CO_2: mobile-diesel)

In this category emissions from off-road machinery in agriculture and forestry (mainly tractors) are considered.

Table 86: Greenhouse gas emissions for mobile sources of Agriculture and Forestry 1990–2012.

Year	Agriculture			Forestry		
	CO_2 [Gg]	CH_4 [Gg]	N_2O [Gg]	CO_2 [Gg]	CH_4 [Gg]	N_2O [Gg]
1990	687	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	698	0.05	0.24	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	0.25	84	0.02	0.02
1997	734	0.05	0.26	87	0.02	0.03
1998	721	0.04	0.26	85	0.02	0.03
1999	728	0.04	0.27	85	0.02	0.03
2000	706	0.04	0.26	82	0.02	0.03
2001	728	0.04	0.27	84	0.02	0.03
2002	724	0.04	0.27	85	0.02	0.03
2003	693	0.04	0.25	85	0.02	0.03
2004	714	0.04	0.25	86	0.02	0.03
2005	752	0.04	0.26	90	0.02	0.03
2006	730	0.04	0.25	91	0.02	0.03
2007	725	0.04	0.24	100	0.03	0.03
2008	729	0.04	0.23	101	0.03	0.03
2009	674	0.03	0.21	76	0.02	0.02
2010	657	0.03	0.19	82	0.02	0.02
2011	714	0.03	0.19	85	0.02	0.02
2012	660	0.03	0.17	82	0.02	0.02
Trend 1990–2012	**-4%**	**-39%**	**-27%**	**-2%**	**-19%**	**-23%**

Methodological Issues

The applied methodology is described in the subchapter on mobile sources of *1.A.2.f*.

Activity Data & Emission Factors

Activities used for estimating the emissions and the implied emission factors of *1.A.4.c Agriculture and Forestry – mobile sources* are presented below.

Table 87: Emission factors and activity data for mobile sources of Agriculture and Forestry 1990–2012.

Year	Agriculture				Forestry			
	Activity [TJ]	Implied Emission Factors			Activity [TJ]	Implied Emission Factors		
		CO_2 [t/TJ]	CH_4 [kg/TJ]	N_2O [kg/TJ]		CO_2 [t/TJ]	CH_4 [kg/TJ]	N_2O [kg/TJ]
1990	9 281	74.0	5.1	24.9	1 135	74.1	22.7	20.6
1991	9 311	74.0	5.0	24.9	1 063	74.1	18.6	21.7
1992	9 381	74.0	5.0	25.0	1 085	74.1	19.3	21.6
1993	9 427	74.0	5.0	25.0	1 090	74.1	19.2	21.7
1994	9 474	74.0	4.9	25.3	1 134	74.1	20.9	21.4
1995	9 088	73.9	4.8	25.6	1 087	73.9	20.7	21.7
1996	9 444	73.8	4.7	26.1	1 139	73.9	21.1	21.9
1997	9 934	73.8	4.5	26.5	1 178	73.9	20.0	22.5
1998	9 761	73.8	4.5	26.9	1 148	73.9	19.2	23.0
1999	9 879	73.7	4.4	27.2	1 158	73.7	18.7	23.3
2000	9 589	73.7	4.3	27.5	1 115	73.7	18.0	23.6
2001	9 887	73.7	4.3	27.7	1 145	73.7	17.4	23.9
2002	9 824	73.7	4.2	27.5	1 159	73.7	18.1	23.5
2003	9 400	73.7	4.1	27.0	1 153	73.7	19.9	22.4
2004	9 688	73.7	4.0	26.3	1 170	73.7	18.6	22.1
2005	10 193	73.8	3.9	25.7	1 215	73.8	17.7	21.9
2006	9 851	74.1	3.9	25.7	1 224	73.9	19.6	21.2
2007	9 773	74.2	3.7	24.6	1 352	74.0	19.3	20.5
2008	9 819	74.2	3.6	23.6	1 367	74.0	19.3	19.7
2009	9 058	74.4	3.6	22.8	1 024	74.5	19.5	19.2
2010	8 824	74.4	3.5	21.3	1 096	74.4	19.2	18.1
2011	9 535	74.9	3.3	20.3	1 139	74.8	19.1	17.3
2012	8 808	74.9	3.2	19.1	1 098	74.8	19.0	16.4

Recalculations

Revisions of the national energy balance between 2009 and 2011 resulted in minor changes of the sectorial diesel consumption data applied in the national off-road model GEORG (HAUSBERGER & SCHWINGSHACKL 2013).

3.2.14 1.A.5 Other

In this category emissions of military transport (off-road and aviation) are reported.

3.2.14.1 1.A.5.a Military Off-Road Transport

Methodological Issues

The applied methodology is described in the subchapter on mobile sources of *1.A.2.f*.

Activity Data

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. 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 of *1.A.5.a Military Off-Road* are presented in the following table.

Table 88: Greenhouse gas emissions from Military (Off-Road without Aviation) 1990–2012.

Year	CO_2 [Gg]	CH_4 [Gg]	N_2O [Gg]	Activity [TJ]
1990	2.1	0.00010	0.0008	28.7
1991	2.1	0.00010	0.0008	28.6
1992	2.1	0.00010	0.0008	28.6
1993	2.1	0.00010	0.0008	28.5
1994	2.1	0.00009	0.0008	28.4
1995	2.1	0.00009	0.0008	28.2
1996	2.1	0.00009	0.0008	28.1
1997	2.1	0.00008	0.0008	27.9
1998	2.0	0.00008	0.0008	27.7
1999	2.0	0.00008	0.0008	27.6
2000	2.0	0.00008	0.0008	27.5
2001	2.0	0.00008	0.0008	27.4
2002	2.0	0.00007	0.0008	27.3
2003	2.0	0.00006	0.0008	27.2
2004	2.0	0.00006	0.0007	27.2
2005	2.0	0.00005	0.0007	26.8
2006	1.9	0.00005	0.0006	25.8
2007	1.9	0.00004	0.0005	25.7
2008	1.9	0.00004	0.0005	25.5
2009	1.9	0.00004	0.0004	25.1
2010	1.9	0.00004	0.0004	25.2
2011	1.9	0.00004	0.0003	25.0
2012	1.9	0.00004	0.0003	25.1
Trend 1990–2012	**-11%**	**-60%**	**-58%**	**-13%**

Emission Factors

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). Details concerning emission factors for mobile off-road sources are described in the subchapter on mobile sources of *1.A.2.f*.

Recalculations

Revisions of the national energy balance between 2009 and 2011 resulted in minor adjustments of the sectorial diesel consumption data applied in the national off-road model GEORG (HAUSBERGER & SCHWINGSHACKL 2013).

1.A.5.b Military Aviation

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.

Activity Data

Activities used for estimating the emissions and the emissions of *1.A.5.b Military Aviation* are presented in the following table.

Table 89: Greenhouse gas emissions from 1.A.5.b Military Aviation 1990–2012.

Year	CO_2 [Gg]	N_2O [Gg]	CH_4 [Gg]	Activity [TJ]
	military kerosene			
1990	33	0.0021	0.0011	455
1991	35	0.0022	0.0011	484
1992	32	0.0020	0.0010	437
1993	37	0.0024	0.0012	516
1994	39	0.0025	0.0013	546
1995	30	0.0019	0.0010	419
1996	37	0.0023	0.0012	507
1997	35	0.0021	0.0011	483
1998	40	0.0024	0.0013	556
1999	40	0.0023	0.0013	544
2000	39	0.0024	0.0013	533
2001	39	0.0025	0.0013	541
2002	40	0.0025	0.0013	549
2003	40	0.0025	0.0013	556
2004	41	0.0026	0.0013	564
2005	42	0.0026	0.0014	572
2006	42	0.0026	0.0014	579
2007	43	0.0027	0.0014	587
2008	43	0.0027	0.0014	595
2009	44	0.0027	0.0014	603
2010	44	0.0028	0.0015	611
2011	45	0.0028	0.0015	619
2012	46	0.0029	0.0015	626

Emission Factors

For calculation of CO_2 emissions an emission factor of 3 150 kg CO_2/Mg fuel has been used, it was taken from (KALIVODA et al. 2002).

CH_4 emission factor follows the CORINAIR Guidebook (10% of total VOC emissions, simple methodology).

As recommended in the IPCC GPG, for calculation of N_2O emissions of military flights the IEF of civil aviation domestic LTO was applied as no military specific emission factor was available.

Recalculations

No recalculations have been made in this years' submission.

3.2.15 Quality Assurance/Quality Control and Verification

For general QA/QC see Chapter 1.6.

In 2008 STATISTIK AUSTRIA provided an updated documentation for the national energy balance and a document which covers a more actual quantification of uncertainties.

Concerning activity data for sectors *1.A.1* and *1.A.2* there are specific regulations in the Austrian legislation:

- BGBl II No. 1997/331 Feuerungsanlagen-Verordnung,
- BGBl 1989/19 Luftreinhalteverordnung für Kesselanlagen,
- BGBl 1988/380 Luftreinhaltegesetz für Kesselanlagen,
- BGBl 150/2004 Emissionsschutzgesetz für Kesselanlagen – EG K,
- BGBl 84/2006 Emissionsschutzgesetz für Kesselanlagen – EG K,
- BGBl II No. 2007/292 Emissionserklärungsverordnung – EEV.

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

- activity data check
  - Survey for the „National Emission Trading Allocation Plan" 1 (NAP1) 1990 to 2002 with almost complete data for 1998 to 2002,
  - 1.A.1.a: public report: fuel consumption and energy production by plant (1990),
  - discussion of activity data with Refinery (incl. methodology of CO_2 emission calculation) and Iron and Steel Industry,
  - check of gas consumption with data from E-Control,
  - check of oil consumption with data from Mineral Oil Association.
- indicators and analysis (activity data and CO_2 emissions)
  - Public „Kyoto Progress" Reports until 2007. Public „Climate Protection" Reports since 2008,
  - energy intensity indicators: Iron and Steel, Cement industry, Refinery, Households.
- external review
  - Federal provinces air emission inventory,
  - Check of methodology and CO_2 emissions by WIFO.
- emission factors check
  - check of IEF (time series),
  - NAP1 survey: Country specific CO_2 emission factors used in the inventory were widely accepted,
  - comparison with IPCC.
- time series consistency
  - plausibility checks of dips and jumps,
  - yearly public trend report,
  - 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.

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

Table 90: Uncertainty parameters for fuel combustion activities.

	Fossil solid	Biomass & waste	liquid	Black liquor	Gas
large sources	0.5	10	0.5	–	2.0
small sources	1.0	10	1.0	10.0	5.0
transport			3.0		

Uncertainty factors presented account for the generally high quality level of Austrian fuel statistics, which is based on physical measurements (weighing, flow-metering), but data reported in statistics are derived from the respective heat content of fuels. Transformation requires analysis or measurement of the heat content in the fuel. Biomass, waste and black liquor, which are not contained in detail by trade statistics, exhibit a much larger uncertainty.

Emission factors in fuel combustion are also considered to be well-known. CO_2 emissions can be derived from stoichiometry. Carbon content of fuels (within gaseous/liquid/solid fuels, respectively) is largely proportional to its heat content. Thus we estimate uncertainty of the emission factor – separately for solid, liquid and gaseous fuels – at 0.5%. Within these respective fuel classes we consider uncertainty correlated.

Even more interesting is the case of methane. A considerable number of seemingly independent emission factors for different emission situation are available. At closer inspection, however, it appears that data presented by STANZEL et al. (1995) and used in OLI actually derive from HC measurements. The fraction of CH_4 in total HC combustion exhaust has been estimated by ORTHOFER (1991) at 75% in gaseous fuels, 20% in solid fuels and 25% in liquid fuels. As this percentage is what drives overall uncertainty for methane emission factors, we again have to treat gaseous, liquid and solid fuels as dependent (correlated) parameters. As an indicator of overall uncertainty we may refer to CHARLES et al. (1998) who reported 50% for methane from combustion sources.

For nitrous oxide, emission measurements have been performed by VITOVEC (1991) and resulting uncertainty has been estimated at 20%. This figure has previously been used for Austria, but is not sustainable any more considering the fact that emission factors originally used for an Austrian inventory by ORTHOFER et al. (1995) are now more than 15 years old and refer to a considerably different combustion regime. We now apply 50% (taken from MONNI & SYRI 2003; see also RAMIREZ et al. 2006), a figure which we understand to also include uncertainty due to limited knowledge on the fraction of fluidized bed combustion in the installation park. Emission factors reported for nitrous oxide by STANZEL et al. (1991) and used in OLI originally derive from the GEMIS modelling system, again just one source. Thus they again need to be considered correlated within each fuel class (solid, liquid and gaseous).

3.2.17 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.

Industrial waste 2005–2011: For data reported under the ETS (*1.A.2.c,d,f*) only the fossil energy content of industrial waste is now considered. The share of biomass is reported under biomass (following the changed systematic of the energy balance). CO_2 emissions resume the same but the IEF is higher (especially for cement and pulp and paper industries, where the biomass share is high).

3.2.17.1 Overview

Updates of activity data and of NCVs follow the updates of the IEA-compliant energy balance compiled by the federal statistics authority Statistik Austria.

Revision of the Energy Balance

Main revisions affect the years 2005 to 2011 which results between -4.2 and -7.9 PJ of total gross inland consumption. Minor revisions affect the years 2002 to 2004 which result between -0.4 PJ and -0.9 PJ of total gross inland consumption.

Natural gas

2005–2011: Revision of the net calorific value calculation method (2005-2011). The previous method was: Net calorific value = gross calorific value /1.1. The new method is: Net calorific value = gross calorific value * 0.9. This leads to a lower inland consumption of about -1%.

2010–2011: Shift of natural gas from *public electricity and heat* to final energy consumption (between 2.1 and 4.0 PJ) which is 4.0 PJ in 2011.

2010–2011: Shift of final energy consumption from c*ommerce – public services* to *manufacturing industries* (between 4.9 and 7.3 PJ) which is 7.3 PJ in 2011.

2010: Shift of final energy consumption from *energy industries (refinery)* to *other sectors* (+5.6 PJ) and *manufacturing industries* (+1.4 PJ).

Liquid fuels

Residual fuel oil 2009–2011: Due to a reallocation of refinery fuels the *final energy consumption* has been revised (between -1.5 and -2.6 PJ) which is -2.2 PJ in 2011. This mainly affects the residential sector (1.A.4.b).

Solid fuels

Hard coal 2009–2011: Revision of final energy consumption of *pulp and paper industries* (between -1.5 PJ and +1.0 PJ) which is +1.0 PJ in 2011.

Lignite 2009–2011: Revision of final energy consumption of *non metallic mineral industries* (between +0.1 and +0.2 PJ) which is +0.2 PJ in 2011.

Coke oven coke 2008–2011: Revision of final energy consumption of *non metallic mineral industries* (between –0.1 and -1.8 PJ) which is -1.8 PJ in 2011.

Lignite and coke oven coke 1999–2004: harmonisation of the *final energy consumption* heating values with the values of the national energy balance. In the previous submission the heating values of the *IEA-Joint questionnaires for coal* were used. However, a slight revision of the heating values in the national energy balance has been settled out in the past which is not reflected in the actual *Joint questionnaires*. For lignite the revision results in ahigher *final energy consumption* between +0.3 and +1.3 PJ. For coke oven coke the revision results in a lower *final energy consumption* between -0.1 and -0.2 PJ.

Other fuels

Industrial waste 2009–2011: Revision of final energy consumption of *non metallic mineral industries* (between +0.6 and -4.6 PJ) which is -4.6 PJ in 2011.

Biomass

Fuel wood 2009–2011: Revision of final energy consumption of *wood products* industries (between -2,2 PJ and -4 PJ) which is -4.0 PJ in 2011.

Other solid and liquid biomass 2009–2011: Revision of final energy consumption of *pulp and paper* and *wood products* industries (between +4.2 and +7.5 PJ) which is +7.5 PJ in 2011.

Revision of final energy consumption of *non metallic mineral industries* (between +0.2 and -2.1 PJ) which is -2.1 PJ in 2011.

3.2.17.2 CO_2 emissions

Table 91 shows the recalculations of CO_2 emissions for the subcategories of sector *1.A Fuel Combustion.*

Table 91: Recalculation difference of CO_2 emissions in [Gg] for Category 1.A Fuel Combustion with respect to previous submission.

Year	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	0.01	0.00	0.01	0.00	0.01	0.00
1992	0.01	0.00	0.00	0.00	0.01	0.00
1993	-0.03	0.00	-0.01	0.00	-0.02	0.00
1994	-0.03	0.00	-0.02	0.00	-0.02	0.00
1995	-0.01	0.00	0.00	0.00	-0.01	0.00
1996	0.01	0.00	0.00	0.00	0.01	0.00
1997	0.05	0.00	0.02	0.00	0.03	0.00
1998	0.04	0.00	0.02	0.00	0.02	0.00
1999	18.37	0.00	11.35	0.00	7.01	0.00
2000	44.13	0.00	29.44	0.00	14.70	0.00
2001	50.06	0.00	31.37	0.00	18.70	0.00
2002	61.40	0.00	44.66	0.00	16.74	0.00
2003	72.23	0.00	51.75	0.00	20.48	0.00
2004	43.76	0.00	33.39	0.00	10.38	0.00
2005	-306.38	-51.57	-202.66	-3.65	-48.50	0.00
2006	-356.66	-84.25	-219.41	-4.76	-48.24	0.00
2007	-274.03	-48.65	-176.91	-4.48	-43.99	0.00
2008	-91.45	-40.99	0.00	-5.74	-44.73	0.00
2009	187.28	-141.93	-111.06	7.41	432.87	0.00
2010	-198.26	-158.47	481.59	-13.29	-508.09	0.00
2011	19.80	-137.91	726.03	-12.78	-555.54	0.00

3.2.17.3 CH_4 emissions

Table 92 shows the recalculations of CH_4 emissions for the subcategories of sector *1.A Fuel Combustion.*

Table 92: Recalculation difference of CH_4 emissions in [Gg] for Category 1.A Fuel Combustion with respect to previous submission.

Year	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	0.00	0.00	0.00	0.00
1993	0.00	0.00	0.00	0.00	0.00	0.00
1994	0.00	0.00	0.00	0.00	0.00	0.00
1995	0.00	0.00	0.00	0.00	0.00	0.00
1996	0.00	0.00	0.00	0.00	0.00	0.00
1997	0.00	0.00	0.00	0.00	0.00	0.00
1998	0.00	0.00	0.00	0.00	0.00	0.00
1999	0.00	0.00	0.00	0.00	0.00	0.00
2000	0.00	0.00	0.00	0.00	0.00	0.00
2001	0.04	0.00	0.00	0.00	0.04	0.00
2002	0.07	0.00	0.00	0.00	0.07	0.00
2003	0.09	0.00	0.00	0.00	0.09	0.00

Year	1.A	1.A.1	1.A.2	1.A.3	1.A.4	1.A.5
2004	0.12	0.00	0.00	0.00	0.12	0.00
2005	0.19	0.01	0.00	0.00	0.18	0.00
2006	0.12	0.00	0.00	0.00	0.12	0.00
2007	0.14	0.00	0.00	0.00	0.14	0.00
2008	0.17	0.01	0.00	0.00	0.16	0.00
2009	0.16	0.02	0.00	0.00	0.14	0.00
2010	0.10	0.02	0.00	-0.01	0.08	0.00
2011	0.10	0.02	0.00	-0.01	0.08	0.00

3.2.17.4 N_2O emissions

Table 93 shows the recalculations of N_2O emissions for the subcategories of sector *1.A Fuel Combustion.*

Table 93: Recalculation difference of N_2O emissions in [Gg] for Category 1.A Fuel Combustion with respect to previous submission.

Year	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	0.00	0.00	0.00	0.00
1993	0.00	0.00	0.00	0.00	0.00	0.00
1994	0.00	0.00	0.00	0.00	0.00	0.00
1995	0.00	0.00	0.00	0.00	0.00	0.00
1996	0.00	0.00	0.00	0.00	0.00	0.00
1997	0.00	0.00	0.00	0.00	0.00	0.00
1998	0.00	0.00	0.00	0.00	0.00	0.00
1999	0.00	0.00	0.00	0.00	0.00	0.00
2000	0.00	0.00	0.00	0.00	0.00	0.00
2001	0.00	0.00	0.00	0.00	0.00	0.00
2002	0.00	0.00	0.00	0.00	0.00	0.00
2003	0.00	0.00	0.00	0.00	0.00	0.00
2004	0.00	0.00	0.00	0.00	0.00	0.00
2005	0.00	0.00	0.00	0.00	0.00	0.00
2006	0.00	0.00	0.00	0.00	0.00	0.00
2007	0.00	0.00	0.00	0.00	0.00	0.00
2008	0.00	0.00	0.00	0.00	0.00	0.00
2009	0.02	0.00	0.01	0.00	0.01	0.00
2010	-0.01	-0.01	0.01	0.00	-0.01	0.00
2011	0.00	0.00	0.00	0.00	-0.01	0.00

3.2.17.5 Emissions in Gg CO_2 equivalent

Table 94 shows the recalculations in [Gg CO_2 equivalent] for the subcategories of sector *1.A Fuel Combustion.*

Table 94: Recalculation difference of GHG emissions in [Gg CO_2 equivalent] for Category 1.A Fuel Combustion with respect to previous submission.

	1.A	1.A.1	1.A.2	1.A.3	1.A.4	1.A.5
1990	2.03	1.05	0.00	0.00	0.98	0.00
1991	2.17	1.04	0.01	0.00	1.12	0.00
1992	2.15	1.02	0.00	0.00	1.12	0.00
1993	2.35	1.12	-0.01	0.00	1.25	0.00
1994	2.01	1.07	-0.02	0.00	0.96	0.00
1995	2.30	1.06	-0.01	0.00	1.25	0.00
1996	2.28	1.01	0.00	0.00	1.27	0.00
1997	2.30	0.99	0.02	0.00	1.29	0.00
1998	3.92	1.01	0.02	0.00	2.89	0.00
1999	20.52	0.76	11.44	0.00	8.32	0.00
2000	47.04	0.81	29.73	0.00	16.49	0.00
2001	53.26	0.82	31.69	0.00	20.75	0.00
2002	64.64	0.77	45.14	0.00	18.73	0.00
2003	76.01	0.79	52.37	0.00	22.86	0.00
2004	47.11	0.71	33.77	0.00	12.63	0.00
2005	-304.12	-50.52	-202.84	-3.66	-47.11	0.00
2006	-354.25	-83.18	-219.59	-4.77	-46.71	0.00
2007	-271.26	-47.47	-177.05	-4.16	-42.58	0.00
2008	-88.11	-39.79	-0.09	-5.06	-43.17	0.00
2009	195.18	-141.17	-108.84	8.65	436.53	0.00
2010	-198.38	-159.79	482.63	-12.45	-508.78	0.00
2011	19.11	-137.15	725.51	-11.30	-557.95	0.00

3.2.18 Planned Improvements

Currently no relevant improvements are planned.

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 2012 0.6% of national total emissions arose from IPCC Category *1.B* Fugitive Emissions. Table 95 presents GHG emissions arising from this category, their share and trend from 1990 to 2012.

Table 95: Greenhouse gas emissions from Category 1.B Fugitive Emissions.

Year	GHG emissions [Gg CO_2 equivalent]		
	Total	CO_2	CH_4
1990	311.25	102.09	209.16
1991	318.39	111.09	207.30
1992	345.36	120.13	225.23
1993	339.51	112.13	227.38
1994	346.81	127.64	219.17
1995	353.46	127.15	226.32
1996	296.37	71.14	225.23
1997	347.28	120.63	226.66
1998	364.70	141.94	222.76
1999	381.78	170.65	211.13
2000	375.90	164.65	211.25
2001	390.06	182.85	207.21
2002	371.64	167.15	204.49
2003	435.62	233.15	202.46
2004	428.78	210.15	218.62
2005	425.18	205.15	220.02
2006	457.97	232.16	225.81
2007	465.81	237.16	228.65
2008	437.66	212.16	225.50
2009	499.69	265.16	234.53
2010	479.87	237.17	242.70
2011	473.80	233.17	240.63
2012	475.60	237.17	238.43
Trend 1990–2012	***53%***	***132%***	***14%***

3.3.1.2 Completeness

Table 96 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 mainly included in the energy sector (sub category *Iron and Steel*), because the only solid fuel transformation for production of coke oven coke occurring in Austria is one coking plant as part of an integrated iron and steel site. In response to the Saturday Paper from the ERT (In-Country Review 2013) in addition CH_4 emissions from traditional charcoal production from wood as feedstockhave been estimated and reported in this sector.

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 CO_2 emissions from sour gas processing, which is reported separately under gas extraction.

Regarding petroleum refining, all CO_2 emissions, thus including flaring, are reported in the Energy Sector, as these are emissions due to combustion. Fugitive CO_2 losses are considered negligible. In category *1.B* only CH_4 and NMVOC emissions, included venting, are considered.

Table 96: Overview of subcategories of Category 1.B Fugitive Emissions: transformation into SNAP Codes and status of estimation.

IPCC Category	SNAP	Status	
		CO_2	CH_4
1 B 1 a Coal Mining and Handling			
i Underground Mines	050102 Underground mining	NO	NO
ii Surface Mines	050101 Open cast mining	NA	✓
1 B 1 b Solid Fuel Transformation		IE[1)]	IE, ✓[1)]
1 B 2 a Oil			
i Exploration	0502 Extraction, 1st treatment and loading of liquid fossil fuels	IE[2)]	IE[2)]
ii Production		✓	✓
iii Transport	050502 Transports and Depots	IE[2)]	IE[2)]
iv Refining/Storage	0401 Processes in Petroleum Industries	NA[3)]	✓
v Distribution of oil products	0504 Liquid fuel distribution 0505 Petrol distribution	NA	NA[4)]
1 B 2 b Natural Gas			
i Exploration	0503 Extraction, 1st treatment and loading of gaseous fossil fuels	NA	IE[2)]
ii Production/Processing		✓[2)]	
iii Transmission	050601 Pipelines/Storage	✓	✓
iv Distribution	050603 Distribution Networks	NA	✓
v Other Leakage		NO	NO
1 B 2 c Venting/Flaring		IE[5)]	IE[6)]

1) *Under this category only CH_4 of traditional charcoal production with wood as feedstock is reported. The production of coke oven coke is 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 (CH_4 emissions only, CO_2 emissions are NA) and 1.B.2.b ii Natural Gas Production/Processing, except CO_2 emissions from processing of sour gas, are included in 1.B.2.a ii.*

3) *CO_2 emissions due to combustion are included in 1.A.1.b Petroleum Refining, fugitive CO_2 emissions are assumed to be negligible.*

4) *also includes storage in storage tanks and refinery dispatch station – only NMVOC emissions are estimated as CH_4 emissions are assumed to be negligible.*

5) *included in 1.A.1.b Petroleum Refining*

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

3.3.2 1.B.1 Solid fuels

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

Emissions: CH_4

Key Source: No

This category covers methane emissions from one brown coal surface mine. CH_4 emissions from this category decreased by more than 50% from 1990 to 1999 due to lower mining activities. Before coal mining was stopped in 2007 emissions decreased sharply between 2003 and 2004 (80%, Table 97).

Emissions are calculated by multiplying the amount of brown coal produced (= activity data) by the CORINAIR default emission factor of 214 g CH_4/Mg coal (Emission Factor Data Base #11378[37]). Activity data are taken from the national energy balance and statistical year books (e.g. WKÖ 2005, WKÖ 2006, WKÖ 2007, BMWFJ 2008, BMWFJ 2010, BMWFJ 2011, BMWFJ 2012).

Table 97: Activity data (brown coal produced) and CH_4 emissions for Fugitive Emissions from Fuels – Coal Mining 1990–2012.

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
2011	NO	NO
2012	NO	NO

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

3.3.2.2 1.B.1.b Fugitive Emissions from Solid Fuel Transformation

Emissions: CH_4

Key Source: No

CH_4 emissions from Charcoal transformation are covered in this category. Fugitive emissions from production of coke oven coke are included in *1.A.2.a Iron and Steel*.

For the most recent years (2005–2012) Austria uses the data from the National Energy Balance to calculate emissions from charcoal production

For the years 1990–2004 an average production amount of 1 000 t was assumed, as the National Energy Balance only provides data for this fuel category starting from 2005. Although the IEA Joint Questionnaire figures also do not show indigenous production for the years previous to 2001, it is unlikely that there was no traditional charcoal production based on wood as feedstock at all as charcoal is produced within small communities for many decades mainly to keep this old tradition in rural areas as a cultural heritage. Hence, it is reasonable to assume a constant charcoal production for the years before 2001. In Table 98 the activity data of charcoal production is presented.

Table 98: Activity data (charcoal produced) and CH_4 emissions for Fugitive Emissions from Solid Fuel Transformation 1990–2012.

Year	Charcoal production (in t)	Charcoal [TJ]	CH_4 emissions [Mg]
1990	1 000	31	0.031
1991	1 000	31	0.031
1992	1 000	31	0.031
1993	1 000	31	0.031
1994	1 000	31	0.031
1995	1 000	31	0.031
1996	1 000	31	0.031
1997	1 000	31	0.031
1998	1 000	31	0.031
1999	1 000	31	0.031
2000	1 000	31	0.031
2001	1 000	31	0.031
2002	1 000	31	0.031
2003	1 000	31	0.031
2004	1 000	31	0.031
2005	1 101	34	0.034
2006	1 220	38	0.038
2007	1 149	36	0.036
2008	1 253	39	0.039
2009	1 365	42	0.042
2010	1 181	37	0.037
2011	1 130	35	0.035
2012	1 377	43	0.043

For calculating the emissions, Austria is using a constant country specific NCV of 31 MJ/kg from its National Energy Balance. Due to the absence of measurements which are needed to derive a country specific emission factor, the default emission factor of the revised IPCC 1996 guidelines (Table 1-14) has been applied for CH_4 (1 000 kg/TJ).

3.3.3 1.B.2 Oil and natural gas

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

Emissions: CH_4, *CO_2*

Key Source: No

In this category, fugitive emissions from oil refining (CH_4) and CO_2 and CH_4 emissions from combined oil and gas production are considered. CO_2 emissions from the refinery resulting from combustion processes (including flaring) are included in *1.A.1.b Petroleum Refining*.

For transport, distribution and storage only NMVOC emissions are estimated, the CH_4 content of the NMVOC emissions is assumed to be negligible.

CO_2 and CH_4 emissions contribute approximately equally to GHG emissions from *1.B.2.a* (53% and 47% in 2012 respectively). In 2012 fugitive CH_4 and CO_2 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).

For the calculation an emission factor of 745 kg CH_4/PJ crude oil input is used. This emission factor is in the medium range of default emission factors for Western Europe for the sum of Refining and Storage Tanks presented in table 1-58 of the IPCC Reference Manual. This emission factor is assumed to be conservative since crude oil is being transported by pipeline and, therefore, it is stored for a short period only which reduces the potential to release fugitive CH_4 emissions compared to the processes represented by the IPCC default emission factors. Further, high standards for the recovery of fugitive CH_4 emissions in accordance with the Austrian Best Available Technology regulations are implemented.

The emission factor of 745 kg CH_4/PJ crude oil input is converted to 31.66 CH_4 g/t crude oil by multiplying it by the net calorific value of 42.5 GJ/t oil (taken from the national energy balance).

Emissions are then calculated by multiplying the amount of crude oil input (= activity data, taken from the national energy balance) by this converted emission factor of 31.66 CH_4 g/t crude oil.

Production

The amount of gas produced and the related CO_2 emissions from combined oil and gas production were reported by the *Association* of the *Austrian Petroleum Industry (FVMI 2013)* (see Table 99).

Methane emissions from production are calculated using IPCC Tier 1 with an aggregate production-based emission factor and the national production data.

In response to a recommendation of the ERT during the In-Country Review 2013 the calculation method applied for estimating CH_4 emissions has been revised to achieve consistency in the time-series. The calculation method by the *Association of the Austrian Petroleum Industry* changed between 2006 and 2007 due to use of different EFs, but the appropriate EF – the OGP Tier 1[38] emission factor (0.0026 t CH_4/t oil and gas produced) – was not applied consistently across the whole time series.

Data from the *Association of the Austrian Petroleum Industry* is reported as a total of natural gas and oil gas. Since those two components have a different density a new calculation based on assumptions on the composition of raw gas, derived from the [FVMI 1999-2012] has been developed and a recalculation with the OGP Tier 1 emission factor was done for the whole time series (see Table 99).

Table 99: Activity data (Crude Oil Refined and Gas Produced, respectively) and emissions for Fugitive Emissions from Fuels – Oil Refining and Production 1990–2012.

Year	Refining		Production			
	Crude Oil Refined [Gg]	CH_4 [Gg]	Gas Produced [Mio m³]	CH_4 [Gg]	CO_2 [Gg]	IEF CO_2 [kg/1 000 m³]
1990	7 952	0.25	1 288	5.77	43	33
1991	8 273	0.26	1 326	6.19	43	32
1992	8 732	0.28	1 437	6.17	40	28
1993	8 522	0.27	1 488	6.21	37	25
1994	8 898	0.28	1 355	5.78	48	35
1995	8 619	0.27	1 482	5.89	38	26
1996	8 754	0.28	1 492	5.82	41	27
1997	9 376	0.30	1 428	5.61	31	22
1998	9 190	0.29	1 568	5.87	61	39
1999	8 636	0.27	1 741	6.35	90	52
2000	8 240	0.26	1 805	6.41	72	40
2001	8 799	0.28	1 954	6.69	88	45
2002	8 947	0.28	2 014	6.76	84	42
2003	8 819	0.28	2 030	6.76	133	66
2004	8 442	0.27	1 963	6.55	122	62
2005	8 778	0.28	1 637	5.80	122	75
2006	8 512	0.27	1 819	6.14	140	77
2007	8 496	0.27	1 848	6.20	142	77
2008	8 710	0.28	1 531	5.56	135	88
2009	8 286	0.26	1 670	5.83	163	98
2010	7 719	0.24	1 816	6.24	145	80
2011	8 170	0.26	1 684	5.86	145	86
2012	8 349	0.26	1 807	6.07	145	80

[38] Methods for estimating atmospheric emissions from E&P Operations, Report No. 2.59/197, The Oil Industry International Exploration and Production Forum, London, 1994

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

Emissions: CH_4, *CO_2*

Key Source: No

In this category CO_2 emissions from sour gas processing, CH_4 emissions from gas distribution and storage and CO_2 and CH_4 emissions from gas transmission are reported.

CO_2 emissions from this category mainly arise from sour gas processing; the general trend is that CO_2 emissions increased due to increasing gas production. The exceptional low CO_2 emissions in 1996 are due to a break in processing during the implementation of pollution control measures. Gas transmission is only a minor source of CO_2 emissions.

CH_4 emissions contributed 55% to total GHG emissions from *1.B.2.b* in 2012. In 2012 fugitive CH_4 and CO_2 emissions from natural gas contributed 0.3% to total greenhouse gas emissions in Austria. CH_4 emissions from natural gas increased between 1990 and 2012 by 14% due to extension of the pipeline network and storage sites. Although the natural gas distribution network has more than doubled since 1990 in length, CH_4 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).

Due to the implementation of technical measures there is only a slight increase of 13% in CH_4 emissions from storage between 1990 and 2012 although the storage capacity and volume increased by 197% within the same period of time.

Sour Gas Processing

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

Distribution, Transmission (pipelines) and Storage

Detailed information on fugitive CH_4 emissions from natural gas distribution and storage has been collected in a national study for the year 1999 (WARTHA 2005). In this study emissions were calculated for each transport system, for each storage site and for each distribution system. The study accounted for the different emission sources, with the respective emission factors. The study was updated in 2011 (WARTHA 2011) to reflect technical measures that were implemented to reduce fugitive emissions from gas transmission and distribution and gas storage. For this update a detailed survey and a literature study were performed. The data in this update was collected for the year 2009.

Fugitive CH_4 emissions from storage mainly result from storage sensors, compressors, separators and venting. As the information on these emissions is limited to the years 1999 and 2009 (WARTHA 2005, WARTHA 2011) 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 (WARTHA 2005) and was considered to be appropriate as emissions are directly related to the amount of gas handled. The 1999 and 2009 emissions from storage as compiled in the national studies were divided by the mean value of the annual amount of gas injection and withdrawal for the year 1999 and 2009 respectively. The resulting EFs equal to 541 kg CH_4 per Mm^3 natural gas for 1999 and 207 kg CH_4 per Mm^3 for 2009. The lower emission factor in 2009 is due to technical improvements such as the exchange of valves and a reduction of gas that is released to the atmosphere during tests. It was assumed that technical improvements to reduce fugitive emissions from gas storage were made continually since the year that was assessed in the original study (WARTHA 2005) the emission factor was interpolated between 1999 and 2009. For years before 1999 the emission factor from the original study was used. From 2009 onwards the emission factor for 2009 was used. The emission factors were 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 CH_4 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 and 2009, 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 (WARTHA 2005, WARTHA 2011) and relating them to the total length of the pipeline system. The developed EFs equal to 495 kg and 386 kg CH_4 per km pipeline and year for 1999 and 2009 respectively. The lower emission factor in 2009 is due to technical improvements such as recompression and smart plug and the exchange of gas-pneumatic to electric valves. It was assumed that the technical improvements to reduce fugitive emissions from gas storage were made continually since the year that was assessed in the original study (WARTHA 2005) the emission factor was interpolated between 1999 and 2009. For years before 1999 the emission factor from the original study was used. From 2009 onwards the emission factor for 2009 was used.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 100. 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. In the updated study (WARTHA 2011) no data on pipeline material was published and no new information could be obtainted from the Association of Gas- and District Heating Supply Companies. Therefore the calculation for gas distribution was not changed.

Table 100 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 100: 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**	**2012**	**1990–2012**	
Insulated steel	2 881	3 760	3 539	+23%	25
Plastics (HDPE,PVC)	6 368	18 501	24 196	280%	13
Ductile cast iron	2 213	1 720	1 515	-32%	701
Grey cast iron	210	118	9	-96%	892
Total	**11 672**	**24 099**	**29 260**	**+151%%**	

Table 101: Activity data and emissions for Fugitive Emissions from Fuels – Natural Gas Distribution and Sour Gas Processing 1990–2012.

Year	Natural Gas Distribution		Sour Gas Processing	
	Gas network	CH_4 Emissions	Sour Gas Prod.	CO_2 Emissions
	[km]	[Gg]	[1 000 m³]	[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	1.74	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	1.59	397 132	92
2011	29 023	1.60	375 168	88
2012	29 260	1.58	375 420	92

Table 102: Activity data and emissions for Fugitive Emissions from Fuels – Natural Gas Transmission and Storage 1990–2012.

Year	Natural Gas Transmission (Pipelines Fugitive & Venting)			Natural Gas Storage	
	Pipelines	CH_4 Emissions	CO_2 Emissions	Natural Gas Stored	CH_4 Emissions
	[km]	[Gg]	[Gg]	[Mm³]	[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	0.64
2000	5 966	2.89	0.15	1 665	0.85
2001	6 213	2.94	0.15	1 132	0.54
2002	6 232	2.88	0.15	861	0.38
2003	6 243	2.82	0.15	1 574	0.64
2004	6 288	2.77	0.15	1 507	0.56
2005	6 290	2.70	0.15	1 828	0.62
2006	6 354	2.66	0.16	2 112	0.65
2007	6 495	2.65	0.16	2 530	0.69
2008	6 545	2.60	0.16	2 949	0.71
2009	6 574	2.54	0.16	3 560	0.74
2010	6 798	2.62	0.17	3 070	0.64
2011	6 983	2.70	0.17	3 850	0.80
2012	7 109	7.74	0.17	4 449	0.92

3.3.4 QA/QC

Before the studies Life Cycle Inventory Austria 2000 – Review (WARTHA 2005) and Life Cycle Inventory „Erdgasbereitstellung Austria – Update 2010 (WARTHA 2011) were 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 for 1999 (541 kg CH_4 per Mm^3) lies within the range given in the IPCC GPG (low end of the range provided in Table 2.16). The emission factor for 2009 (207 kg CH_4 per Mm^3) is a bit lower than the lowest value given in Table 2.16 of the IPCC

GPG but well above the Tier 1 emission factor for Gas Storage (25 kg CH_4 per Mm^3 marketable gas) given in the 2006 IPCC GL (Table 4.2.4). Emissions in 2012 equal to 0.02% of the working gas capacity, which is classified as low (0.05%) 2006 IPCC GL.

For transmission the developed EFs (1999: 495 kg per km pipeline and year, 2009 386 kg CH_4 per km pipeline and year) are lower than the range given in the IPCC GPG. Nevertheless, the gas losses in 2012 of 497 m^3/km/a are classified between low (200) and medium (2000) in the 2006 IPCC GL.

For distribution the IEFs range between 0.05 and 0.17 t/km/a, this is lower than the range given in the IPCC GPG. The mean gas losses of 107 m^3/km/a are classified between low (100 m^3/km/a) and medium (1 000 m^3/km/a) in the 2006 IPCC GL. Material specific emission factors of pipelines are neither provided in the IPPC GPG nor in the 2006 IPPC GL for comparison.

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

3.3.5 Uncertainty

For *1.B.2.b* Natural Gas – CH_4 an uncertainty estimate was made that was calculated from the combination of estimated uncertainties of the sub-sources.

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

Storage: The amount of natural gas injected and withdrawn from the storage sites is well known (uncertainty 5%). For the uncertainty of the country-specific EF 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, 6% for EF, resulting in a total uncertainty of emissions of 7%.

3.3.6 Recalculations

Recalculations are reported in the categories *1.B.1.b Solid Fuel Transformation* and *1.B.2.a Oil and natural gas* and were implemented in response to the In-Country Review 2013. CH_4 emissions from charcoal production were estimated and reported for the first time, leading to slightly higher emissions over the whole time series. In the combined oil and gas production the method for estimating CH_4 emissions has been changed to achieve time series consistency, resulting in slightly lower emissions in the years 2009-2011 (e.g. 2011: −0.21 Gg CH_4) and higher emissions in the years 1990-2008 (e.g. 1990: +1.21 Gg CH_4).

Table 103: Recalculations in Sector 1.B 1990–2012.

Year		1.B.1.b	1.B.2.a	Year		1.B.1.b	1.B.2.a
1990	[Gg CO_2e]	0.65	25.4	2001	[Gg CO_2e	0.65	54.4
1991		0.65	34.3	2002		0.65	54.2
1992		0.65	33.8	2003		0.65	59.6
1993		0.65	35.1	2004		0.65	30.3
1994		0.65	27.1	2005		0.72	12.3
1995		0.65	31.2	2006		0.79	13.3
1996		0.65	28.3	2007		0.75	12.1
1997		0.65	22.4	2008		0.82	1.1
1998		0.65	31.2	2009		0.89	-3.4
1999		0.65	46.3	2010		0.77	-4.1
2000		0.65	49.9	2011		0.74	-4.5

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 Sector *2 Industrial Processes* for the period from 1990 to 2012.

Emissions from this category comprise emissions from the following sub categories: *Mineral Products*, *Chemical Industry*, *Metal Production* and *Consumption of Halocarbons and* SF_6.

Only process related emissions are considered in this Sector; emissions due to fuel combustion in manufacturing industries are allocated to 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 110.

4.1.1 Emission Trends

In 2012, greenhouse gas emissions from Sector *2 Industrial Processes* amounted to 10 877 Gg CO_2 equivalent, compared to 10 005 Gg in the base year 1990. These emissions constituted 13.6% of Austria's total greenhouse gas emissions (excluding LULUCF) in 2012 and 12.8% of total emissions in the base year.

Greenhouse gas emissions from the industrial processes sector fluctuate during the reporting period:

- The minimum in 1993 results from the termination of primary aluminium production in Austria.
- The decrease from 2003 to 2004 is due to a strong reduction of N_2O emissions from the chemical industry.
- In the following years, emissions increased due to extended activities in the iron and steel industry.
- The trend from 2008 onwards is dominated by the effects of the economic crisis, followed by a moderate recovery.

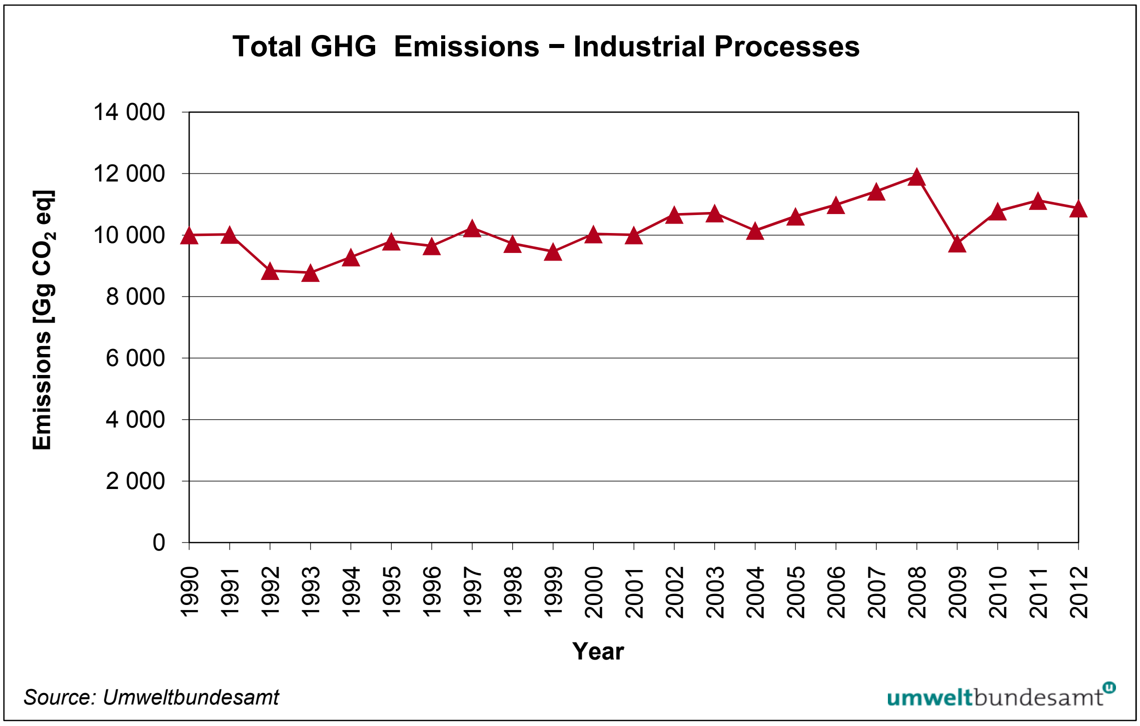

Figure 18: GHG emissions from Sector 2 Industrial Processes 1990–2012.

Emission trends by gas

The following table presents greenhouse gas emissions from the industrial processes sector as well as their share in total greenhouse gas emissions in the base year and in 2012.

Table 104: GHG emissions from Sector 2 Industrial Processes by gas in the base year and in 2012.

GHG	Base year*	2012	Base year*	2012
	[Gg CO_2 equivalent]		[%]	
Total	10 005.29	10 877.24	100%	100%
CO_2	7 539.87	9 008.12	75.4%	82.8%
CH_4	14.83	18.33	0.2%	0.2%
N_2O	912.02	52.70	9.1%	0.5%
HFCs	22.55	1 431.45	0.2%	13.2%
PFCs	1 022.65	40.46	10.2%	0.4%
SF_6	493.37	326.18	4.9%	2.9%

* *1990 for all gases*

Carbon dioxide constitutes the most important greenhouse gas of the industrial processes sector, contributing 82.8% of emissions to this sector in 2012, followed by HFCs with 13.2%, SF_6 with 2.9%, N_2O with 0.5%, PFCs with 0.4%, and finally CH_4 with 0.2%.

Table 105: Emissions from IPCC Sector 2 Industrial Processes by gas from 1990 to 2012 and overall trend.

	GHG emissions [Gg CO_2 equivalent]						
	Total	**CO_2**	**CH_4**	**N_2O**	**HFCs**	**PFCs**	**SF_6**
1990	10 005	7 540	15	912	23	1 023	493
1991	10 023	7 382	15	927	25	1 030	644
1992	8 845	6 839	14	837	27	440	688
1993	8 783	6 820	15	879	237	53	780
1994	9 287	7 158	15	825	260	58	971
1995	9 801	7 368	14	857	340	68	1 153
1996	9 650	7 069	15	874	393	66	1 234
1997	10 233	7 659	15	863	461	96	1 139
1998	9 726	7 302	15	897	555	44	912
1999	9 469	7 126	15	923	632	64	709
2000	10 038	7 755	15	952	647	67	602
2001	10 007	7 683	14	786	774	90	660
2002	10 669	8 246	15	807	875	83	643
2003	10 718	8 189	15	883	953	102	576
2004	10 151	8 203	15	281	1 020	125	507
2005	10 613	8 683	16	274	997	125	517
2006	10 986	9 070	19	280	1 004	137	475
2007	11 425	9 526	19	270	1 043	184	384
2008	11 911	9 926	19	326	1 082	167	391
2009	9 739	8 035	18	165	1 134	29	358
2010	10 781	8 998	18	63	1 286	64	352
2011	11 125	9 328	18	48	1 349	60	322
2012	10 877	9 008	18	53	1 431	40	326
Trend 1990–2012	***9%***	***19%***	***24%***	***-94%***	***6 248%***	***-96%***	***-34%***

Concerning sub-categories of the Industrial Processes sector, approx. 50% of GHG emissions (expressed in CO_2 equivalent) originate from *Metal Production* (mainly *Iron and Steel Production*) and approx. 27% from *Mineral Products*. 16% originate from *Consumption of Halocarbons and SF_6*, the remainder from *Chemical Industry* (mainly *Ammonia Production*).

CO_2 emissions

As can be seen in Figure 19, CO_2 emissions from the Industrial Processes sector showed a strong increase in the period from 1999 to 2008, mainly due to increasing emissions from metal production. The effect of the economic crisis is strongly visible in 2009. In 2012, CO_2 emissions from industrial processes amounted to 9 008 Gg, which corresponds to an increase of 19% compared to base year emissions.

CH_4 emissions

CH_4 emissions from this sector mainly arise from *Chemical Industry (Production of Ethylene, Urea, Fertilizers and Ammonia). Metal Production (Electric Furnace Steel Plants, Rolling Mills)* constitutes a minor source.

As can be seen in Figure 19, CH_4 emissions from industrial processes remained quite stable until 2005. The increase in 2006 can be attributed to an increase in ethylene production capacity. In the following years, emissions remained at similar levels and in 2012 were 24% above base year level.

N_2O emissions

N_2O emissions from the Industrial Processes sector arise from *Nitric Acid Production (Chemical Industry)* which in Austria takes place at one site with two (and for some years three) plants. As can be seen in Figure 19, N_2O emissions remained quite stable until 2000. The decreases since then are due to the introduction of emission control measures:

- 2001: installation of a new catalyst
- 2004: installation of a N_2O decomposition facility
- installation of a second catalyst in the nitric acid plant in May 2009
- full operation of the second catalyst in 2010
- 2011 further optimisation of the production process as well as slightly reduced production

In 2012, N_2O emissions from *Industrial Processes* were 94% below the level of the base year.

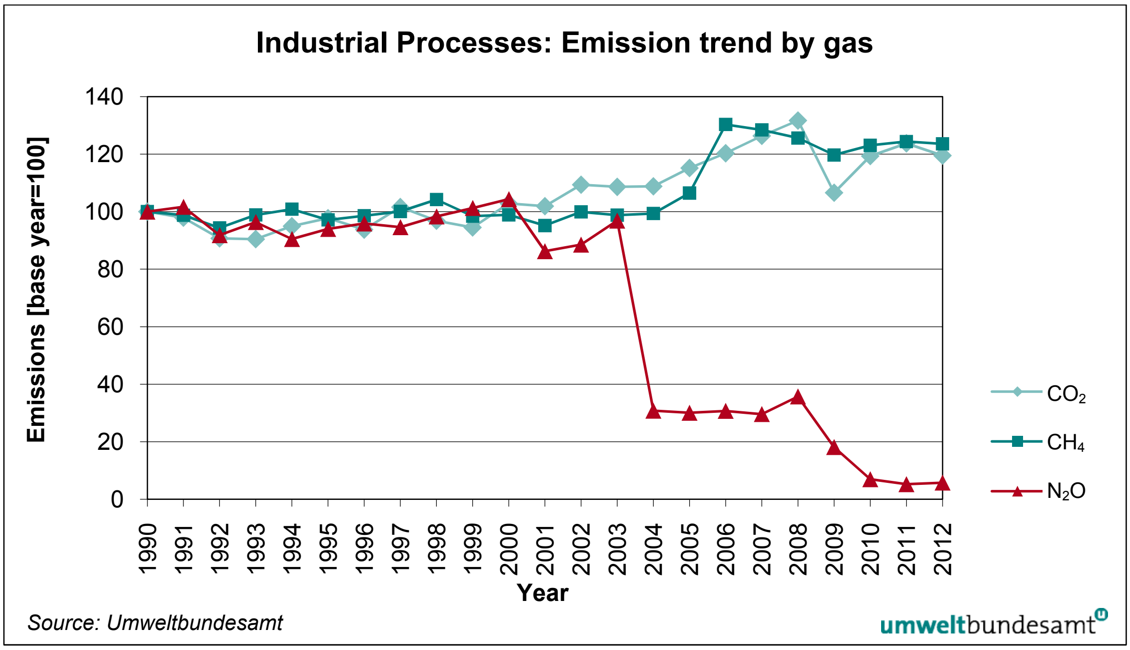

Figure 19: CO_2, CH_4 and N_2O emissions from Industrial Processes 1990–2012 (base year = 100).

HFC emissions

As can be seen in Figure 20, HFC emissions increased remarkably during the period from 1990 to 2012 due to the use of these gases as substitutes for ozone depleting substances. HFC emissions mainly arise from *Refrigeration and Air Conditioning Equipment*. Other important categories include *Foam Blowing, Semiconductor manufacture and uses of SF_6*.

HFC emissions continued to increase in recent years, as large numbers of HFC containing refrigerators, placed on the market at the beginning of the millennium, are decommissioned and emissions occur during disposal. Overall HFC emissions amounted to approx. 64 times the base year level in 2012.

PFC emissions

As can also be seen in Figure 20, PFC emissions decreased remarkably during the period from 1990 to 1993 – from 1 023 Gg CO_2 equivalent to approx. 53 Gg CO_2 equivalent – due to the termination of primary aluminium production in 1992 which was the major source for PFC emissions. From 1993 onwards, PFC emissions solely arise from semiconductor manufacture, where a strong increase in production capacity was partly counterbalanced by emission reduction measures. The level from 2009 onwards is dominated by the economic crisis which strongly affected this industry branch.

In 2012, PFC emissions amounted to 40.46 Gg CO_2 equivalents, which is 96% below the level of the base year 1990.

SF_6 emissions

Finally, as depicted in Figure 20, SF_6 emissions increased at the beginning of the reporting period and reached a maximum in 1996 as a result of increasing emissions from metal production and semiconductor manufacture, which decreased in the subsequent years. Current emissions mainly result from disposal of noise insulating windows. In 2012, SF_6 emissions amounted to 326 Gg CO_2 equivalents which is 34% below the base year level.

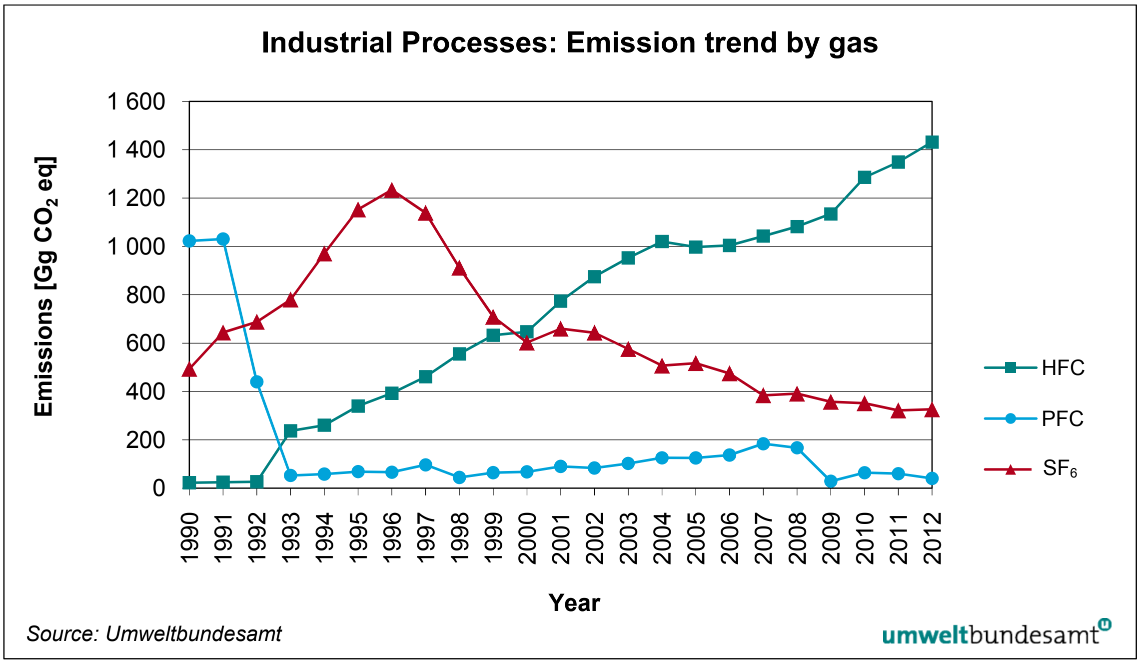

Figure 20: HFC, PFC and SF_6 emissions from Industrial Processes 1990–2012.

Emission trends by sources

The main sources of greenhouse gas emissions in the industrial processes sector are *Metal Production* and *Mineral Products*, which cause 50% and 27%, respectively, of the emissions from this sector in 2012 (see Table 106).

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).

Table 106: Greenhouse gas emissions from IPCC Sector 2 Industrial Processes by Category, their share and trend for the base year and 2012.

	Emissions [Gg CO_2e]		Share [%]		Trend BY–2012
	BY*	2012	BY*	2012	
2 Industrial Processes	10 005	10 877	100%	100%	9%
A Mineral Products	3 274	2 946	33%	27%	-10%
B Chemical Industry	1 468	659	15%	6%	-55%
C Metal Production	4 972	5 479	50%	50%	10%
F Consumption of Halocarbons and SF_6	292	1 793	3%	16%	515%

* *Base year: 1990 for all gases*

Figure 21 and Table 107 present greenhouse gas emissions from IPCC Sector 2 *Industrial Processes* by category for the years 1990 to 2012.

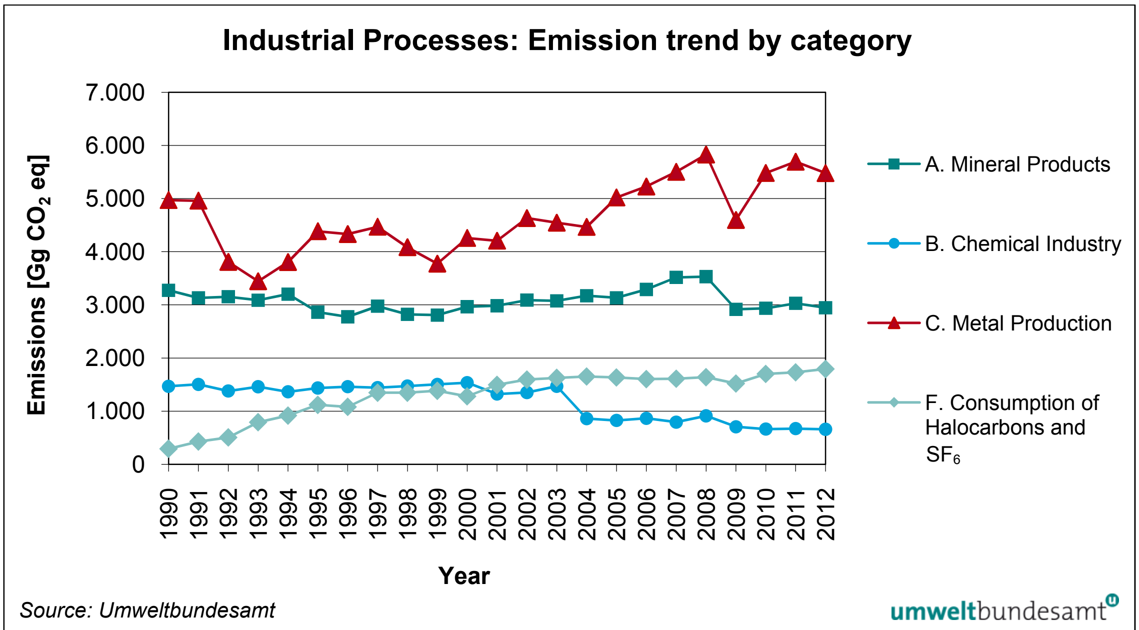

Figure 21: Greenhouse gas emissions from IPCC Sector 2 Industrial Processes per category 1990–2012.

Table 107: Greenhouse gas emissions from IPCC Sector 2 Industrial Processes (total and per category),1990–2012.

Year	GHG emissions [Gg CO_2 equivalent]				
	2 Total	2.A	2.B	2.C	2.F
1990	10 005	3 274	1 468	4 972	292
1991	10 023	3 132	1 503	4 960	428
1992	8 845	3 153	1 379	3 807	506
1993	8 783	3 087	1 460	3 443	792
1994	9 287	3 202	1 364	3 805	917
1995	9 801	2 863	1 435	4 385	1 118

Year	GHG emissions [Gg CO_2 equivalent]				
	2 Total	2.A	2.B	2.C	2.F
1996	9 650	2 775	1 461	4 332	1 082
1997	10 233	2 975	1 443	4 468	1 347
1998	9 726	2 822	1 473	4 084	1 347
1999	9 469	2 807	1 504	3 775	1 383
2000	10 038	2 966	1 535	4 258	1 279
2001	10 007	2 983	1 322	4 206	1 495
2002	10 669	3 089	1 352	4 634	1 594
2003	10 718	3 076	1 468	4 546	1 627
2004	10 151	3 172	861	4 465	1 653
2005	10 613	3 133	825	5 020	1 635
2006	10 986	3 291	866	5 226	1 603
2007	11 425	3 518	794	5 504	1 610
2008	11 911	3 531	912	5 828	1 640
2009	9 739	2 916	706	4 597	1 520
2010	10 781	2 936	663	5 481	1 701
2011	11 125	3 030	672	5 694	1 730
2012	10 877	2 946	659	5 479	1 793

2.A Mineral Products

Greenhouse gas emissions decreased by 10% from 1990 to 2012 in this category. In particular, emissions from *Cement Production, Sinter Production and Glass Production* as well as *Bricks* decreased over that time period. Emissions from *Lime Production, Limestone, Dolomite and Soda Ash Use* increased. Only CO_2 emissions arise from this category.

2.B Chemical Industry

For the source *Chemical Industry*, greenhouse gas emissions remained quite stable over the period from 1990 to 2003, with nitric acid production as the main emission source (60% in 1990). Due to the implementation of emission reduction measures, ammonia production is now the main source, contributing 78% to total emissions from this category in 2012. Minor sources include nitric acid, carbide and ethylene production. In 2012, emissions were 55% below the level of the base year.

2.C Metal Production

Greenhouse gas emissions from *Metal Production* fluctuated over the reporting period, which is mainly a result of a drop in PFC emissions from primary aluminium production which was terminated in 1992 and a strong increase in CO_2 emissions from *Iron and Steel Production* (+54%). The overall trend from 1990 to 2012 shows an increase by 10%. The main source of this category is CO_2 emissions from pig iron production.

2.F Consumption of Halocarbons and SF_6

In 2012, greenhouse gas emissions are approx. 6 times higher than base year emissions for the category *Consumption of Halocarbons and SF_6.* This increase is mainly due to increased 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 IPCC Sector *2 Industrial Processes*.

Table 108: 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
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_2O	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	Refrigeration and Air Conditioning Equipment	HFC	LA 2012; TA
2.F.9	Other Sources of SF_6	SF_6	LA 2012; TA

LA = Level Assessment (if not further specified – for the years 1990 and 2012)

TA = Trend Assessment BY–2012

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 methodology applied is similar to IPCC Tier 2, including accounting for carbon bound using country-specific parameters and accounting for emissions from downstream processes (urea, fertilizer and nitric acid production) to avoid double counting of emissions.

Detailed information on the methodologies can be found in the corresponding subchapters.

Emission data reported under the European Emission Trading Scheme

Verified CO_2 emissions reported under the EU ETS were available for the years 2005–2012. 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.7.a Bricks production*, *2.A.7.b Magnesia Sinter Plants*, *2.A.7.c Glass production* and *2.C.1 Iron and Steel*. Special attention was given to time-series consistency. Furthermore, background data for 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 by WINIWARTER (2007) and on estimates by Umweltbundesamt are provided (see Table 109, for explanations see the respective subchapters).

Table 109: Uncertainty assessment for key sources of Sector 2 Industrial Processes.

IPCC Category	Source Categories	Uncertainty [%]		
		Activity data	Emission factor	Emission estimate
2.A.1	Cement Production – CO_2	5.0	2.0	5.4
2.A.2	Lime Production – CO_2	20.0	5.0	20.6
2.A.3	Limestone and Dolomite Use – CO_2	20.0	2.0	20.1
2.A.7.b	Magnesia Sinter Plants – CO_2	2.0	5.0	5.4
2.B.1	Ammonia Production – CO_2	2.0	4.6	5.0
2.B.2	Nitric Acid Production – N_2O	0.0	5.0	5.0
2.C.1	Iron and Steel Production – CO_2	0.5	0.5	0.7
2.C.3	Aluminium production – PFC	2.0	50.0	50.0
2.C.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 within the EU Emission Trading Scheme (EU ETS), Commission Decision 2004/156/EC established guidelines for monitoring and reporting of greenhouse gas emissions. This decision provided general guidelines on emission reporting and verification as well as sector specific guidelines on the methodologies to account for process specific CO_2 emissions. These include guidance on calculations and measurements at different level of detail, similar to the different Tier methods in the IPCC guidelines. The original Commission Decision was replaced by Commission Decision 2007/589/EC and, most recently, Commission Regulation (EU) No 601/2012.

In Austria, the EU ETS is implemented by specific national regulations: the Austrian Emissions Allowance Trading Act[39] and the Ordinance regarding Monitoring and Reporting of Greenhouse Gas Emissions[40].

Furthermore, most of the plants that report emission data – this includes plants that are not obliged to participate in the EU ETS – have quality management systems in place according to the ISO 9000 series or similar systems.

4.1.6 Recalculations

A summary of the changes made compared to the submission of 2013 is presented below:

Update of activity data

2.A.2 Lime Production

Activity and emission data were updated based on information available from the Association of the Stone & Ceramic Industry, resulting in slightly lower emissions in the years 2002, 2003 and 2004.

2.C.1 Pig Iron

Revised coke input data became available in the energy balance for the year 2011 leading to lower CO_2 emissions (-95 Gg) for this year.

2.F.1 Refrigeration and Air Conditioning Equipment

Heat pumps
Based on a new study, the number of heat pumps installed in 2011 was adjusted, resulting in slightly lower HFC emissions in that year.

Improvements of methodologies and emission factors

2.A.2 Lime Production

For the year 2006, a transcription error in the emission estimate was corrected, resulting in lower emissions in that year.

2.B.1 Ammonia Production

In response to a finding of the 2013 in-country-review, all carbon inputs and outputs of Austria's integrated ammonia plant were reviewed. As CO_2 emissions from fertilizer production and nitric acid production are reported under the respective subcategories, they were subtracted from CO_2 emissions reported under ammonia production. This resulted in lower CO_2 emissions in the order of 20 to 40 Gg per year for the whole time series.

[39] *Emissionszertifikategesetz 2011*, Federal Law Gazette I No. 118/2011, as amended

[40] Überwachungs-, Berichterstattungs- und Prüfungsverordnung, Federal Law Gazette II No. 339/2007, as amended

2.C.3 Aluminium Production

A transcription error in the calculation of C_2F_6 emissions was corrected, leading to lower emissions in the order of 2 to 6 tonnes of C_2F_6 in the years 1990 to 1992.

2.F.1 Refrigeration and air conditioning equipment

In the sub-category "mobile air condition", a transcription error in the emission calculation for the year 2011 was corrected, resulting in slightly lower HFC emissions in that year.

For the Industrial Processes sector, all recalculations combined result in lower emissions for the base year (−98.44 Gg CO_2 equivalent) and lower emissions for the year 2011 (−121.63 Gg CO_2 equivalent).

For further information see the recalculation sections of the respective subchapters of this chapter and the tables presented in Chapter 8.

4.1.7 Completeness

Table 110 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 110: Overview of subcategories of Sector 2 Industrial Processes: transformation into SNAP Codes and status of estimation.

	IPCC Category	SNAP		Status		
				CO_2	CH_4	N_2O
2.A	**MINERAL PRODUCTS**					
2.A.1	Cement Production	040612	Cement (decarbonising)	✓	NA	NA
2.A.2	Lime Production	040614	Lime (decarbonising)	✓	NA	NA
2.A.3	Limestone and Dolomite Use	040618	Limestone and Dolomite Use	✓	NA	NA
2.A.4	Soda Ash Production and Use	040619	Soda Ash Production and Use	✓	NA	NA
2.A.5	Asphalt Roofing	040610	Roof covering with asphalt materials	IE[1)]	NA	NA
2.A.6	Road Paving with Asphalt	040611	Road paving with asphalt	IE[1)]	NA	NA
2.A.7	*Other*					
	2.A.7.a Bricks	040617	Bricks (decarbonising)	✓	NA	NA
	2.A.7.b Magnesia Sinter	040617	Other – Magnesia Sinter Plants	✓	NA	NA
	2.A.7.c Glass Production	040613	Glass (decarbonizing)	✓	NA	NA
2.B	**CHEMICAL INDUSTRY**					
2.B.1	Ammonia Production	040403	Ammonia	✓	✓	NA
2.B.2	Nitric Acid Production	040402	Nitric acid	✓	NA	✓
2.B.3	Adipic Acid Production	040521	Adipic acid	NA	NA	NO[2)]
2.B.4	Carbide Production	040412	Calcium carbide production	✓	NA[3)]	NA
2.B.5	Other	040407 040408	NPK fertilisers Urea	✓	✓	NA
2.B.5	Other	040501	Ethylene production	NA	✓	NA

2.C	**METAL PRODUCTION**					
2.C.1	Iron and Steel Production	040202 040206 040207 040208	Blast furnace charging Basic oxygen furnace steel plant Electric furnace steel plant Rolling mills	✓	✓	NA
2.C.2	Ferroalloys Production	040302	Ferro alloys	✓	NA	NA
2.C.3	Aluminium Production	040301	Aluminium production (electrolysis) – except SF_6	✓/NO [4]	✓/NO [4]	NA
2.C.4	SF_6 Used in Aluminium and Magnesium Foundries	040301 040304	Aluminium Production – SF_6 only Magnesium Production – SF_6 only		SF_6 ✓	
2.C.5	*Other*			NA	NA	NA
2.D	**OTHER PRODUCTION**					
2.D.1	*Pulp and Paper*			NA	NA	NA
2.D.1	*Food and Drink*			NA [5]	NA	NA

	IPCC Category		SNAP	HFCs, PFCs, SF_6
2.E	**PRODUCTION OF HALOCARBONS AND SULPHUR HEXAFLUORIDE**	0408	Production of halocarbons and sulphur hexaflouride	NO [6]
2.F	**CONSUMPTION OF HALOCARBONS AND SULPHUR HEXAFLUORIDE** [7]	0605	Use of HFC, PFC and SF_6	
2.F.1	Refrigeration and Air Conditioning Equipment			✓
2.F.2	Foam Blowing			✓
2.F.3	Fire Extinguishers			✓
2.F.4	Aerosols			✓
2.F.5	Solvents			✓
2.F.6	Other applications using ODS substitutes			NO
2.F.7	Semiconductor Manufacture			✓
2.F.8	Electrical Equipment			✓
2.F.9	*Other*			✓

1) *Emissions are included in Sector 3 Solvent and Other Product Use.*
2) *There is no adipic acid production in Austria.*
3) *Silicon carbide is not produced in Austria.*
4) *Primary aluminium production was terminated in 1992.*
5) *CO_2 emissions from this source are of biogenic origin.*
6) *There is no production of halocarbons or SF_6 in Austria.*
7) *No corresponding SNAP category is presented here as the actual estimation is based on IPCC Categories.*

4.2 Mineral Products (CRF Source Category 2.A)

4.2.1 Cement Production (2.A.1)

4.2.1.1 Source Category Description

Emissions: CO_2

Key Source: Yes (CO_2)

CO_2 emissions from cement production are a key category because of their contribution to the level of the greenhouse gas inventory in the base year and in 2012. In 2012, CO_2 emissions from cement production contributed 2.1% to total greenhouse gas emissions in Austria (without LULUCF).

In this category, process specific CO_2 emissions are reported only; emissions due to combustion are reported in the energy sector (category *1.A.2.f*).

Process specific CO_2 is emitted during the production of clinker (calcination process) when carbonates (mainly $CaCO_3$) is heated in a cement kiln up to temperatures of about 1 300°C. During this process, calcium carbonate is converted into lime (CaO – Calcium Oxide) and CO_2.

Table 111 presents process-related CO_2 emissions from cement production for the period from 1990 to 2012.

To increase transparency (in response to a question in the course of the UNFCCC review 2012), data on raw meal used was incorporated into the table.

Table 111: CO_2 emissions from decarbonising in cement production, clinker production, raw meal used and implied emission factor, 1990–2012.

Year	Process specific CO_2 emissions [Gg]	Clinker [t/a]	Raw meal used [t/a]	IEF [kg CO_2/t Clinker]
1990	2 033	3 693 539	5 832 777	551
1991	2 005	3 635 462	5 748 943	552
1992	2 105	3 820 397	6 037 658	551
1993	2 032	3 678 293	5 830 089	552
1994	2 102	3 791 131	6 032 917	555
1995	1 631	2 929 973	4 671 693	557
1996	1 634	2 915 956	4 688 132	560
1997	1 761	3 103 312	5 056 336	567
1998	1 599	2 869 035	4 614 457	557
1999	1 607	2 891 785	4 648 493	556
2000	1 712	3 052 974	4 890 919	561
2001	1 720	3 061 338	4 911 083	562
2002	1 736	3 118 227	5 014 871	557
2003	1 754	3 119 808	5 016 291	562
2004	1 790	3 222 802	5 179 877	555
2005	1 797	3 221 167	5 175 628	558
2006	1 954	3 653 477	5 804 052	535
2007	2 131	3 992 376	6 297 527	534
2008	2 133	3 996 243	6 326 187	534

Year	Process specific CO_2 emissions [Gg]	Clinker [t/a]	Raw meal used [t/a]	IEF [kg CO_2/t Clinker]
2009	1 799	3 428 140	5 376 515	525
2010	1 622	3 097 043	4 854 280	524
2011	1 666	3 175 642	4 947 150	525
2012	1 673	3 206 055	4 942 334	522

CO_2 emissions mainly follow production figures: they remained quite constant from 1990 to 1994 and dropped afterwards due to an economic downturn in the cement industry and the shutdown of one clinker oven. After 1995, emissions as well as production of clinker increased slowly, following cement demand, with minor fluctuations only. The trend from 2008 onwards is a result of the economic crisis followed by a (slow) recovery in the cement industry.

The overall emission trend from 1990 to 2012 is minus 17.7%. Production decreased by 13.1% during that period.

As process specific emissions are considered only, the IEF solely depends on the raw materials used (carbonate contents of fresh materials but also of secondary raw materials such as clay substitute, brick chips, and recycled gypsum) – smaller fluctuations of the IEF are also a result of opening/closing or shifting of production between plants that operate under different conditions (such as with respect to the use of secondary materials). Currently, nine plants operate in Austria.

As can be seen in Figure 22, the IEF largely follows the trend of the raw meal/clinker ratio as it is a result of the raw materials used.

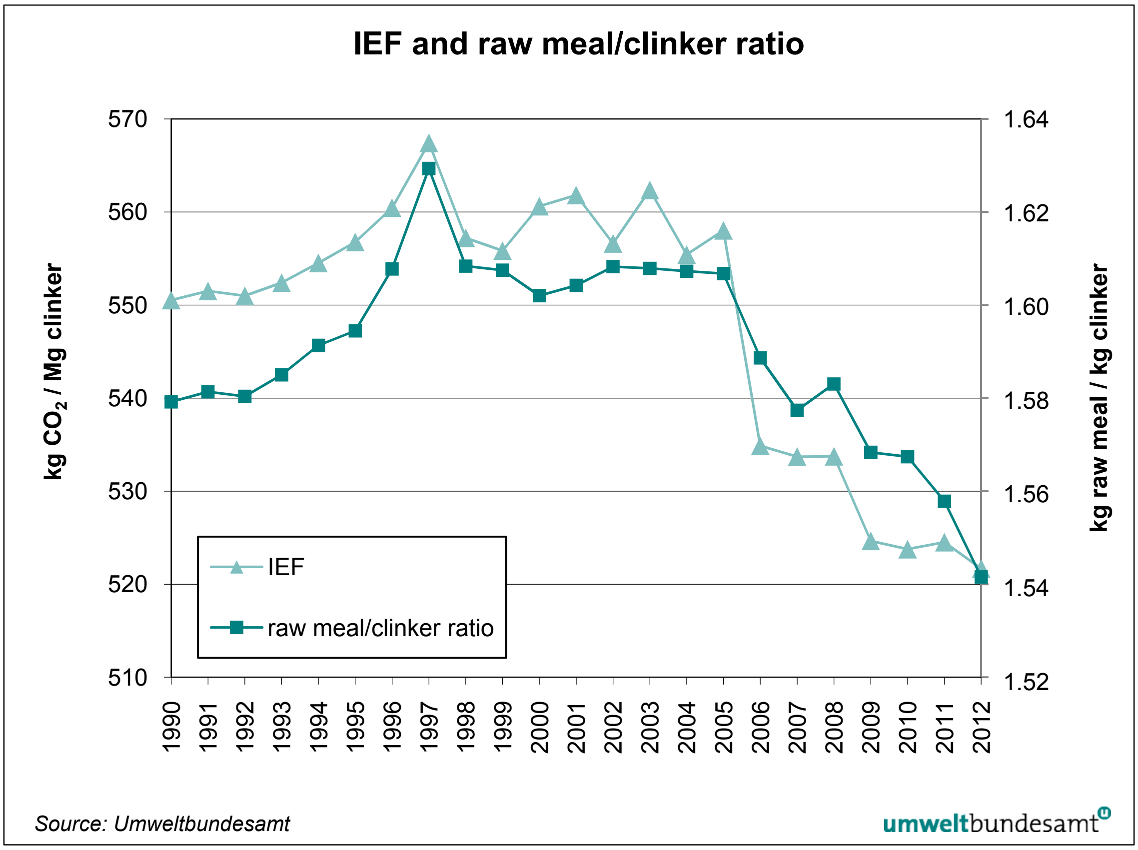

Figure 22: Time series of the implied emission factor (IEF) for cement production and ratio of raw meal used to clinker produced.

In an effort to enhance transparency, information on the composition of raw material and its calcium carbonate and magnesium carbonate was collected. In 2011, the average $CaCO_3$ content was 76.3% and the average $MgCO_3$ content was 3.1% in the nine plants in operation in that year.

It has to be noted that from 2005 onwards, emissions are calculated for each plant in line with the requirements of the EU ETS. Total carbonate contents of the raw meal are determined for each plant individually. However, the specific shares of $CaCO_3$ and $MgCO_3$ are not determined under this approach as this is not required for the determination of process emissions.

4.2.1.2 Methodological Issues

Until 2004, CO_2 emissions from cement production were estimated using a country specific method similar to the IPCC Tier 2 methodology. CO_2 emissions from raw meal calcination (decarbonising) were calculated based on the raw meal composition:

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

Where:

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

x ...... mass portion

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

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

Me ... Ca, Mg

Based on raw meal data and plant specific production data, total emissions from this source were calculated. With this 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.

Activity data (clinker production) as well as emission data were taken from studies on emissions from the Austrian cement production industry (HACKL & MAUSCHITZ 1995, 1997, 2001, 2003 and MAUSCHITZ 2004). The studies cover the years 1988 to 2003. In these studies process-specific CO_2 emissions and CO_2 emissions due to combustion are presented separately. In the course of these studies all cement production plants in Austria were investigated. The determination of the emission data took place by inspection of every single plant, recording and evaluation of plant specific records and also plant specific measurements and analysis carried out by independent scientific institutes.

Activity data and emissions for 2004–2012 were determined in line with the requirements of the EU ETS. Verified CO_2 emissions, covering the whole cement industry in Austria, were reported directly by the Association of the Austrian Cement Industry; data are also published in annual reports (MAUSCHITZ (2008, 2009, 2010, 2011, 2012, 2013). The methodology for these emission calculations is the same as in the years before.

4.2.1.3 Source specific QA/QC

Raw material analysis was carried out by independent scientific institutes. Clinker production was checked with publications from the Association of the Austrian Cement Industry to ensure completeness.

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

For 2005–2012, verified CO_2 emissions (total of all plants) were checked against national emissions taken from the studies – no deviations were identified.

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 CO_2 emission factor for Tier 2 is low (1–2%). In the Austrian method, the uncertainty basically derives from the raw meal composition as the uncertainty for the stochiometric emission factor is negligible; thus, the uncertainty of the emission factor is assumed to be 2%. This results in a combined uncertainty of 5.4%. According to the IPCC GPG Table 3.2, the uncertainty for emissions using Tier 2 methodology (based on clinker production data) is 5–10%.

4.2.1.5 Recalculations

No recalculations have been required for this years´ submission.

4.2.2 Lime Production (2.A.2)

4.2.2.1 Source Category Description

Emissions: CO_2

Key Source:Yes (CO_2)

CO_2 emissions from lime production are a key category because of their contribution to the total inventory's level in the base year and in 2012, as well as because of their contribution in terms of their trend. In the year 2012, emissions from this category contributed 0.7% to the total amount of greenhouse gas emissions in Austria (see Table 108).

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

Table 112 presents activity data for this category (lime produced) as well as CO_2 emissions from lime production for the period from 1990 to 2012.

Table 112: CO_2 emissions, activity data and implied emission factors for lime production 1990–2012.

Year	CO_2 emissions [Gg]	Lime Produced [t/a]	IEF [kg CO_2/t lime produced]
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	543	718 662	755
2003	572	754 156	758
2004	595	785 931	757
2005	579	788 328	734
2006	570	780 565	730
2007	596	816 370	730
2008	621	846 298	734
2009	507	695 019	730
2010	574	764 845	751
2011	605	809 982	747
2012	569	761 040	748

The overall trend for CO_2 emissions from this category shows increasing emissions, with a pronounced dip due to the economic crisis in 2009. In the year 2012, emissions were 44% higher than in 1990 (see Table 112).

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 2005–2012, verified CO_2 emissions reported under the ETS were used for the inventory.

The methodology for this emission calculation is the same as in the years before. The reported CO_2 emission data is based on detailed data of each of the seven lime production plants in Austria, including production volumes and the respective CaO and MgO contents of lime produced in the respective plant.

For the years from 2005 onwards, detailed, verified data from the ETS is available: some plants calculate emissions based on raw material data, most calculate emissions from lime produced; thus the activity data reported under the ETS for some plants is production volumes, others report the amount of raw materials used. For the calculation of an overall IEF, the overall value of Austrian lime production as reported by the *Association of the Stone & Ceramic Industry* is used.

The IEF depends on the quality ($CaCO_3$/$MgCO_3$ content) of the limestone used; it ranges between 0.73 and 0.77 tonnes CO_2 per tonne lime produced – which corresponds to the default range for purity of high calcium lime of 93–98%.

Lime is also used in the process of sugar purification. In Austria, two sugar processing plants are in operation, owned by the same company and integrated in the EU ETS. In these plants, limestone is converted into lime, using coke as fuel. All CO_2 resulting from decarbonising of limestone and combustion of coke is collected in a closed system and transferred to the purification unit. In fact, coke is used as a fuel specifically to maximise the amount of CO_2 available for the internal process.

In the sugar purification unit, lime is added to the raw sugar solution and, in a subsequent step, all CO_2 collected during decarbonisation is injected into the solution. In this step, CO_2 and lime react to limestone, which is sedimented and collected (see Figure 23).

At this point, excess CO_2 leaves the system. It has to be noted that this excess CO_2 corresponds to the amount of CO_2 from coke combustion, which is reported as combustion emission in the energy sector. The share of CO_2 originating from lime production is contained in the sedimented limestone and no lime leaves the system.

The solid mixture leaving the system contains limestone, but also organic substances and minerals (WASNER 2009). This mixture (known as "Carbokalk") is used as a fertilizer.

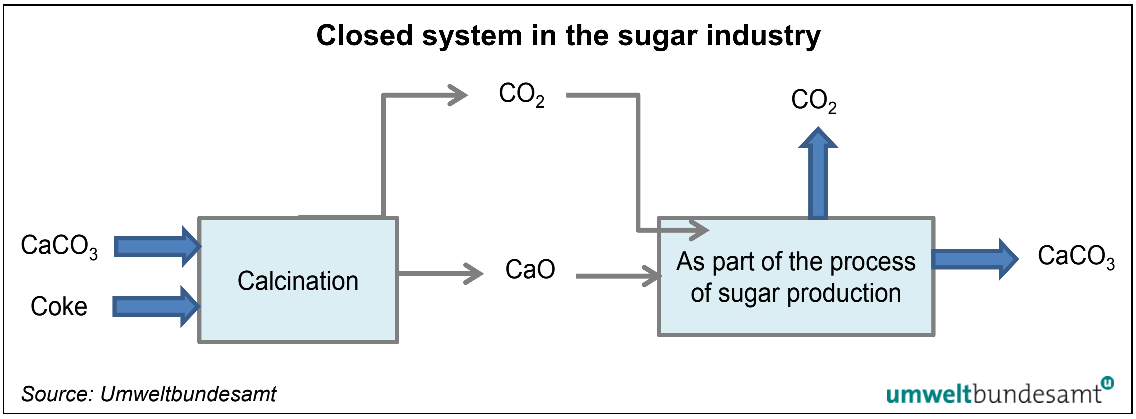

Figure 23: Lime production and reaction of CO_2 and lime back to limestone in a closed system in the sugar industry.

In addition, there is non-marketed lime production in the chemical industry in Austria that is reported under category 2.A.3. CO_2 emissions from the lime production step in calcium carbide production are included in category 2.B.4. 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.

4.2.2.3 Source specific QA/QC

The emission values for 2005 onwards are verified under the EU ETS. IEFs are compared with IPCC default values. The *Association of the Stone & Ceramic Industry* reported total CO_2 emissions, which were compared to ETS data.

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%.

To address the possibility of non-identified, non-marketed lime production (see section 4.2.2.2, above), a systematic uncertainty of plus 15% is added to the previously mentioned random uncertainty of 5%.

Uncertainties for activity data are considered to be low as they are based on plant specific data of all Austrian plants, we assumed 1.6%.

This leads to a combined uncertainty of 20.6%.

4.2.2.5 Recalculations

Activity and emission data were updated based on information available from the Association of the Stone & Ceramic Industry, resulting in slightly lower emissions in the years 2002 (−3.78 kt CO_2), 2003 (−5.01 kt CO_2) and 2004 (−5.99 kt CO_2). For the year 2006, a transcription error was corrected, also resulting in lower emissions (−16.03 kt CO_2) for that year.

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

4.2.3.1 Source Category Description

Emissions: CO_2

Key Source: Yes (CO_2)

CO_2 emissions from limestone and dolomite use are a key category because of their contribution to the total inventory's level for the year 2012. In 2012, emissions from this category contributed 0.3% to the total amount of greenhouse gas emissions in Austria (see Table 108).

In this category, CO_2 emissions from decarbonising of limestone in the iron and steel industry and from limestone use for desulphurization in power plants, chemical and other industry are considered. CO_2 emissions from decarbonising of limestone and dolomite in glass industry are accounted for in *2.A.7.c* Glass Production.

GHG emissions from this category are 26% higher in 2012 compared to 1990. This is mainly due to increased limestone use in the iron and steel industries.

Table 113: Activity data and CO_2 emissions from limestone and dolomite use 1990–2012.

Year	CO_2 emissions (Iron & steel industry) [Gg]	Limestone Used (Iron & steel industry) [t/a]	CO_2 emissions Desulfurisation [Gg]	Limestone Used (Desulfurisation) [t/a]	CO_2 emissions (total) [Gg]
1990	182	413 280	21	48 647	203
1991	182	413 040	21	48 647	203
1992	162	368 880	23	53 247	186
1993	162	368 400	23	53 247	186
1994	175	398 400	24	54 065	199
1995	205	466 560	25	56 767	230
1996	181	411 840	25	56 767	206
1997	210	476 640	25	56 767	235
1998	220	499 191	25	56 767	245
1999	201	456 959	25	56 767	226
2000	233	528 643	25	56 767	258
2001	225	511 150	25	56 767	250
2002	247	560 799	25	56 767	272
2003	247	561 209	25	56 767	272
2004	257	583 276	25	56 767	282
2005	244	561 797	27	61 961	271
2006	237	551 117	38	87 010	275
2007	252	582 971	28	65 391	280
2008	255	590 632	26	58 505	281
2009	201	466 405	21	48 112	222
2010	275	633 632	19	43 036	294
2011	250	580 292	17	39 747	268
2012	241	563 083	15	33 642	256

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 up to 2004, activity data was estimated using a ratio of limestone used per tonne of pig iron produced, which had been obtained as an average for the years 1998–2002.

For 2005–2012, verified CO_2 emissions and activity data, reported under the ETS, were used for the inventory. These data cover limestone use in the iron and steel and chemical industry. The use of limestone in chemical industry is included in the inventory since 2005. Under the ETS, plant operators calculate the emissions on the basis of the Austrian Monitoring, Reporting and Verification Ordinance[3]. The important part is §8(2) which defines the calculation-based approach as the methodology to be used. Annex 2 (7) provides the relevant TIERs for this approach.

Activity data for limestone used for desulphurization were taken from a national report on desulphurization technologies in Austria (WINDSPERGER & HINTERMEIER 2002). The time series was constructed with the help of plant specific SO_2 emission declarations from the Austrian steam boiler database.

For calculation of CO_2 emissions, the IPCC default emission factors of 440 kg CO_2/t limestone and 477 kg CO_2/t dolomite were used. From 2005 onwards, ETS background data provided more detailed information on the actual carbon content of the limestone and dolomite used. Therefore, the IEFs from 2005 onwards are slightly different to the IPCC default values.

4.2.3.3 Source specific QA/QC

The country specific EFs for limestone were compared with the IPCC default range, they deviate from the IPCC default in the range of 1–2%, depending on the actual composition and fractional purity of limestone used.

For the sectors *2.A.1*, *2.A.2*, *2.A.3*, *2.A.4*, *2.A.7* and *2.B.4,* several sector specific QA/QC procedures are carried out in order to deliver accurate emission data (avoid missing emissions as well as double-counting) from limestone/dolomite use in Austria:

a) For 2005–2012, verified CO_2 emission and activity data, reported under the EU ETS, were used for the inventory.
b) Emissions were estimated using the methodology and – for comparison – the default emission factor of the IPCC guidelines.
c) It was checked whether data cover all industrial activities of this type in Austria.
d) Validations were carried out based on mass flow balance and comparison with plant specific data (directly reported and/or environmental report), data from national statistics and/or associations (Association of the Austrian Cement Industry, Association of the Stone & Ceramic Industry and Association of Glass Industry) as well as with information from relevant studies (e.g. HACKL & MAUSCHITZ 1995, 1997, 2001, 2003, MAUSCHITZ 2004, 2008, 2009, 2010; 2011, 2012, WINDSPERGER & HINTERMEIER 2002, WINDSPERGER & TURI 1997).

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

4.2.3.4 Uncertainty Assessment

According to the IPCC GPG (Table 3.4) the uncertainty of the CO_2 emission factor is ±2%. This derives from the uncertainty about the composition and fractional purity of limestone in $CaCO_3$ (or of dolomite in $CaCO_3 \cdot MgCO_3$) per tonne of total raw material. Uncertainty of activity data derives mainly from omission of limestone and dolomite use in unidentified industries. For limestone, the uncertainty range is assumed to be plus 20% and minus 10%, as the use in iron and steel industry covers the major part and this is included. This approach results in a combined uncertainty of emissions of 20.1% (based on plus 20% for 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: *CO_2*

Key Source: *No*

In Austria, soda ash is *produced* by the Solvay process only which is CO_2-neutral except for coke used for calcination of limestone. This coke used in soda ash production was considered as fuel in the energy sector (subcategory *1.A.2.c*).

CO_2 emissions from soda ash *use* occur in metallurgy and other industries. CO_2 emissions from soda ash used in glass production are included in *2.A.7.c* Glass Production.

In 2012, CO_2 emissions from soda ash use contributed 0.02% to total GHG emissions in Austria. The following table presents CO_2 emissions from this category.

Table 114: Activity data and CO_2 emissions for soda ash use 1990–2012.

Year	CO_2 emissions [Gg]	Soda ash 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
2000	8	18 247
2001	7	16 195
2002	8	18 533
2003	8	19 876
2004	16	37 552
2005	13	30 208

Year	CO_2 emissions [Gg]	Soda ash used [t/a]
2006	12	29 241
2007	11	27 489
2008	10	24 814
2009	9	22 269
2010	10	23 325
2011	11	27 234
2012	14	33 585

4.2.4.2 Methodological Issues

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

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 - 2012. 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 CO_2 emission calculation.

4.2.4.3 Recalculations

No recalculations have been required for this years´ submission.

4.2.5 Asphalt Roofing (2.A.5) and Road Paving with Asphalt (2.A.6)

Emissions previously reported under these categories resulted from asphalt roofing production and bitumen production as well as pre-painting before the asphalt roofing or road paving activity. However, these emissions are already accounted for in the solvents sector, therefore emissions are reported as included elsewhere „IE".

4.2.6 Mineral Products – Other (2.A.7)

4.2.6.1 Source Category Description

In this category, bricks (decarbonising) and magnesia sinter and glass (decarbonising) production are addressed.

4.2.6.2 Bricks Production

Emissions: CO_2

Key Source: *No*

This category includes CO_2 emissions from the production of bricks where CO_2 is generated through decomposition of the carbonate content of the raw materials.

Table 115 presents CO_2 emissions from bricks production for the period from 1990 to 2012. CO_2 emissions from bricks production showed a maximum in 1995/1996, which coincided with a peak in brick production. In 2012, emissions from this category contributed 0.1% to total greenhouse gas emissions in Austria.

Methodological Issues

No IPCC methodology is available for this source.

Emission values for the years 1998–2001 were reported by the *Association of the Stone & Ceramic Industry*. The reported CO_2 emission data is based on data of the different brick production sites in Austria, also considering the carbonate contents of raw materials used for bricks production at the respective plants. For 2005–2012, verified CO_2 emissions, reported under the ETS, were used for the inventory. These data cover the complete 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 prior to 1998 were calculated and the IEF of 2001 was used to calculate emissions of 2002 to 2004.

Table 115 presents activity data for production of bricks and CO_2 emissions for this category for the period from 1990 to 2012.

Table 115: Activity data and CO_2 emissions for bricks production 1990–2012.

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
2011	99	2 371 494	41.58
2012	93	1 749 297	53.26

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.

Variations in the implied emission factor over time can also be attributed to changes in the carbon content of the raw material. For example, in 2010 and 2011, raw material (loam) with lower carbon content was used (verified by chemical analysis: loss on ignition), resulting in a lower average implied emission factor for these two years.

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 emissions from magnesia sinter production are a key category due to their contribution to total emissions in the base year and in 2012 and also with regard to the trend assessment. In 2012, this category contributed 0.4% to the total amount of greenhouse gas emissions in Austria (see Table 108).

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 116 presents CO_2 emissions from production of magnesia sinter for the period from 1990 to 2012. CO_2 emissions from magnesia sinter plants vary over the period from 1990 to 2012, with an overall decreasing trend. 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. For example, magnesia sinter production showed a distinct dip in 2009 due to the economic crisis.

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 2005–2012, verified CO_2 emissions, reported under the ETS, were used for the inventory.

Emissions are calculated according to "calculation method B: alkali oxides" in Annex II of the EU ETS monitoring and reporting guidelines[41]. The composition of the oxides is measured using X-ray fluorescence analysis.

Table 116 presents activity data and CO_2 emissions from this category for the period from 1990 to 2012.

Table 116: CO_2 emissions from magnesia sinter production 1990–2012.

Year	CO_2 Emissions [Gg]	Magnesite [t]	IEF [kg CO_2/t magnesite]
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
2011	345	710 573	486
2012	305	625 259	488

Source specific QA/QC

The calculation is based on a recognised European standard method. Order of magnitude and time-series checks are performed. The operator is contacted in case of inconsistencies. The operator reported total CO_2 emissions, which were compared with EU ETS data and found to accord.

[41] Commission Decision 2004/156/EC of 29 January 2004 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.

Uncertainty Assessment

The uncertainty of the emission factor equals 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 year's submission.

4.2.6.4 Glass Production

Emissions: CO_2

Key Source: *no*

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

Methodological Issues

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

For calculation of CO_2 emissions from 1990 to 2004, the IPCC default emission factors of 415 kg CO_2/t soda ash, 440 kg CO_2/t limestone and 477 kg CO_2/t dolomite were used. Starting with 2005, EU ETS background data provided more detailed information on the actual carbon content of the carbonates used. Therefore, the IEFs from 2005 onwards are slightly different compared to the IPCC default values.

Activity data for limestone, dolomite and soda ash 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 tonne 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 1970s.

For 2005–2012, verified CO_2 emissions and activity data, reported under the ETS, were considered for the inventory. These data cover small amounts of other carbonates used in glass industry that have been included from 2005 onwards.

Table 117 presents activity data and CO_2 emissions from this category for the period from 1990 to 2012. To increase transparency (in response to a question in the course of the UNFCCC review 2012) data on glass production was added.

The lower input of soda ash in 2011 and 2012 was compensated by the use of flinders of an equivalent of 5kt soda ash.

Table 117: CO_2 emissions and carbonate use in glass production 1990–2012.

Year	Glass Prod. [t]	Limestone [t]	Dolomite [t]	Soda ash [t]	Other Carbonates [t]	CO_2 Emissions [Gg]
1990	398 515	17 449	24 020	46 690		39
1991	458 666	20 082	27 646	53 737		44
1992	405 863	17 770	24 463	47 551		39
1993	406 222	17 786	24 485	47 593		39
1994	434 873	19 040	26 212	50 950		42
1995	435 094	19 050	26 225	50 975		42
1996	435 094	19 050	26 225	50 975		42
1997	405 760	17 766	24 457	47 539		39
1998	405 760	17 766	24 457	47 539		39
1999	445 069	19 487	26 826	52 144		43
2000	375 348	16 434	22 624	43 976		36
2001	440 865	19 303	26 573	51 652		43
2002	389 497	17 054	23 477	45 633		38
2003	476 901	20 892	30 368	45 263		42
2004	356 702	15 178	19 208	28 559		28
2005	417 685	21 163	21 241	36 876	2 467	35
2006	448 176	21 103	23 405	38 814	2 673	37
2007	496 709	23 632	24 914	41 539	2 577	40
2008	504 213	25 852	28 411	45 186	1 741	44
2009	442 515	24 757	26 817	40 731	1 153	41
2010	498 156	23 841	26 082	40 527	1 276	40
2011	474 222	22 168	24 358	35 766	1 010	36
2012	472 040	20 364	26 218	34 328	609	37

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

No recalculations have been required for this year's submission.

4.3 Chemical Industry (CRF Source Category 2.B)

4.3.1 Ammonia Production (2.B.1)

4.3.1.1 Source Category Description

Emissions: *CO_2 and CH_4*

Key source: *Yes (CO_2)*

CO_2 emissions from production of ammonia are a key category due to their contribution to total greenhouse gas emissions in Austria in the base year and in 2012. In 2012, this category contributed 0.6% to Austria's total greenhouse gas emissions (see Table 108).

Ammonia (NH_3) is produced by catalytic steam reforming of natural gas or other light hydrocarbons (e.g. liquefied petroleum gas, naphtha) – in Austria, natural gas is used. By way of these processes, the feedstock is reformed with steam in a heated primary reformer and subsequently with air in a second reformer in order to produce the synthesis gas. CO_2 is produced by stoichiometric conversion and is mainly emitted during the primary reforming step (Umweltbundesamt 2001f).

Ammonia is produced at one plant in Austria. The following process chart (Figure 24) shows the scheme of ammonia synthesis and downstream processes at the integrated plant: the main production lines (ammonia, urea, melamine, nitric acid, fertiliser etc.) with their main raw material as well their internal subsequent processing of related products.

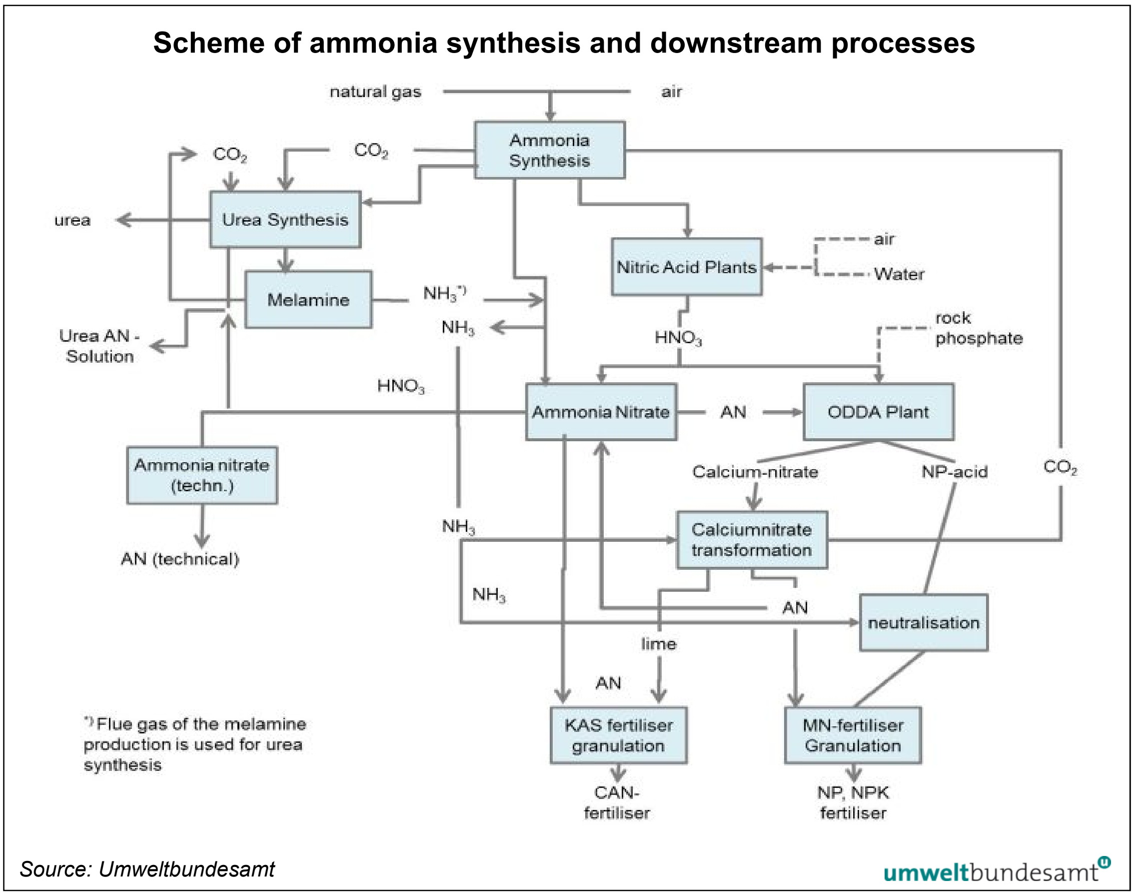

Figure 24: Scheme of ammonia synthesis and downstream processes at Austria's integrated ammonia plant.

Approximately half of the methane introduced in the synthesis is CH_4 that is generated in the so called methanator: small amounts of CO and CO_2, remaining in the synthesis gas, are harmful for the ammonia synthesis catalyst and have to be removed by conversion to CH_4 in the methanator. The other half consists of 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 118 presents CO_2 and CH_4 emissions from ammonia production as well as ammonia production figures and natural gas input for the period from 1990 to 2012.

Emissions vary during the period and closely follow the trend in ammonia production. CO_2 emissions reach a first minimum in 1994, a second in 2001, a third in 2007 and a fourth in 2009, all due to low production figures. In 2007 and 2009, production figures are low due to a lower demand as raw material for the production of fertilizers. In 2012, CO_2 emissions are 8% higher than in the base year.

4.3.1.2 Methodological Issues

Activity data (ammonia production and natural gas input) for the whole time series and CH_4 emission data from 1994 onwards were reported directly to the Umweltbundesamt by the only ammonia producer in Austria and thus represent plant specific data. The composition of the synthesis gas is measured regularly.

CH_4 emissions are calculated from the measured synthesis gas composition and the number and duration of start-ups. The implied emission factor for CH_4 that was calculated from activity and emission data from 1994 was applied to calculate emissions of the years 1990 to 1993 as no emission data was available for these years.

CH_4 emission factors of ammonia plants largely depend 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 needs a prolonged start up procedure resulting in an increase of the IEF.

CO_2 emissions are calculated from natural gas input – Tier 2 method of the IPCC guidelines – with an emission factor of 55.4 t/TJ. Natural gas is the only carbon input for the ammonia synthesis and its downstream processes. Plant-specific natural gas data are available for the whole time series. The total carbon input equals the total carbon output, consisting of the following components:

- CO_2 emissions from ammonia production
- Fugitive CH_4 emissions during start-ups of the ammonia production
- CO_2 emissions from nitric acid production (downstream process at the same site). These emissions are reported under CRF category *2.B.2,* see section 4.3.2, below).
- CO_2 and CH_4 emissions from urea production at the same site that both derive directly from ammonia. These emissions are reported under CRF category *2.B.5*, see section 4.3.4, below).
- CO_2 emissions from fertilizer production (downstream process at the same site). These emissions are reported under CRF category *2.B.5,* see section 4.3.4, below).
- Carbon stored in melamine.[42]

[42] According to the IPCC guidelines no account should be taken for intermediate binding of CO_2 in downstream manufacturing processing and products. Nevertheless in the Austrian ammonia production facility melamine is produced, 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.

Consequently, CO_2 emissions from ammonia production were calculated by subtracting the outputs under bullet points number 2 to 6, above, from the overall carbon input.

Table 118 shows relevant parameters for the calculation of CO_2 emissions from ammonia production. The resulting CO_2 IEF (with respect to ammonia) decreases over time because of increasing melamine production.

Table 118: Activity data, emissions and implied emission factor for ammonia production 1990–2012.

Year	Ammonia produced [t]	Natural gas input [TJ]	Carbon stored [Gg C]	CO_2 Emissions [Gg]	IEF [kg CO_2/ t Ammonia]	CH_4 Emissions [Mg]
1990	461 000	10 193	13.6	472	1 024	62.2
1991	475 000	10 441	10.4	498	1 048	64.1
1992	432 000	9 528	11.2	448	1 037	58.3
1993	469 000	10 321	10.2	500	1 065	63.3
1994	444 000	9 882	13.1	476	1 072	59.9
1995	473 000	10 516	12.2	517	1 093	61.2
1996	484 772	10 779	15.7	520	1 073	59.1
1997	479 698	10 666	15.8	514	1 072	81.1
1998	484 449	10 550	15.9	506	1 045	102.0
1999	490 493	10 689	15.9	513	1 046	54.8
2000	482 333	10 548	17.2	499	1 035	60.0
2001	448 176	9 989	21.2	455	1 015	51.0
2002	464 028	10 380	23.3	465	1 001	68.8
2003	510 887	11 324	26.6	504	987	47.3
2004	510 024	11 364	27.1	505	990	56.4
2005	478 427	10 719	25.7	474	992	93.9
2006	502 286	11 399	25.9	509	1 013	105.1
2007	441 299	10 015	23.4	447	1 014	140.6
2008	489 131	11 137	24.4	501	1 024	87.7
2009	449 395	10 214	23.1	464	1 032	70.9
2010	495 353	11 248	22.9	512	1 033	69.5
2011	502 461	11 347	19.6	530	1 054	76.6
2012	479 475	10 881	17.2	511	1 066	76.3

4.3.1.3 Source specific QA/QC

The emission factor for natural gas is consistent with the emission factor used in fuel combustion. Natural gas input from the energy balance was checked for plausibility with ammonia production figures using the conversion factor 0.451 t natural gas per tonne ammonia. This factor is plant specific and derived from natural gas input and ammonia output.

4.3.1.4 Uncertainty assessment

As activity data are obtained from the only ammonia plant in Austria, 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

In response to a finding of the 2013 in-country-review, all carbon inputs and outputs of Austria's integrated ammonia plant were reviewed. As CO_2 emissions from fertilizer production and nitric acid production are reported under the respective subcategories, they were subtracted from CO_2 emissions reported under ammonia production, in order to avoid double counting. This approach resulted in lower CO_2 emissions in the order of 20 to 40 Gg per year for the whole time series (see Figure 25).

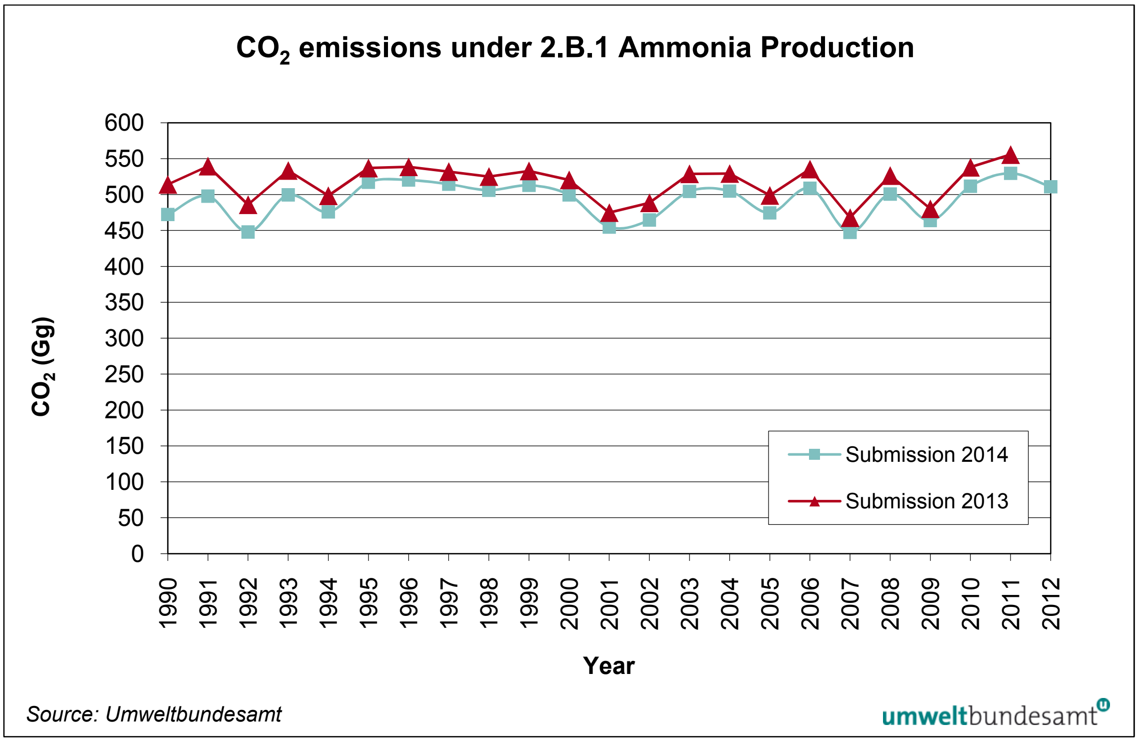

Figure 25: CO_2 emissions reported under category 2.B.1 Ammonia Production.

4.3.2 Nitric Acid Production (2.B.2)

4.3.2.1 Source Category Description

Emission: N_2O, CO_2

Key Source: Yes (N_2O)

N_2O emissions from nitric acid production are a key source due to their contribution to total greenhouse gas emissions in Austria in the base year and in terms of their trend. In 2012, they contributed 0.07% to the total amount of greenhouse gas emissions in Austria, down from 1.2% in 1990.

Nitric acid (HNO_3) is manufactured from ammonia (NH_3). In a first step, NH_3 reacts with air to NO and NO_2 and is then transformed with water to HNO_3.

Ammonia used as feedstock (gaseous or liquid) in the nitric acid plant always contains small amounts of methane, which is dissolved in ammonia. By burning ammonia on an alloy catalyst – which is the basis of the nitric acid process – a small amount of CO_2 is produced and leads to CO_2 emissions in the tail gas.

In Austria there is only one producer of nitric acid which operates two different dual pressure plants at one site. So called weak nitric acid is produced with a concentration of 59.6% HNO_3 by oxidation of ammonia produced at the same location (Umweltbundesamt 2001f). There is no production of concentrated nitric acid in Austria. Nitric acid is mainly used for the production of fertilisers.

Table 119 presents N_2O and CO_2 emissions from production of nitric acid for the period from 1990 to 2012.

N_2O emissions follow the trend of nitric acid production for the period 1990 to 2000 with only minor fluctuations. The increasing IEF between 1993 and 1994 is due to the closing down of part of a production facility that contributed to total emissions with lower specific N_2O emissions per produced unit of HNO_3. In 2007 and 2008 the IEF slightly increased again due to changes in the combustion system of one plant.

The decrease of the IEF is due to the introduction of emission reduction measures:

- 2001: installation of a new catalyst (IEF decreased from an average of 5.7 kg N_2O/t nitric acid to approx. 5.0 kg N_2O/t nitric acid)
- 2004: installation of a N_2O decomposition facility[43] called Uhde process (Envinox® process) for the combined removal of N_2O and NO_x from the tail gas of nitric acid plants. The IEF decreased from an average of 5.0 kg N_2O/t nitric acid, to approx. 1.6 kg N_2O/t nitric acid.
- May 2009: installation of a second catalyst in the nitric acid plant
- 2010: full operation of the second catalyst
- 2011 further optimisation of the production process as well as slightly reduced activities

The increase of the IEF (increase of N_2O emissions despite lower activities) in 2012 can be attributed to a combination of various reasons with the last option being the predominant one:

- Reduced activity of the catalyst over time
- Reduced activity of the catalyst at lower productivity
- Emissions dependent on which of the two plants was in operation as their N_2O emissions differ

In 2012, N_2O emissions were 94% below the emissions in the base year.

CO_2 emissions also varied over the period from 1990–2012, closely following the trend of nitric acid production until 1999. Specific emissions decreased since 2000 due to process optimisation (see implied emission factors in Table 119).

4.3.2.2 Methodological Issues

Following the IPCC Guidelines and monitoring and reporting guidelines[44] for the European Emission trading scheme (ETS), plant specific measurement data was collected.

Activity and N_2O emission data was obtained directly from the plant operator. From 1998 onwards, emissions are measured continuously using a calibrated concentration monitor and volumetric flow meter. The monitoring method remained unchanged over time. Based on the

[43] This facility is documented as example in BAT Reference Document LVIC-AAF, section 3.4.7 (EUROPEAN COMMISSION, 2007)

[44] Commission Decision 2007/587/EC 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.

analysed emission data of 1998 and due to the fact that the production technology has not changed between 1990 and 1998, emission factors per tonne of product were calculated for the technologies used (nitric acid has been produced at one site in five types of plants with different technologies over the years – with some of the plants closed or refurbished; currently two are in operation). With these estimates of plant specific emission factors and the production volume of the individual plants, the total emissions of N_2O per year were calculated.

Activity and emission data of CO_2 emissions from the years 1994 onwards have been reported directly to the Umweltbundesamt by the plant operator and thus represent plant specific data. CO_2 emissions are measured discontinuously in the exhaust gas flow. The implied emission factor that was calculated from activity and CO_2 emission data from 1994 was applied to calculate CO_2 emissions of the years 1990 to 1993 as no CO_2 emission data was available for these years.

Table 119: Activity data, emissions and implied emission factors for N_2O and CO_2 from nitric acid production 1990–2012.

Year	Nitric acid produced [t]	N_2O emissions [t]	CO_2 emissions [t]	IEF N_2O [kg/t]	IEF CO_2 [kg/t]
1990	529 998	2 942	413	5.55	0.78
1991	534 910	2 991	417	5.59	0.78
1992	484 731	2 702	378	5.57	0.78
1993	513 224	2 835	400	5.52	0.78
1994	467 391	2 662	365	5.70	0.78
1995	484 016	2 765	368	5.71	0.76
1996	495 738	2 820	376	5.69	0.76
1997	489 376	2 783	358	5.69	0.73
1998	504 977	2 893	381	5.72	0.75
1999	512 797	2 979	398	5.81	0.78
2000	533 715	3 070	370	5.75	0.69
2001	510 800	2 537	362	4.97	0.71
2002	522 410	2 604	366	4.98	0.70
2003	558 226	2 850	405	5.11	0.73
2004	572 719	906	409	1.58	0.71
2005	557 870	884	410	1.59	0.74
2006	579 623	904	420	1.56	0.72
2007	499 402	871	355	1.74	0.71
2008	561 749	1 051	397	1.87	0.71
2009	495 711	534	347	1.08	0.70
2010	547 699	205	400	0.37	0.73
2011	542 289	154	399	0.28	0.74
2012	534 641	170	393	0.32	0.74

4.3.2.3 Source specific QA/QC

Measurements are done by an accredited testing body with internationally recognized standard methods. In the Austrian Ordinance regarding Monitoring and Reporting of Greenhouse Gas Emissions[45], the requirements for laboratories carrying out the analysis are described in § 15 and in Annex 2, section 5 the methods for determination of the flue gas are described.

[45] Überwachungs-, Berichterstattungs- und Prüfungsverordnung, Federal Law Gazette II No. 339/2007, as amended

Furthermore at Austrian plants, continuous measurements of N_2O and NO_x are state-of-the-art technology and the emission values are forwarded online to the local authority.

Order of magnitude and time-series checks are performed and the operator is contacted in case of inconsistencies.

Further QA/QC checks:

- Comparison with BAT
  - Modern M/H-type plant complies with BAT
  - For older L/M-type plants no BAT conclusions have been drawn
- Comparison with international studies: ENTEC UK LIMITED (2006) page 15 and ECOFYS et al. (2009)

4.3.2.4 Uncertainty assessment

According to WINIWARTER (2007), uncertainty of N_2O emissions is mainly affected by EF uncertainty (20%). The EF uncertainty is based on a national study from the beginning of the 1990s and is considered to be valid for base year emissions. For recent years, an uncertainty of 5% was considered to be more appropriate because the analyses of N_2O concentrations changed from discontinuous measurements to online spectroscopic measurements.

4.3.2.5 Recalculations

No recalculations have been required for this year's submission.

4.3.3 Calcium Carbide Production (2.B.4)

4.3.3.1 Source Category Description

Emission: CO_2

Key Source: No

Calcium carbide is produced by producing lime from calcium carbonate and subsequently reducing the lime obtained with carbon – both steps lead to emissions of CO_2.

This category is a minor source of CO_2 emissions in Austria. In 2012, it contributed 0.06% to national total emissions.

4.3.3.2 Methodological Issues

Activity data were directly reported by the plant operator of the only carbide production plant in Austria.

Emissions were estimated using a country specific methodology. An emission factor of 1.2957 t CO_2/t carbide obtained from industry was applied. It was obtained by summing up the emission factors for the lime production and the reduction step:

- Emission factor for the lime production step: 0.7153 t CO_2/t carbide produced
- Emission factor for the reduction step: 0.5804 t CO_2/t carbide produced

Table 120: Activity data and CO_2 emissions from calcium carbide production 1990–2012.

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
2011	38 155	49
2012	37 606	49

4.3.3.3 Recalculations

No recalculations have been required for this year's submission.

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

4.3.4.1 Source Category Description

Emission: CH_4, CO_2

Key Source:No

This category includes CH_4 and CO_2 emissions from the production of urea and from the production of fertilizers (NPK as well as calcium ammonium nitrate). There is only one producer of urea in Austria; it is also the main producer of fertilizers in Austria.

This category is a minor GHG emission source in Austria: in 2012, total emissions from this category contributed 0.04% to national total emissions.

CO_2 emissions varied over the reporting period, following the trend of fertilizer production. They first decreased, reaching a minimum in 1997 and since then increased again. In 2012, emissions from this category are 9% lower than in 1990 (see Table 121).

The high CO_2 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 NH_3 and CO_2; the latter is a by-product of ammonia production. In urea production, CO_2 is emitted at start-ups of the process and emissions are calculated from the number and duration of start-ups. The ammonia stream entering the process contains a small amount of non-reacted CH_4 that is released when NH_3 reacts to urea. These CH_4 emissions are calculated from the ammonia input into the urea production process and the methane content of the ammonia stream.

CH_4 emissions from the production of urea were reported for the years 2002–2012. For earlier years, no data is available; therefore the implied emission factor for the year 2002 was used for all years. CO_2 emissions are reported by the operator since 1995. The IEF from this year was applied to calculate emissions for previous years.

Data for fertilizer production for 1990 to 1994 were taken from national statistics (STATISTIK AUSTRIA), for 1995 to 2012, production data were reported directly by the main producer of fertilizers in Austria.

Emission data for CO_2 emissions from the production of fertilizers for 1994 to 2012 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 to the years 1993 to 1990. CO_2 emissions from fertilizer production were calculated using a mass-balance approach.

CH_4 emissions from the production of fertilizers were reported for the years 2002–2012; these data became available due to a measurement programme for CH_4 at the plant starting in 2002. For earlier years, no data is available; therefore the implied emission factor for the year 2002 was used for these years.

Table 121 presents activity data, emissions and implied emission factors for CH_4 and CO_2 emissions from *Fertilizer Production* and *Urea Production* for the period from 1990 to 2012.

Table 121: Activity data, emissions and implied emission factors for CO_2 and CH_4 from NPK fertilizer production and urea production 1990–2012.

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	1 388 621	30.26	21.79	183.5
1991	295 000	0.29	113	1 273 467	27.75	21.79	168.3
1992	259 000	0.25	100	1 182 595	37.75	31.92	156.3
1993	305 000	0.30	117	1 250 804	33.53	26.81	165.3
1994	360 000	0.35	138	1 222 578	22.27	18.22	161.6
1995	393 000	0.40	151	916 265	19.55	21.34	121.1
1996	417 705	0.30	161	940 313	18.07	19.22	124.3
1997	392 017	0.35	151	924 856	17.22	18.62	122.2
1998	395 288	0.29	152	977 212	18.68	19.12	129.2

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]
1999	408 386	0.24	157	988 662	19.65	19.88	130.7
2000	390 185	0.22	150	1 022 983	20.59	20.13	135.2
2001	367 218	0.26	141	959 698	19.75	20.58	126.9
2002	389 574	0.35	150	1 013 767	23.61	23.29	134.0
2003	447 450	0.18	163	1 073 940	24.07	22.41	134.0
2004	442 252	0.14	166	1 090 069	24.03	22.05	126.0
2005	416 407	0.21	156	1 043 916	23.94	22.93	148.6
2006	429 243	0.22	162	1 092 182	26.32	24.10	149.4
2007	384 402	0.43	144	892 680	20.16	22.58	118.2
2008	419 711	0.34	157	1 042 098	25.41	24.38	137.9
2009	400 420	0.29	151	859 852	16.13	18.75	120.3
2010	419 997	0.49	156	1 051 087	26.03	24.76	139.9
2011	426 861	0.26	160	1 058 249	25.75	24.33	137.9
2012	421 659	0.22	156	1 034 833	27.54	26.61	136.5

4.3.4.3 Recalculations

No recalculations have been required for this year's submission.

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

4.3.5.1 Source Category Description

Emission: CH_4

Key Source: No

Ethylene is produced by steam cracking of petrochemical feedstock. This production process leads to fugitive methane emissions. This category is a minor source of CH_4 emissions in Austria; in 2012, 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 equal to the capacity of the only ethylene producing plant in Austria and amount to 350 000 t ethylene per year until 2005. In 2006, the capacity of the ethylene plant was expanded to 500 000 t. The IPCC default emission factor of 1 g CH_4/kg ethylene produced was used to calculate the emissions that amount to 350 tonnes CH_4 until 2005 and 500 tonnes CH_4 from 2006 onwards.

4.3.5.3 Recalculations

No recalculations have been required for this year's 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: CO_2, CH_4

Key Category: Yes (CO_2)

CO_2 emissions from iron and steel production are an important key category of the Austrian greenhouse gas inventory because of their contribution to the total emission level for the base year and for 2012 and in terms of their trend. In the year 2012, CO_2 emissions from production of iron and steel contributed 6.8% to total greenhouse gas emissions in Austria (see Chapter 1.5).

CH_4 emissions from this category contributed 0.002% to national total emissions (in CO_2 equivalent) in 2012.

In Austria, iron and steel production is concentrated at two integrated sites operated by the same company. It is the only company operating blast furnaces in Austria. Additionally there are companies operating electric arc furnaces, contributing approx. 10% to total steel production in Austria.

In this category, process specific CO_2 emissions are reported only. Emissions due to combustion in iron and steel industry are reported in the energy sector (Category *1.A.2.a*).

Process specific CO_2 emissions result from the use of reducing agents in pig iron production (in blast furnaces) and in steel production (consumption of electrodes in electric arc furnaces). In steel production, CO_2 emissions also result from the lowering of the carbon content of the input material (pig iron or steel scrap).

CH_4 emissions from rolling mills and from electric arc furnaces are also reported in this category.

Table 122 presents total CO_2 and CH_4 emissions from the production of iron and steel for the period from 1990 to 2012. CO_2 emissions from *Iron and Steel Production* decreased from 1990 to 1992, then increased steadily following the trend of pig iron production, until this trend was interrupted by the economic downturn in 2009. In 2012, emissions were 54% above the level of 1990.

Table 122: Total CO_2 and CH_4 emissions from iron and steel 1990–2012.

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	3 734	0.061
2000	4 202	0.068
2001	4 159	0.069
2002	4 609	0.068

Year	CO_2 [Gg]	CH_4 [Gg CO_2 eq]
2003	4 526	0.072
2004	4 448	0.077
2005	4 997	0.079
2006	5 195	0.081
2007	5 484	0.089
2008	5 810	0.090
2009	4 579	0.072
2010	5 461	0.081
2011	5 674	0.087
2012	5 454	0.085

4.4.1.2 Methodological Issues

General Remark

Total CO_2 emissions from the two main integrated iron and steel production sites in Austria were reported directly by industry until 2002. They were calculated by applying a very detailed mass balance approach for carbon. Process specific emissions[46] were estimated by the Umweltbundesamt according to the IPCC good practice guidance; these emissions were subtracted from total CO_2 emissions reported by the company. The remaining emissions are reported in the energy sector as emissions due to combustion in category *1.A.2.a Iron and Steel*.

Thus, some shortcomings of the methodology applied for calculating process specific CO_2 emissions do not have an effect on national total emissions but only on the split between process specific and combustion specific emissions (for example only carbonatious ore was considered for calculating the split of process specific and combustion specific CO_2 emissions from blast furnaces whereas the carbon content of other ore used was not considered; however, the detailed mass balance approach used by the operator does consider all carbon introduced to the process, thus also considering ore other than carbonatious ore).

For the years 2003 and 2004, total CO_2 emissions were not reported by industry, thus they were estimated using information from the national energy balance and from the years before (see below and description of category *1.A.2.a*).

For 2005–2012, verified CO_2 emissions, reported under the ETS, were taken for the inventory, which constitutes a similar – slightly more detailed – approach as for the years before. The ETS data cover CO_2 emissions from pig iron, basic oxygen and electric arc furnace steel production.

CO_2 emissions from blast furnace pig iron production

CO_2 emissions were calculated following closely the IPCC GPG guidelines Tier 2 approach, applying the default emission factor of table 3.6 of the IPCC GPG:

*CO_2 Emissions = Mass of reducing agent * 3.1 t CO_2/t reducing agent + (Mass of Carbon in the Ore – Mass of Carbon in the Crude Iron) * 44/12*

[46] Process specific emissions considered are CO_2 emissions resulting from the use of reducing agent in pig iron production in blast furnaces and CO_2 emissions from steel production resulting from the lowering of the carbon content of steel compared to pig iron in basic oxygen furnaces as well as CO_2 emissions from limestone use in blast furnaces. The latter is reported under 2.A.3.

The mass of reducing agent – coke – was taken from the national energy balance (see Annex 4). According to a national study (HIEBLER et al.) 56.3% of coke used in blast furnaces is actually needed as reducing agent, this part is reported as non-energy use in the national energy balance[47].

This non-energy use is used for calculating CO_2 emissions from pig iron production in blast furnaces with the equation presented above, as this is assumed to be more accurate than the approach of the GPG where total mass of reducing agent is considered as non-energy use and the resulting emissions as process specific emissions.

Only carbonatious ore was considered for the calculation as no statistical data was available for the amount of other ore[48] (however, the carbon content of iron oxide is small only). Carbon content of the ore was calculated assuming pure ore, thus the factor used for calculating the mass of carbon in the ore was based on the stochiometric ratio of carbon in $FeCO_3$:

*Mass of Carbon in the Ore = Mass of ore * 12/116*

Mass of ore used in pig iron production for the years 1990 to 1995 was taken from national statistics (statistical yearbook of STATISTIK AUSTRIA), the value of 1995 was also used for 1996 and 1997. From 1998–2002 the mass of ore was directly reported by industry; for 2003 the value of the Steel statistical yearbook 2004 was used (INTERNATIONAL IRON AND STEEL INSTITUTE 2004). The value for 2004 was estimated using pig iron production, multiplied by the mean proportion iron ore/pig iron from the years 2000–2003. The values for 2005–2012 correspond to the background data (for consistency reasons just carbonatious ore) given in the ETS report.

Mass of carbon in pig iron was calculated by applying the IPCC default value of 4% carbon in crude steel.

Pig iron production data for 1990 and 1995 to 2001 was taken from national statistics (statistical yearbook of STATISTIK AUSTRIA), data for 1991 to 1994 was taken from World Steel Association[49], for 2002–2012 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 2005–2012 CO_2 emissions from non-carbonatious ore – calculated by its carbon content – and other additives – including plastics and coal fines used as reducing agents – were taken into account additionally. This information became available from background data reported under the ETS. Again it has to be stressed that this additional accounting does not affect total CO_2 emissions, but only improves the accuracy of the split made between process and combustion specific emissions.

Activity data, calculated CO_2 emission data as well as the implied emission factor for CO_2 emissions from pig iron production are presented in Table 123. The trend in IEF values from pig iron production fluctuates until 2005, because CO_2 emissions follow closely the coke input (more than 91% of CO_2 emissions originate from coke input). Coke input (non-energy-use) from the national energy balance shows a different trend to pig iron production. The reason for this to some extent could be the imperfect separation of total coke input in energy and non-energy use

[47] 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.

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

[49] World Steel Association annual iron production archive, http://www.worldsteel.org/statistics/statistics-archive/annual-iron-archive.html

in the national energy balance and the use of other reducing agents that are not directly allocated. From 2005 onwards, the IEF is quite stable because background data reported under the ETS allowed to account 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 123: Activity data, CO_2 emissions and implied emission factor for pig iron production 1990–2012.

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	992	1 734	3 912	3 160	808
2000	1 125	1 879	4 320	3 568	826
2001	1 113	1 875	4 380	3 518	803
2002	1 252	1 925	4 669	3 927	841
2003	1 201	2 119	4 677	3 841	821
2004	1 178	2 100	4 861	3 736	769
2005	1 332	2 038	5 458	4 188	767
2006	1 358	2 130	5 565	4 368	785
2007	1 360	2 010	5 888	4 600	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	4 623	819
2011	1 286	2 207	5 822	4 808	826
2012	1 266	2 230	5 751	4 602	800

CO_2 emissions from basic oxygen furnace steel production

CO_2 emissions from steel production, which corresponds to steel production at the two integrated sites operating basic oxygen furnaces, were calculated following the IPCC GPG guidelines Tier 2 approach:

*CO_2 Emissions = (Mass of Carbon in the Crude Iron used for Crude Steel – Mass of Carbon in the Crude Steel) * 44/12*

For the years 1990 to 2001, activity data for electric steel production was subtracted from total steel production in Austria taken from national statistics (statistical yearbook of STATISTIK AUSTRIA) to obtain steel production of the two integrated sites operating blast furnaces. For 2002 to 2012, steel production of the two integrated sites operating blast furnaces was directly reported by industry.

The average carbon content of 0.15% for steel was obtained from the operator of the two integrated sites; as mentioned above, the IPCC default value was used for the carbon content of pig iron (4%).

CO_2 and CH_4 emissions from electric arc furnace steel production

Emissions were estimated using a country specific methodology.

CO_2 emissions for the year 2003 have been reported by each electric steel site in Austria. The IEF calculated for this year (52 kg/t steel) was also used to calculate emissions for earlier years and for 2004. For 2005–2012, verified CO_2 emissions, reported under the ETS, were used for the inventory.

The plant operators calculate emissions on the basis of the Austrian Monitoring, Reporting and Verification Ordinance[3]. The important part is §8(3) which defines the mass balance approach as the methodology to be used. Annex 2, (5) provides the relevant Tiers for this approach and the formula regarding carbon content.

The CO_2 emissions and production data are based on data of each of the three electric arc furnace plants in Austria. All CO_2 emissions from electric arc furnaces are allocated in *2.C.1* according to IPCC guidelines. There are no fuel related emissions.

The IEF depends on

- the raw material (carbon content of the used scrap)
- the production process (different processes with more or less input of electrical power and different additions of surcharges)

The increase of the IEF in 2005 is due to a change in the production process in one plant in Austria. The average IEF for the years 2005 to 2012 (approx. 0.075 Gg CO_2 per kt steel) is close to the IPCC default value of 0.08.

For calculating CH_4 emissions, an emission factor of 5 kg CH_4/kt steel was applied, based on WINDSPERGER & TURI (1997). Activity data were obtained from the *Association of Mining and Steel* and represent plant specific data.

CH_4 emissions from rolling mills

Emissions were estimated using a country specific methodology.

The emission factor for VOC emissions from rolling mills (1 kg VOC/kt steel) was reported directly by industry and thus represents plant specific data. It was assumed that VOC emissions are composed of 10% CH_4 and 90% NMVOC.

Activity data as used for calculating CO_2 emissions from steel production (see above) was applied.

Table 124 presents steel and electric steel production, CO_2 and CH_4 emissions and implied emission factors as well as total CO_2 emissions from this category.

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

Table 124: Activity data, emissions and implied emission factors for CO_2 and CH_4 from steel production 1990–2012.

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	123	0.36	361	19	1.80	2.16	450
1993	3 738	430	124	0.37	411	22	2.05	2.43	451
1994	3 968	465	120	0.40	431	23	2.15	2.55	488
1995	4 538	545	115	0.45	454	24	2.27	2.72	569
1996	4 032	481	117	0.40	396	21	1.98	2.38	502
1997	4 718	557	120	0.47	466	25	2.33	2.80	581
1998	4 801	565	119	0.48	503	27	2.51	2.99	592
1999	4 722	548	118	0.47	486	26	2.43	2.90	573
2000	5 183	605	118	0.52	541	29	2.70	3.22	634
2001	5 346	613	116	0.53	546	29	2.73	3.26	642
2002	5 647	654	117	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	116	0.59	614	32	3.07	3.66	713
2005	6 408	763	115	0.64	622	45	3.11	3.75	808
2006	6 487	778	115	0.65	643	49	3.21	3.86	827
2007	6 871	826	119	0.69	708	58	3.54	4.23	884
2008	6 873	820	120	0.69	723	57	3.62	4.30	877
2009	5 077	614	120	0.51	588	42	2.94	3.45	656
2010	6 570	792	119	0.66	637	47	3.19	3.84	839
2011	6 786	817	121	0.68	689	49	3.44	4.12	866
2012	6 746	806	120	0.67	674	46	3.37	4.05	853

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 2005–2012, detailed information on the carbon mass balance applied by the company to calculate total emissions from pig iron and basic oxygen furnace steel were available from the EU ETS. Thus it was possible to validate CO_2 emissions with this background data.

The annual emission reports of the plant covered by the above mentioned ordinance regarding monitoring, reporting and verification of GHG emissions are checked by independent verifiers before submitting to the competent authority. On behalf of the Federal Ministry of Agriculture, Forestry, Environment and Water Management, the Umweltbundesamt conducts spot checks of the annual emissions and verification reports, time series consistency and consistency with monitoring plans.

In addition, the data included in the annual emission reports were checked regarding completeness and plausibility and they were also compared with national and international statistics (Statistic Austria and World Steel association[50]).

4.4.1.4 Uncertainty Assessment

The iron and steel industry is related to the energy sector, as the major share of CO_2 emissions results from the use of fossil fuel as reducing agent. Thus, the same uncertainty values as for solid fuel combustion in large point sources have been applied, namely 0.5% for activity data and 0.5% for emission factor; this leads to an overall uncertainty for CO_2 emissions of 0.7% (WINIWARTER 2007).

4.4.1.5 Recalculations

Revised coke input data became available in the energy balance for the year 2011 leading to lower CO_2 emissions (-95 Gg) for this year.

4.4.1.6 Planned Improvements

An update of the methodology and respectively of the calculations based on the 2006 IPCC guidelines is planned for the next submission.

4.4.2 Ferroalloys Production (2.C.2)

4.4.2.1 Source Category Description

Emissions: CO_2

Key source: No

Ferroalloy production involves a metallurgical reduction process which results in CO_2 emissions.

This category is a minor source of CO_2 emissions in Austria: in 2012, emissions from this source contributeed 0.02% to national total emissions.

4.4.2.2 Methodological Issues

Emissions were estimated using the IPCC Tier 1b methodology.

Activity data of ferro-molybdenum, ferro-vanadium and ferro-nickel production from 1995 to 2010 were taken from publications of the *British Geological Survey* (BRITISH GEOLOGICAL SURVEY 2001, 2005–2010). As no data were available for 1990–1994, the value from 1995 was taken as a proxy for these years. For 2011, data was directly obtained from industry (personal communication) due to the late publication of the relevant report by the British Geological Survey. Similarly, data for 2012 were obtained by personal communication from the British Geological Survey, as the report had not been published at the time of emission calculation.

The emission factor for ferro-nickel of 1.36 t CO_2/t product was taken from SJARDIN (2003) and applied to all ferroalloys as no specific emission factors for ferro-molybdenum and ferro-vanadium were available. Investigations were carried out in order to find adequate emission factors

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[50] World Steel Association statistics archive, http://www.worldsteel.org/statistics/statistics-archive.html

for ferro-molybdenum and ferro-vanadium. However, other countries where the production of ferroalloys is relevant are using country/plant specific emission factors. Therefore the emission factor used at present (based on a company specific report) was maintained.

Table 125: Activity data and emissions from ferroalloys production 1990–2012.

Year	Ferroalloys production [kt]	CO_2 emissions [Gg]
1990	15.3	20.8
1991	15.3	20.8
1992	15.3	20.8
1993	15.3	20.8
1994	15.3	20.8
1995	15.3	20.8
1996	13.8	18.8
1997	14.2	19.3
1998	14.1	19.2
1999	13.9	18.9
2000	13.9	18.9
2001	13.3	18.1
2002	12.6	17.1
2003	12.3	16.7
2004	12.4	16.9
2005	13.8	18.7
2006	13.8	18.7
2007	14.5	19.7
2008	12.8	17.4
2009	12.7	17.3
2010	14.5	19.7
2011	14.5	19.7
2012	14.5	19.7

4.4.2.3 Recalculations

No recalculations have been required for this year's submission.

4.4.3 Aluminium Production (2.C.3)

4.4.3.1 Source Category Description

Emissions: *PFCs and CO_2*

Key Source: *Yes (PFCs)*

This category includes emissions of CO_2 and PFCs from aluminium production. Primary aluminium production in Austria was terminated in 1992.

Two PFCs, tetrafluoromethane (CF_4) and hexafluoroethane (C_2F_6) are emitted from the process of primary aluminium smelting. They are formed during the phenomenon known as the anode effect (AE).

CO_2 emissions arise from the consumption of the anode in the production process.

This category is a key category for PFC emissions because of the contribution to the total level of greenhouse gas emissions in the base year; and a key source for both PFC and CO_2 emissions in terms of emission trends.

Table 126 presents PFC and CO_2 emissions from primary aluminium production for the period from 1990 to 1992.

Table 126: PFC emissions from primary aluminium production from 1990 to 1992.

	1990	1991	1992
PFC emissions [Gg CO_2 equivalent]	994	994	395
CO_2 emissions [Gg]	158	158	63

4.4.3.2 Methodological Issues

CO_2 emissions were calculated by applying the IPCC default emission factor of 1.8 t CO_2/t aluminium produced taken from the IPCC guidelines (Table 2.16).

PFC emissions were estimated using the IPCC Tier 3b methodology. The specific CF_4 emissions (and C_2F_6 emissions respectively) of the anode effect were calculated by applying the following formula (BARBER 1996), (GIBBS & JACOBS 1996), (TABERAUX 1996):

kg CF_4/t_{Al} = (1.7 x AE/pot/day x F x AE_{min})/CE

Where:

AE/pot/day	*= frequency of occurrence of the anode effect (dependent on type of oxide supply (1,2/day)*
t_{Al}	*= effective production capacity per year [t]*
AE_{min}	*= anode effect duration in minutes (5 min)*
F	*= fraction of CF_4 in the anode gas (13%)*
CE	*= current efficiency (85%)*
1.7	*= constant resulting from Faraday's law*

In Austria so called „Søderberg" anodes were used. The technology applied was head to head HSS. The frequency of the anode effect (AE/pot/day) was about 1.2 per day. The duration of the anode effect (AE_{min}) was in the range of 4 to 6 minutes. The average fraction of CF_4 formed in percent of the anode gas (F) can be determined as a function of the duration of the anode effect. International values are about 10% after two minutes, 12% after three minutes and after that there is only a marginal increase. Therefore for Austrian aluminium production a CF_4 fraction in the anode gas of 13% was assumed.

Because C_2F_6 is formed only during the first minute of the anode effect, the rate of C_2F_6 is the higher the shorter the duration of the anode effect is. For the aluminium production in Austria the rate of C_2F_6 is about 8% and the current efficiency (CE) about 85.4%.

Activity data were taken from national statistics (88 021 t for 1990 and 1991, and 35 000 t in 1992).

By inserting these data into the formula mentioned above an emission factor of 1.56 kg CF_4/t aluminium was calculated. The resulting emission factor for C_2F_6 was 0.1248 kg per tonne of aluminium produced.

4.4.3.3 Uncertainty Assessment

The uncertainty for the PFC emission factors („Søderberg" process) is between 30–80% according to the IPCC GPG (p.3.43). Activity data do not influence the uncertainty of emissions to that extent, because PFCs are formed during the anode effect that is associated with the EF. Assuming a mean value for the emission factor, the uncertainty of PFC emissions is 50%.

Uncertainty of CO_2 emissions is assumed to be 2%, mainly deriving from AD uncertainty (WINIWARTER 2007).

4.4.3.4 Recalculations

A transcription error in the calculation of C_2F_6 emissions was corrected, leading to lower emissions in the order of 2 to 6 tonnes of C_2F_6 in the years 1990 to 1992.

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 in terms of its trend in emissions.

In the base year 1990, SF_6 emissions from aluminium and magnesium foundries contributed 0.3% to the total amount of greenhouse gas emissions in Austria, in the year 2012 very low emissions arose from this category (see Table 108).

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 and to quench fires of molten magnesium. It has been a common assumption that the SF_6 in magnesium cover gas will not be destroyed but more or less completely emitted. Recent studies showed that SF_6 undergoes destruction to some degree. The low intensity of this process depends on specific operation conditions. Industry introduced alternative cover gases in the last years.

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

Table 127 presents SF_6 emissions from magnesium and aluminium foundries for the period from 1990 to 2012.

As can be seen in the table below, SF_6 emissions have been fluctuating during the period, but the overall trend has been decreasing SF_6 emissions; from 1990 to 2012 they decreased by nearly 100%. This decreasing trend is explained by technological advances and the replacement of SF_6 by other substances used for surface protection; since 2008 the use of SF_6 per foundry is limited to 850 kg per year in Europe[51].

[51] Regulation (EC) No 842/2006 of the European Parliament and of the Council of 17 May 2006 on certain fluorinated greenho use gases.

Table 127: SF_6 emissions from magnesium and aluminium foundries 1990–2012.

Year	SF_6 emissions [Mg]
1990	10.60
1991	11.60
1992	10.60
1993	11.60
1994	15.60
1995	18.54
1996	25.55
1997	14.61
1998	6.87
1999	0.93
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
2011	0.01
2012	0.20

4.4.4.2 Methodological Issues

Emissions were estimated following the IPCC methodology using annual consumption data of SF_6.

Information about the amount of SF_6 used was obtained directly from the aluminium and magnesium producers in Austria and thus represents plant-specific data (for verification, data was checked against data from SF_6 suppliers).

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

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

4.4.4.3 Source specific QA/QC

The amount of SF_6 used was cross-checked with data from SF_6 suppliers. The IEFs for magnesium casting (based on the amount of magnesium cast) range between 0.1 and 7.4 kg SF_6/t and are all within the range of the Norsk Hydro survey (0.1 to 11 kg/t Mg) cited in the IPCC GPG (p.3.47).

4.4.4.4 Uncertainty Assessment

According to the IPCC GPG (p 3.49) the uncertainty associated with plant SF_6 use data is low (5%).

4.4.4.5 Recalculations

No recalculations have been required for this year's submission.

4.5 Consumption of Halocarbons and SF_6 (CRF Source Category 2.F)

4.5.1 Source Category Description

This category includes the following emission sources: refrigeration and air conditioning equipment, foam blowing, fire extinguishers, aerosols, solvents semiconductor manufacture, electrical equipment and other sources (noise insulation windows, tyres and research).

There is no production of Halocarbons in Austria.

The year 1990 was chosen as base year for HFC, PFC and SF_6 emissions.

Potential emissions are reported as sums under category *2.F*, for estimates of actual emissions please refer to the respective sub-categories.

On the European level, the so-called F-gas Regulation[52] includes a number of measures to reduce emissions such as recovery of equipment containing F-gases for e.g. refrigeration, air conditioning and heat pump equipment, equipment containing F-gas based solvents, fire protection systems and fire extinguishers, high-voltage switchgear (Article 4 of the F-gas Regulation).

This Regulation is implemented by the Austrian Ordinance on Qualification and Certification measures in the context of HV switch gear. According to Article 2(2) of this Ordinance, personnel in charge of handling, refilling etc., have to prove their knowledge about recovery techniques and prevention of emissions.

Emission Trends

For the category *Consumption of Halocarbons and SF_6*, greenhouse gas emissions were about six times as high in 2012 as 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;

[52] Regulation (EC) No 842/2006 of the European Parliament and of the Council of 17 May 2006 on certain fluorinated greenhouse gases.

ODS are regulated under the Montreal Protocol and are therefore not considered under the UNFCCC and the Kyoto Protocol). The dip in emissions in 2009 is due to the economic crisis which strongly affected semiconductor manufacture and cut this sub-category's emissions by over 60%.

In 2012, F-Gas emissions from Category 2.F amounted to 1.79 Mio t CO_2 equivalents. Emissions increased in recent years (+3.5% from 2011 to 2012) as large numbers of HFC containing refrigerators, placed on the market at the beginning of the millennium, are decommissioned and emissions occur during disposal.

Potential and actual emissions per substance group are presented in Table 128, emissions by sub sector and gas are presented in Table 130 and Table 131.

From 2003 onwards, actual SF_6 emissions exceed potential emissions. This is due to high actual emissions from disposal of noise insulating windows.

Table 128: Potential and actual emissions from IPCC Category 2 F per substance group [Gg CO_2e] 1990–2012.

	HFCs [Gg CO_2e]		PFCs [Gg CO_2e]		SF_6 [Gg CO_2e]		Total [Gg CO_2e]	
Year	**Potential**	**Actual**	**Potential**	**Actual**	**Potential**	**Actual**	**Potential**	**Actual**
1990	34.48	22.55	32.28	29.05	461.93	240.03	528.69	291.63
1991	36.65	24.73	40.99	36.89	713.78	366.58	791.42	428.19
1992	47.44	26.51	49.70	44.73	807.04	434.63	904.18	505.87
1993	162.14	237.01	58.41	52.57	873.41	502.69	1 093.95	792.26
1994	255.36	260.33	64.77	58.30	1 037.26	598.04	1 357.40	916.67
1995	581.26	339.64	75.99	68.39	1 152.50	710.09	1 809.74	1 118.12
1996	770.19	392.57	73.24	65.92	951.95	623.04	1 795.38	1 081.53
1997	954.53	460.99	107.20	96.48	1 109.84	789.63	2 171.57	1 347.11
1998	1 157.45	555.40	110.71	44.40	1 110.61	747.65	2 378.77	1 347.44
1999	1 303.99	632.48	191.14	64.19	1 004.56	686.76	2 499.69	1 383.43
2000	2 075.48	646.82	236.57	67.46	751.08	565.11	3 063.14	1 279.38
2001	2 057.90	773.86	314.70	90.03	734.31	630.94	3 106.92	1 494.83
2002	2 266.98	874.78	301.96	83.46	744.73	635.70	3 313.67	1 593.94
2003	2 206.46	952.51	380.60	102.20	508.04	571.98	3 095.10	1 626.69
2004	2 318.26	1020.17	340.98	125.49	405.84	507.07	3 065.07	1 652.73
2005	2 110.06	997.37	351.35	125.04	202.29	512.33	2 663.69	1 634.74
2006	2 302.57	1 004.15	380.99	136.94	201.16	462.18	2 884.72	1 603.27
2007	2 374.79	1 042.65	451.77	183.72	124.21	383.91	2 950.76	1 610.28
2008	2 448.79	1 082.02	421.90	167.13	142.96	390.55	3 013.65	1 639.70
2009	2 613.60	1 134.26	222.85	28.64	137.81	356.97	2 974.26	1 519.88
2010	2 866.21	1 285.65	343.47	63.93	207.74	351.21	3 417.42	1 700.80
2011	2 400.73	1 349.00	328.36	60.07	207.70	321.37	2 936.79	1 730.44
2012	2 593.55	1 431.45	285.89	40.46	333.85	321.50	3 213.29	1 793.40

Key Categories

For the key category analysis, emission data of this category were aggregated as suggested in the IPCC GPG:

- 2.F.1/2/3/4/5 ODS (Ozone Depleting Substances) Substitutes (HFCs),
- 2.F.7 Semiconductor Manufacture (HFCs, PFCs and SF_6),
- 2.F.8 Electrical Equipment (SF_6) and
- 2.F.9 Other (SF_6, PFC).

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 their contribution to total emissions in 2012 and to the trend of emissions. In the year 2012, HFC emissions from ODS contributed 1.8% to the total amount of greenhouse gas emissions in Austria (expressed in CO_2 equivalent), compared to 0.03% in the base year 1990 (see also Table 108).

2.F.9 Other (SF_6, PFC) has been identified as key category because of its contribution to the total inventory's level in 2012. In this year, emissions from category 2.F.9 contributed 0.3% to the total amount of greenhouse gas emissions in Austria, compared to 0.2% in 1990.

For further information on key categories see Chapter 1.5.

4.5.2 Methodological Issues

Data about consumption of HFC, PFC and SF_6 were mainly obtained directly from importers and end users.

Starting in 2004, there is also a reporting obligation under the Austrian Industrial Gas Ordinance[53] for users of fluorinated gases 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 combined with data from the electronic system).

The first reporting year is 2003, from this year on the end users of fluorinated gases are obliged to report annually about the amounts used and recycled. Theoretically, almost the entire activity data used for inventory preparation is covered by the reporting obligation. Data for semiconductor manufacture and electrical equipment and partly for other sub sectors are taken from this data base[54]. 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. Therefore not all enterprises reported their consumption and it was necessary to apply a top down methodology for this sector: information on total import of refrigerants was obtained from all relevant importers, refrigerants used in other subsectors were subtracted and the remaining quantities were allocated in the refrigeration and air conditioning sector.

[53] Verordnung des Bundesministers für Land- und Forstwirtschaft, Umwelt und Wasserwirtschaft über Verbote und Beschränkungen teilfluorierter und vollfluorierter Kohlenwasserstoffe sowie von Schwefelhexafluorid (HFKW-FKW-SF_6-V), Federal Law Gazette II No. 447/2002

[54] For semiconductor manufacture, plant specific data is available for the whole time series; for the other categories the data had to be extrapolated for the other years (see respective sub chapters for description).

Actual emissions for all subcategories were estimated using a country specific methodology; emission factors are based on information from experts from the respective industries (except emissions from aerosols and solvents, where IPCC default emission factors are used). For most sources, emissions are calculated from annual stocks using emission factors. Additionally emissions can occur during production or disposal of halocarbon/SF_6 containing products, and all these emissions have been accounted for. Annual stocks correspond to the amounts of FCs stored in applications in the previous year, minus emissions of the previous year, plus consumption of the previous year.

Potential emissions correspond to the total amounts consumed for filling of new equipment and refilling in the considered year. Due to confidentiality, the potential emissions of the imported (in bulk) halocarbons CF_4, C_2F_6, C_3F_8, C_4F_{10}, c-C_4F_8, C_5F_{12}, C_6F_{14} are reported as unspecified mix of listed PFCs, expressed in CO_2 equivalent (Gg).

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

Methodologies have been developed in studies addressing the country-specific situation:

- UMWELTBUNDESAMT (2001b): All sub categories of Category 2.F for 1990 to 2000
- OBERNOSTERER et al. (2004): Re-evaluation of sub category foam blowing
- Austrian estimates of emissions from the sources *2.F.4* Aerosols and *2.F.5* Solvents, based on a European evaluation of emissions from this sector (HARNISCH & SCHWARZ (2003), disaggregated to provide a top-down estimate for Austria.
- LEISEWITZ & SCHWARZ (2010): All sub categories of Category 2.F for the years 2000 to 2007; some sub categories for 2008 as well.
- LEISEWITZ (2012): Category 2.F.1 for the year 2010

For the years 2008 to 2012, additional data updates were obtained from importers and companies using fluorinated gases, based on the same contacts and data sources as in LEISEWITZ & SCHWARZ (2010).

As an overview, Table 129 provides the data sources and interpolation methods for each subcategory and each year.

Table 129: Data sources for categories 2.F.1 to 2.F.9.

Category	Data source			
	collected	extrapolated	interpolated	technique
2.F.1 Refrigeration and air conditioning equipment				
Stationary refrigeration	2000, 2004, 2007[1)] 2010, 2011, 2012	1990–1999	2001–2003, 2005–2006, 2008–2009	Exponential (1990–1999) Linear (other years)
Commercial refrigeration	2000, 2003–2012	1990–1999	2001–2002	Exponential (1990–1999) Linear (2001–2002)
Room air conditioning	2000, 2008	2009–2012	2001–2007	Linear Note: No HFCs prior to 2000
Heat pumps	1990–2012			
Domestic refrigeration	1993	1994–2008		Linear

Category	Data source			
	collected	extrapolated	interpolated	technique
				Note: No HFCs in new refrigerators prior to 1993 and after 2008
Transport refrigeration	2000[5)], 2007, 2011[5)]	1990–1999, 2012	2000–2006, 2008–2010	Exponential (1990–1999, expert judgement based on information for country with similar structure[1)]) Linear (2001–2007, 2008-2010, 2012)
Mobile air conditioning	1993–2012			Note: No HFCs in vehicles prior to 1993
2.F.2 Foam blowing	2000–2012	1995–1999		Linear[2)]. Note: No HFCs in foams prior to 1995
2.F.3 Fire extinguishers	1990–2012			
2. F.4 Aerosols	2000–2012	1990–1999		Proportional to GDP
2.F.5 Solvents	2001, 2002	1990–2000, 2003		Proportional to GDP
2. F.7 Semiconductor manufacture	1990–2012			
2.F.8 Electrical equipment	1990–1999, 2003–2012		2000–2002	Linear
2.F.9 Other				
Noise insulating windows	1999–2003	1990–1998		Based on production data[3)]
Tyres	1998–2003			Note: no SF_6 in tyres in other years
Research	1990, 2000–2012		1991–1999	Linear
Shoes	2003–2005[4)]			Note: no PFCs in shoes in other years

[1)] *LEISEWITZ & SCHWARZ (2010)*

[2)] *OBERNOSTERER et al. (2004)*

[3)] *Production data and share of noise insulating windows*

[4)] *Using data from Germany*

[5)] *Using indicators (refilling volume, refilling rates)*

For more information on data sources and methods, please see the following subchapters. An overview of emissions of fluorinated gases by sub-category is presented in Table 130 and Table 131.

Table 130: Emissions of IPCC Category 2.F by sub-category 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	0.03	0.16	0.22	0.31	2.28	4.14	5.67
HFC-125	2 800	t	0.00	0.00	0.00	0.00	1.02	2.22	4.30	6.73	13.06	18.94	26.03
HFC-134a	1 300	t	0.00	0.00	0.01	0.97	4.33	9.04	14.36	29.19	50.20	67.59	91.83
HFC-152a	140	t	0.00	0.00	0.00	0.00	0.01	0.01	0.01	0.02	0.02	0.03	0.04
HFC-143a	3 800	t	0.00	0.00	0.00	0.00	1.13	2.37	4.74	7.47	12.60	17.30	23.81
HFC-23	11700	t	NO	NO	NO	IE	IE	IE	IE	IE	IE	IE	IE
C3F8	7 000	t	NO	NO	NO	IE	IE	IE	IE	IE	IE	IE	IE
Mobile													
HFC-134a	1 300	t	0.00	0.00	0.00	0.00	0.43	4.34	9.04	16.50	25.01	36.24	49.80
Gg CO_2e			**0.00**	**0.00**	**0.01**	**1.29**	**13.34**	**32.72**	**60.61**	**106.81**	**183.69**	**256.44**	**351.18**
2.F.2 Foam Blowing													
HFC-134a	1 300	t	0.00	0.00	0.00	151.76	158.66	203.10	220.33	236.66	253.88	256.38	140.56
HFC-152a	140	t	0.00	0.00	0.00	74.88	78.28	81.68	88.47	95.27	102.06	102.06	595.17
Gg CO_2e			**0.00**	**0.00**	**0.00**	**207.78**	**217.22**	**275.46**	**298.82**	**321.00**	**344.33**	**347.59**	**266.05**
2.F.3 Fire Extinguishers													
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	0.00
HFC-227ea	2 900	t	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.05	0.00
Gg CO_2e			**0.00**	**0.00**	**0.00**	**0.00**	**0.02**	**0.02**	**0.03**	**0.03**	**0.04**	**0.18**	**0.03**
2.F.4 Aerosols													
HFC-134a	1 300	t	15.51	15.93	16.22	16.26	16.59	16.84	17.18	17.43	17.91	18.38	18.87
Gg CO_2e			**20.16**	**20.71**	**21.08**	**21.14**	**21.57**	**21.89**	**22.33**	**22.65**	**23.29**	**23.90**	**24.53**
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 CO_2e			**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_2e		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_2e		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 CO_2e			**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	0.48	0.51	0.54	0.57	0.61	0.63	0.63	0.63	0.70	0.69	0.75
Gg CO_2e			**11.37**	**12.14**	**12.92**	**13.69**	**14.47**	**15.00**	**14.94**	**15.13**	**16.81**	**16.54**	**17.84**
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	12.57	11.87	8.98
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 CO_2e			**126.56**	**179.20**	**183.10**	**187.00**	**218.19**	**266.32**	**279.81**	**286.65**	**300.39**	**283.71**	**214.60**

Table 131: Emissions of IPCC Category 2.F by sub-category 2001–2012.

GHG	GWP	Unit	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012
2.F.1 Refrigeration and Air Conditioning Equipment														
Stationary														
HFC-32	650	t	8.77	12.10	16.76	17.48	19.16	20.90	24.67	27.25	32.57	38.92	47.55	55.21
HFC-125	2 800	t	37.31	44.63	57.15	62.61	68.71	75.54	80.15	88.20	98.44	116.73	127.45	141.36
HFC-134a	1 300	t	112.43	125.27	149.36	174.06	172.65	179.55	183.35	189.82	178.93	194.57	208.50	215.97
HFC-152a	140	t	0.04	0.04	0.04	0.04	0.04	0.04	0.05	0.04	0.03	0.02	0.00	0.00
HFC-143a	3 800	t	33.48	38.19	47.41	53.05	58.24	64.24	65.20	71.70	77.52	91.75	94.24	98.95
HFC-23	11 700	t	IE	IE	IE	IE	IE	IE	IE	IE	IE	IE	IE	IE
C3F8	7 000	t	IE	IE	IE	IE	IE	IE	IE	IE	IE	IE	IE	IE
Mobile														
HFC-134a	1 300	t	63.72	78.12	90.99	106.86	122.63	147.11	160.61	179.90	192.34	208.11	221.11	231.03
		Gg CO_2e	**466.41**	**542.38**	**663.55**	**753.46**	**810.04**	**893.86**	**935.37**	**1017.8**	**1074.0**	**1224.3**	**1304.3**	**1388.8**
2.F.2 Foam Blowing														
HFC-134a	1 300	t	142.41	124.23	126.27	128.42	84.85	9.93	9.87	9.80	9.73	9.66	9.60	9.53
HFC-152a	140	t	608.27	946.32	637.09	429.03	204.65	247.77	248.65	87.11	129.34	134.36	0.00	0.00
		Gg CO_2e	**270.29**	**293.99**	**253.34**	**227.01**	**138.95**	**47.60**	**47.64**	**24.93**	**30.76**	**31.37**	**12.48**	**12.39**
2.F.3 Fire Extinguishers														
HFC-23	11 700	t	0.27	0.00	0.00	0.19	0.43	0.33	0.41	0.86	0.86	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	0.00	0.00	0.74	0.00
		Gg CO_2e	**3.21**	**2.14**	**0.38**	**3.79**	**5.96**	**5.72**	**5.15**	**10.11**	**10.10**	**10.10**	**12.21**	**10.07**
2.F.4 Aerosols														
HFC-134a	1 300	t	22.01	23.63	22.73	23.80	29.57	39.95	36.48	16.78	13.60	14.05	14.11	14.27
		Gg CO_2e	**28.61**	**30.72**	**29.55**	**30.94**	**38.44**	**51.94**	**47.42**	**21.82**	**17.68**	**18.27**	**18.34**	**18.55**
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	0.00	0.00
		Gg CO_2e	**1.20**	**1.50**	**1.81**	**0.91**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**
2.F.7 Semiconductor Manufacture														
HFC-unspecified		Gg CO_2e	4.14	4.05	3.88	4.06	3.98	5.03	7.07	7.39	1.71	1.62	1.63	1.65
PFC-unspecified		Gg CO_2e	90.03	83.46	102.20	125.49	125.04	135.50	182.55	166.39	28.64	63.93	60.07	40.46
SF_6	23 900	t	15.02	14.99	15.82	15.91	7.08	7.04	4.12	4.42	3.12	2.88	1.73	1.75
		Gg CO_2e	**453.05**	**445.88**	**484.16**	**509.92**	**298.17**	**308.69**	**288.00**	**279.51**	**104.92**	**134.27**	**103.09**	**83.91**
2.F.8 Electrical Equipment														
SF_6	23 900	t	0.78	0.82	0.84	0.90	0.96	0.98	1.05	1.11	1.14	1.25	1.26	1.35
		Gg CO_2e	**18.68**	**19.56**	**19.96**	**21.47**	**22.95**	**23.46**	**25.18**	**26.53**	**27.27**	**29.95**	**30.03**	**32.35**
2.F.9 Other														
SF_6	23 900	t	10.60	10.79	7.28	4.40	13.40	11.32	10.89	10.81	10.68	10.57	10.46	10.35
C3F8	7 000	t	0.00	0.00	0.00	0.00	0.00	0.21	0.17	0.11	0.00	0.00	0.00	0.00
		Gg CO_2e	**253.38**	**257.77**	**173.95**	**105.24**	**320.23**	**272.01**	**261.52**	**259.02**	**255.14**	**252.55**	**249.95**	**247.34**

4.5.2.1 2.F.1 Refrigeration and Air Conditioning Equipment

This sub sector can be divided into:

a) Category of stationary refrigeration covering large plants/facilities that are filled on site, emissions are estimated using a **top down model**:
- Industrial refrigeration
- Supermarkets (Part of CRF category commercial refrigeration)
- Other commercial refrigeration (Part of CRF category commercial refrigeration)
- Stationary air conditioning (part of CRF category stationary air conditioning)

b) Rest of the sector 2F1 including parts that are, for the most part, not filled in Austria (or at least not filled on site), emissions are estimated using a **bottom up approach**:
- Room air conditioning (part of the CRF category stationary air conditioning)
- Heat pumps (part of CRF category stationary air conditioning)
- Commercial stand-alone refrigeration equipment manufacturing (part of CRF category commercial refrigeration)
- Domestic refrigeration
- Transport refrigeration
- Mobile air conditioning

Details on a) top down model

1) Total refrigerant imported/total refrigerant used

Data on total refrigeration imported is obtained from all relevant importers; values were available for the years 2000, 2004, 2007, 2010, 2011 and 2012. There are four large importers that cover about 95% of the market. Additionally there are several small importers that change over the years.

The information from the importers also includes information on refrigerant used in other sub categories than covered by the top down model (e.g. use for filling of new mobile ACs and refilling of mobile ACs and transport refrigeration in Austria). This information was combined with more detailed information from industry to obtain the remaining refrigerant use in the considered sub categories (see list above).

For 2001 to 2009, the time series was established by interpolation for the years in between where no data on imports/use was available.

For the years before 2000, the total consumed amounts were estimated based on information collected by LEISEWITZ & SCHWARZ (2010) in the Austrian industry on the use of HFCs in refrigeration equipment.

2) Refrigerant consumption in sub categories considered

The total refrigerant use was broken down into the use in each sub category based on information from refrigeration service companies. Based on their GWPs, the refrigerants (apart from R134a) were divided into two groups of similar GWP and composition: on the one hand R404A and R507A and on the other hand the rest of blends (R410, R407C, R413A, R422D) with a GWP of approx. 1600 and all other refrigerants (which have a share of < 1% in all years).

The composition of the blends is unknown and varies over the years; therefore a mean composition was estimated, based on the specific refrigerants used/imported over the time series. The groups of refrigerants and their mean composition are presented in Table 132.

Table 132: Composition of blends (in percent) as used in the top-down model for category 2.F.1

	Refrigerants				
Groups of refrigerants	**R32**	**R125**	**R134a**	**R143a**	**GWP used in the model**
R134a	0	0	100	*0*	1 300
R404A, R507A	0	44	4	52	3 260
Blend (R410,R407C, R413A, R422D and others)	35	35	30	0	1 598

For the sub-categories of 2.F.1 which are included in the top-down approach, time series of emissions are calculated for R134a and for the two blends. In a final step, the blends are again split into their main components R32, R125 and R134a. Emissions of other gases (HFC23 and C_4F_8), which are imported in small quantities only, are not disaggregated but are included in the emissions of the three main components R32, R125 and R134a). Therefore, emissions of HFC23 and C_4F_8 in sub category 2.F.1 are reported as "IE".

3) Estimation of emissions

The refrigerant consumption equals the sum of refrigerants filled in the new equipment plus refrigerants used for refilling.

In the first year, total consumption is used for filling into new equipment. For the subsequent years a part is used for refilling, where the amount refilled has to equal the amount emitted, and the remaining amount is used for filling of new equipment.

Total consumption was allocated to first-fill and re-fill by an iterative methodology, where the resulting emissions from stock (= the amounts refilled) have to be in such a relation to the calculated stock that implied emission factors correspond to the EF values that were estimated by LEISEWITZ & SCHWARZ (2010).

Values for lifetime of equipment per sector, which are required to calculate the refrigerant stock, as well as EF for emissions from manufacturing (= emissions from first fill), and EF for disposal emissions were also taken from LEISEWITZ & SCHWARZ (2010).

Table 133: Emission factors used for the top down model (IPCC Category 2.F.1)

Sub category	**Equipment lifetime**	**EF for first fill emissions**	**EF for emissions from stock***	***IPCC default EF***	**EF for disposal**
Industrial refrigeration	10	0,2%	9–7%	*7–25%*	30%
Supermarkets	10	0,2%	15–14%	*10–30%*	30%
Stationary air conditioning	12	0,05%	10–9%	*2–15%*	30%
Other commercial refrigeration	14	0,2%	20–15%	*10–35%*	30%

* *an improvement of equipment concerning leakage was considered: the first value is related to the EF for the beginning of HFC use as refrigerants in the mid-1990s, the latter value for 2010-2012.*

The approach of combining refrigerants into groups and estimating emissions as described above resulted in a consistent time series, as shown in Figure 26. In earlier submissions, up to the submission in 2012, a different approach had been used, for which inconsistencies had been pointed out by reviewers. These inconsistencies were addressed and removed using the present approach. The previous approach is shown in the figure for comparison.

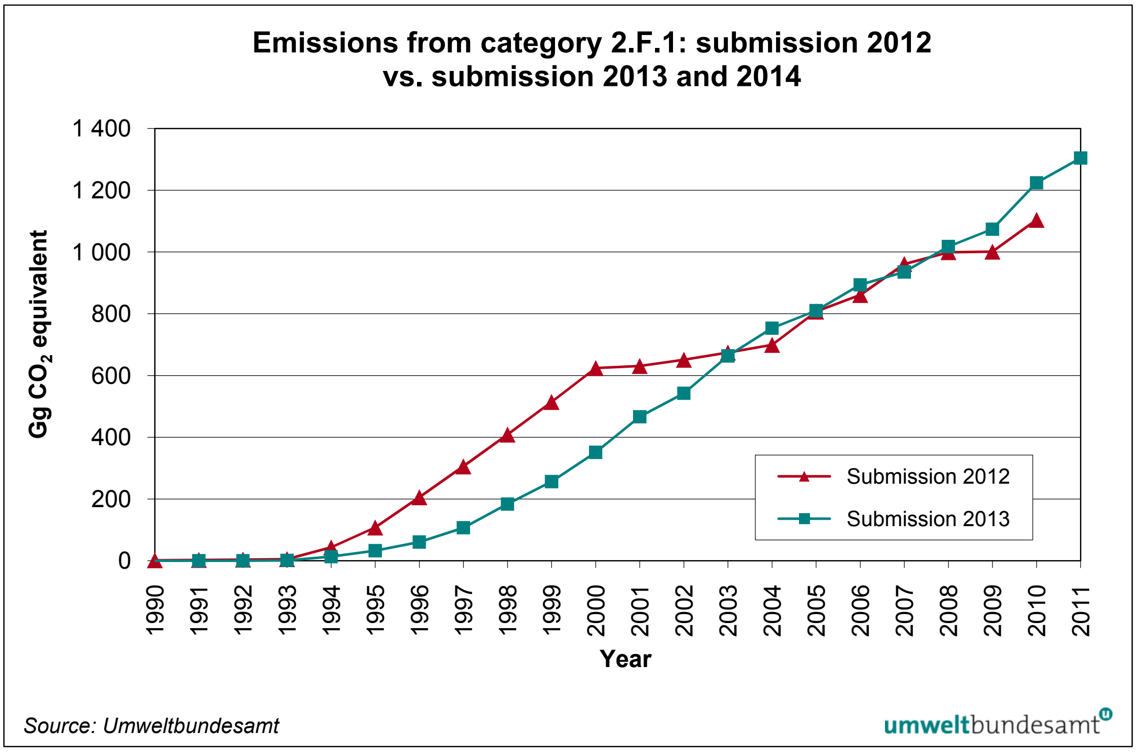

Figure 26: Emissions from category 2.F.1 according to submission 2012 (old approach) and according to submission 2013 and 2014 (new approach as described here).

Details on b) bottom up approach for the rest of the sub category 2.F.1

Room air conditioning (part of the CRF category stationary air conditioning)

Room AC devices (split devices, Variable Refrigerant Flow (VRF) and small mobile equipment) are imported already charged with refrigerant and are not manufactured within the country. However in cases where refilling occurs, these quantities are considered for in the top down approach.

Data on annual sales as well as the filling volumes, type of used refrigerants (R407C and R410A) and the market development (annual rising sales) were estimated based on information from the AC industry (LEISEWITZ & SCHWARZ 2010) for the years 2000–2008. For the subsequent years data was extrapolated. For earlier years, HFC use was not relevant (a pure HCFC – R22 – was used as refrigerant).

From this data stocks were estimated and, an EF of 2.5% (LEISEWITZ & SCHWARZ 2010) was applied for calculating emissions from stocks.

Heat pumps (part of the CRF category stationary air conditioning)

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 > 50 000 units in total. About 65% of the newly installed equipment in 2006 was dedicated to space heating and about 28% to heating of water for domestic use as the main areas of application. Heat pumps are manufactured in Austria, exports roughly outweigh the imports, thus manufacture roughly equals newly installed systems. 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.

Underlying data on installed heat pumps are obtained from an annual report (BIERMAYR et al. 2013). The amounts of HFCs filled into the different types of heat pumps and the share of the individual HFCs were estimated by LEISEWITZ & SCHWARZ (2010) using information from industry experts.

Applied EF were also estimated by LEISEWITZ & SCHWARZ (2010):

- product manufacturing 0.1%
- emissions from stock 2%
- disposal 30% (life time 15 years)

Recalculation

Based on the most recent report on heat pumps (BIERMAYR et al. 2013), the number of heat pumps installed in 2011 was adjusted, resulting in slightly lower HFC emissions in that year.

<u>Domestic refrigeration</u>

Refrigerators for domestic use are mainly imported to Austria (the little production that occurs is considered in commercial refrigeration manufacture).

R134a as refrigerant was introduced by industry at the end of 1993 as replacement of R12 which is a CFC. For this year it was assumed that 100% of the equipment operated with R134a. In the following years R134a was replaced by R600a (iso-butane), therefore – until 2005 – a share of 1% of R134a filled refrigerators was considered. For the years after the share was set to zero as the replacement in Europe was practically complete.

The number of new equipment was estimated as approx. 10% of the total number of refrigerators/freezers (with 1.3 fridges/freezers per household) in 1995, amounting to 400.000 per year which was held constant from 1993 to 2005.

EF according to LEISEWITZ & SCHWARZ (2010):

- emissions from stock: 0.3%
- disposal: 30% (life time 15 years)

<u>Commercial stand-alone refrigeration equipment manufacturing (part of CRF category commercial refrigeration)</u>

Here emissions from manufacturing of small refrigeration equipment mostly for export („stand-alone" commercial application including also some equipment for domestic refrigeration) are included.

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%.

<u>Transport refrigeration</u>

This group includes refrigerated road vehicles (vans, trucks, trailers). Manufacturing of refrigeration units does not take place in Austria. Emissions occur from stock and from disposal.

LEISEWITZ & SCHWARZ (2010) estimated the stock and refilling of refrigeration units (29% of stock = emissions from stocks) for the year 2007, based on information from a main furnisher of refrigeration units. For the years before 2007 data was extrapolated by LEISEWITZ & SCHWARZ

(2010) using information on stock development from the industry expert. Data for 2008–2012 were extrapolated, taking into account additional data for 2011, obtained from the same industry contact person.

An EF for disposal of 30% and a life time of 10 years were estimated by LEISEWITZ & SCHWARZ (2010).

Mobile Air Conditioning

Sub categories considered were passenger cars, trucks, busses, agricultural machines, rail and manufacturing of vehicles for construction sites. In Austria the use of R134a for mobile AC started in 1994.

Passenger cars

Detailed data on brands and models of newly registered passenger cars was available for 2004. This information was combined by LEISEWITZ & SCHWARZ (2010) with information on HFC charge per AC and AC quota taken from a German study (SCHWARZ 2004). For the other years until 2008 data on new registrations per brand were combined with average fill levels and average AC quotas per brands taken from the same study. The fill levels and AC quotas of 2008 were also used for 2009 and 2010. For 2011 and again for 2012 the AC quotas for the main brands were updated using data from the Austrian subsidiaries. The detailed data covers 93–99% of the new registered cars, total charge for all newly registered cars were extrapolated assuming an average charge and quota of the cars with detailed data for the remaining cars.

Information on amounts filled in new cars within Austria was obtained directly from the producers.

EF estimated by LEISEWITZ & SCHWARZ (2010) applied for

- emissions from manufacturing: 0.7%
- emissions from stock: 10%
- disposal: 30% (life time 12 years)

Trucks

Vans, trucks and trailers were considered separately. R134a charge was taken from a typical model for the different types: For trucks, Mercedes Benz Atego and for trailers, Mercedes Benz Actros average values from SCHWARZ (2004) were used. AC quotas were also taken from SCHWARZ (2004).

Data on new registrations for 2004 was also used for the years until 2009. For the years before the data was estimated by LEISEWITZ & SCHWARZ (2010). For 2010, 2011 and 2012 data on new registrations from Austrian statistics were used.

EF estimated by LEISEWITZ & SCHWARZ (2010) applied for

- emissions from manufacturing: 0.5%
- emissions from stock: 10%/15%
- disposal 30% (life time 10 years)

Buses

Data on new registrations were taken from Statistics Austria from 2003 onwards; for the years before the data was estimated by LEISEWITZ & SCHWARZ (2010). 55% were estimated to correspond to urban buses, and 45% to coaches. AC quotas and AC charges were taken from SCHWARZ (2004).

EF estimated by LEISEWITZ & SCHWARZ (2010) applied for

- emissions from stock 15%
- disposal 30% (life time 10 years)

Agricultural machines

Tractors and harvesters were considered separately. Data on new registrations were taken from Statistics Austria from 2006 onwards, for the years before the data was estimated by LEISEWITZ & SCHWARZ (2010). AC quotas and AC charges were taken from from SCHWARZ (2004).

Data on filling in newly manufactured agricultural machines (fist fill) in Austria were obtained directly from producers.

EF estimated by LEISEWITZ & SCHWARZ (2010) applied for

- emissions from manufacturing: 0.3%
- emissions from stock: 15%/25%
- disposal: 30% (life time 10 years)

Rail

Rail includes railways, tramways and metro. Data for stocks and production (first fills) were directly obtained from operators and producers.

EF estimated by (LEISEWITZ & SCHWARZ 2010) applied for

- emissions from manufacturing: 0.04%
- emissions from stock: 5%
- disposal: 30%

Vehicles for construction sites

Figures on first fill of vehicles for construction sites were directly obtained from the producers. Emissions were calculated applying a product manufacturing factor of 0.3% (EF estimated by LEISEWITZ & SCHWARZ 2010).

Recalculation

In the sub-category "mobile air conditioning", a transcription error in the calculation of emissions from rail air conditioning for the year 2011 was corrected, resulting in slightly lower HFC emissions in that year.

4.5.2.2 2.F.2 Foam Blowing and XPS/PU Plates

According to the Austrian Industrial Gas Ordinance the usage of HFC in the area of foam manufacturing and placing on the market is prohibited – with the exemption of XPS panels > 80 mm thickness –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).

Hard foam

XPS plates

For many years the main blowing agent for manufacturing of XPS hard foam has been CO_2. In Austria, from 1995 to 2004 also products blown with R134a were sold and from 2000 to 2010 one Austrian company used R152a as blowing agent for a small portion of about 3% of its XPS production in case of short-dated lots for which CO_2 driven XPS foam is not suitable due to longer storage needs with regard to shrinking behaviour.

Data on R152a consumption were obtained directly from the producer; the total amount consumed is assumed to be emitted during production.

R134a from XPS plates was calculated by LEISEWITZ & SCHWARZ (2010) based on information from industry experts (see Table 134).

25% of consumption is emitted in the production process. Stocks were calculated from the remainder; emissions from stocks were estimated based on information from producers.

Emissions from disposal are not yet to be expected as the lifetime of the foam products is long (>20 years).

PU hard foam

PU plates and PU sandwich panels blown with R134a were sold in Austria from 2000 to 2004 (usually hydrocarbons and CO_2 are used as blowing agents). Emissions were calculated by LEISEWITZ & SCHWARZ (2010) from information from industry experts (see Table 134).

PU pipe insulation

About 10% of the market of PU insulating foam for pipes in Austria has been blown with HFC-245fa and HFC-365mcf during 2000–2004. Emissions were calculated by LEISEWITZ & SCHWARZ (2010) based on information from industry experts (see Table 134). From 2005 onwards usage of HFC in this foam sector is prohibited as well as in the other areas.

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.

Table 134: PU pipe insulation

	XPS plates	**PU plates**	**PU sandwich panels**	**PU pipe insulation**
Sales in Austria (estimated from production/import/ export)	350 000 to 480 000 m³/year	17 000 to 18 000 m³/year	350 000 m³ in 2003 (2% growth per year)	41 000 to 62 000 m³/year
Average density	33 kg/m³	33 kg/m³	41 kg/m³	62,5 kg/m³
Market shares of R134a	15% until 1999 10% afterwards	10%	25%	5% each
Average propellant content	6.5% R134a	3% R134a	3% R134a	12% R245fa and R365mfc
Half life time	Until 2004 100mm plates: 85 years; since 2005 80mm plates: 60 years	150 years	200 years	30 years

	XPS plates	PU plates	PU sandwich panels	PU pipe insulation
Annual diffusion rate (EF)	1.15% (until 2004) and 0,81% (from 2005)	0,46%	0,35%	2,28%
EF (manufacturing)	25%	10%	10%	10%

Soft foam

No use of fluorinated gases in soft foams was identified for Austria. However, for higher level of transparency, PU one component foam is reported in this sub category.

PU one component foam

For PU one component foam (OCF), propellants used include HFC-free formulations (flammable gases, propane and butane among others), blends of flammable gases and HFC-134a or HFC-152a. HFC-134a and HFC-152a have been used as blowing agents for OCF since 1993 in Austria. OCF without HFC was used in Austria for the first time in 1999. The Austrian Industrial Gas Ordinance prohibits the use of OCF with HFC from 2006 onwards. Exemptions according to Article 7(4) IV are possible for fire protection products. The European F-gas Regulation provides a ban on HFC in OCF with a GWP > 150 starting July 2008; HFC-152a (with a GWP of 140) is not affected by this ban. From 2004/2005 onwards the Industrial Gas Ordinance provoked a rigorous decrease of HFC consumption in OCF to a niche of about 5% of the OCF market.

PU OCF containing foams were produced in Austria from 1993 to 2008, data on consumption was obtained directly from industry; the EF applied for calculating manufacturing emissions is 1.5%.

The annual consumption in Austria was estimated to be 4.4 Mio cans in 1993 (where the first HFC containing cans were sold) 6 Mio cans from 2000–2010. 60% of these cans contain HFCs (from 2006 onwards only 5%); on average one can contains 660g of foam with a propellant content of 13%. The share of R134a was 67% until 1999, 50% until 2005 and 0% thereafter; the remainder is R152a.

For estimating emissions from the OFC consumption in Austria it is assumed that the blowing agent is emitted completely in the first year.

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 by HFCs in some cases. 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.

For HFC-227ea, detailed data on consumption for new equipment, the stock in existing fixed flooding systems, annual losses (refilling) and recovered F-gases for disposal are obtained directly from the fire protection companies every year.

For HFC-23, due to lack of data from the one relevant company, data of 2008 was also used for the subsequent years, which probably overestimates emissions as the 2008 emissions from stock were higher than in all years before. However, no better methodology is available as emissions from stock result from fire incidents, and information on the fire extinguisher capacity where there occurred is not available (only a statistics on the insurance volume of fire incidents exists, but this only poorly correlates to emissions).

HFC emissions occur from filling in fixed systems, from stocks (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 from 2000 onwards. The emission factor for filling of fixed systems is calculated as 0.05%, the EF for disposal as 1%, both figures accord with literature and reports from fire protection companies. The implied EF from bank is at ~1.5% within the range estimated in the IPCC 2006 guidelines (page 7.63) for installed flooding systems (2 ± 1% per year). The mean value of 1.7% was applied to estimate emissions for the years before 2000, for which no detailed data on refilled amounts were available.

4.5.2.4 2.F.4 Aerosols/Metered Dose Inhalers

Metered dose inhalers

Production:

Metered dose inhalers containing R134a were produced in Austria from 1990 to 2010. Data on consumption was obtained directly from the producer from 2000 onwards, for the years before, production data was extrapolated using the Austrian GDP; the EF applied for calculating manufacturing emissions is 1.5%.

Consumption:

Detailed data on imported metered dose inhalers and their R134a content from 2000 onwards is provided annually in a pharmaceutical market survey. Based on this data, consumption is calculated, where all propellant is assumed to be released in the same year. For the years prior 2000 consumption was extrapolated using the Austrian GDP.

Aerosols

Technical aerosols

One Austrian company manufactured a technical aerosol for cleaning of cameras (use within the country, no export) until 2008. For the years 2000 and 2003 to 2008, data on consumption was obtained directly from the producer. For the years before and in between production data was extrapolated using the Austrian GDP; the EF applied for calculating manufacturing emissions is 1.5%. All propellant is assumed to be released in the year of production (product is assumed to be consumed in the year of purchase).

Novelty aerosols

The amount of imported novelty aerosols is estimated as 0.4% of the European Union market (estimated by the European Organisation of Aerosol Manufacturers to range between 940 t/year in 2000 and 100 t in 2009). The value of the year 2000 is also used for the years before. This share was verified by comparison with reported data from importers. From 2004 onwards, marketing of novelty sprays is prohibited 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.

4.5.2.5 2.F.5 Solvents

Information about HFC-43-10mee used as solvent was taken from a European evaluation of emissions from this sector (HARNISCH & SCHWARZ 2003) for the years 2001 and 2002, subsequently disaggregated to provide a top-down Austrian estimate. The other years were estimated using the Austrian GDP as indicator. Since 2004 the use of HFC in solvents is prohibited in Austria. Since then no further use occurred, which has been confirmed by industry during the latest inquiries.

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

4.5.2.6 2.F.7 Semiconductor Manufacture (HFC, PFC, SF_6)

Three semiconductor manufacturing companies in Austria currently emit CF_4, CHF_3, C_2F_6, C_3F_8, c-C_4F_8, C_4F_6, NF_3 and SF_6. Emissions are calculated by the companies from the annual consumption of each fluid by plant and the effectiveness of the respective abatement technologies (Tier 2a according to IPCC 2006).

Because of confidentiality claimed for consumption data in this industry emissions are reported in the CRF only for the sum of HFC and PFC. Gases and their applications are presented below:

- SF_6: Isolation gas for high-voltage measurement / process gas for plasma-etching,
- CF_4, C_2F_6, C_3F_8, C_4F_8: Process gas for plasma-etching / cleaning chemical vapour deposition,
- CHF_3: Process gas for plasma-etching,

Between 1997 and 1998 one semiconductor manufacturer quadrupled its exhaust air purification capacity reducing emissions remarkably. The increasing emissions of CF_4, C_2F_6 and SF_6 in the other years are due to an increase of semiconductor production. The lower emissions in 2009 compared to 2008 are due to the economic crisis that very strongly affected semiconductor manufacture.

4.5.2.7 2.F.8 Electrical Equipment (SF_6)

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

According to Article 15(2) of the Austrian Industrial Gas Ordinance, the use of SF_6 is only allowed in electro-technical systems and appliances of voltage > 1 kV if specific reporting obligations are fulfilled (Article 15(4)). The sector of high and medium voltage switchgear is hence not subject to restrictions of the use of SF_6.

Information on SF_6 stocks in electrical equipment from 2003 onwards was obtained from energy suppliers and industrial facilities (as mentioned above, there is a reporting obligation for operators of SF_6 filled equipment since 2004). Data for 2000–2002: estimation based on an annual growth rate 2003–2007 of 16.9% for MV-GIS and 4,1% for HV-GIS. 2% was added to the reported stock to account for equipment used in industry that is not reported otherwise. For 1990–1999 the stock was calculated from consumption data of this sector.

The operating EF of HV and MV GIS correspond to the default emission factors of the IPCC GL 2006 at 0.7% (HV) and 0.1% (MV) per year, respectively.

Manufacturing emissions from first filling were estimated to be 1% according to reported data, the disposal EF is assumed to equal 2%.

In Austria, no destruction of SF_6 in electrical equipment takes place when disposing. Disposed quantities are recovered, emissions from disposal are estimated to be 2%. The disposed amount is also reported by energy suppliers for the years 2004 onwards, the values 2000–2003 were estimated using average disposal rates of 2004–2008: 0.03% for HV and 0,1% for MV. For the years before the average value of 2000–2008 was used.

4.5.2.8 2.F.9 Other Sources of SF_6

Noise insulating windows

Nose insulating windows containing SF_6 were produced in Austria from 1980 to 2003, when the Austrian Industrial Gas Ordinance prohibited this use.

For the years before 1999 consumption and emissions from production were estimated from total production and the share of SF_6 production using the following information from industry:

- 16 mm gap results in about 16l/m^2 of which there are 8l SF_6 per m^2 window
- Filling from 1996 is only 6l SF_6/window
- Overfill of 3l per m^2 window (manual filling) = emissions from manufacture
- Density of SF_6: 6.18 kg/m^3

SF_6 consumption was reported by industry for the years 1999–2003; one third of the consumption is overfill (thus equals emissions from manufacture).

The leakage per year is 1% of the initial fill (which considered premature breaking).

The residual amount after the lifetime of 25 years is assumed to be emitted immediately due to breaking of glass.

Tyres

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

According to IPCC GL 2006 it is assumed that SF_6 completely emits from car tyres with their disposal three years after filling. Filling emissions are regarded to be insignificant. Disposal emissions are therefore assumed to equal the amount consumed three years earlier.

Shoes

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

Data on the import of these products to Austria were not 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 is estimated to be 2.5% (= 10% of the German market).

Operating emissions during use of the footwear are not considered. The lifetime of sport shoes is estimated to be 3 years. At the disposal of old shoes 100% of the initial filling is released to the atmosphere (i.e. EF = 100%). Disposal emissions are therefore assumed to equal the amount imported in sport shoes three years earlier.

Research

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

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

Emissions from bank are equal to the amounts provided in company reports for refilling of losses.

4.5.3 Source specific QA/QC

EF obtained by industry inquiries were compared with the IPCC default values. The total consumption of HFC, PFC and SF_6 was obtained by the main importers and this data was checked against information from retailers, service companies and producers of equipment.

4.5.4 Uncertainty estimate

2.F.1 Refrigeration and Air Conditioning

The uncertainty of the activity data was estimated to be 10%. The amount imported is reported by the importers whereby the large importers covered 90% of the market in all the years of the time series. (The possible omission of one small importer can therefore be considered as justified).

The emission factor mainly depends on the allocation of the sub sectors which is relatively uncertain. Additionally the uncertainty of the emission factors of the sub sectors is to be considered. Hence its uncertainty is set to 50%.

2.F.2 Foam

Activity data uncertainty is estimated to be 20%. The amounts used are well documented due to the reporting obligation under the Austrian Industrial Gas Ordinance. The amount of foam sold in Austria is an estimate and their share in specific years varies.

The uncertainty of the emission factor is set to 0% as emissions were estimated assuming that 100% are emitted in the first year.

2.F.3 Fire extinguishers

The uncertainty of the activity data is estimated to be 10%. To the stock reported by the plant operators, a rate increase of 10% is added in order to ensure that all activities are covered.

The emission factor for filling and suction at demolition is very uncertain (100%), however in the years when release occurs, release is dominating and is reported.

2.F.4 Aerosols

Activity data uncertainty is estimated to be 20%. In Austria filled amounts are well documented, also the amounts of medical aerosols sold. Sale of novelty sprays is estimated based on data from the EU market, however there is a good conformity with the data reported for Austria.

Most of the aerosol used is emitted to 100%, the emissions from manufacturing are relatively uncertain, therefore total uncertainty of the emission factor is assumed to be 10%.

2.F.5 Solvents

The uncertainty of the activity data is assumed to be 100% as this is an estimation based on the EU market. The uncertainty of the emission factor is set to 0% as emissions were estimated assuming that 100% are emitted in the first year.

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.8 Electrical Equipment

Activity data uncertainty is estimated to be low (5%) as data are reported from industry and additionally 2% is added to the calculation to account for equipment not covered in the reported figures. As for the emission factor, uncertainty is estimated to be very high (100%).

2.F.9 Other Use of SF6

According to emissions levels, 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.

5 SOLVENT AND OTHER PRODUCT USE (CRF SECTOR 3)

5.1 Sector Overview

This chapter describes the methodology used for calculating greenhouse gas emissions from solvent use in Austria. Solvents are chemical compounds, which are used to dissolve substances as paint, glues, ink, rubber, plastic, pesticides or for cleaning purposes (degreasing). After application of these substances or other procedures of solvent use most of the solvents are released into air. Because solvents consist mainly of NMVOC, solvent use is a major source for anthropogenic NMVOC emissions in Austria. Once released into the atmosphere NMVOCs react with reactive molecules (mainly HO-radicals) or high energetic light to finally form CO_2.

Estimations for N_2O emissions from other product use (anaesthesia and aerosol cans) are also addressed in this chapter.

5.1.1 Emission Trends

In the year 2012, 0.4% of total GHG emissions in Austria (334.56 Gg CO_2 equivalents) originated from *Solvent and Other Product Use*. 56% of these emissions were indirect CO_2 emissions, 44% were accounted for by N_2O emissions.

The overall trend in greenhouse gas emissions from solvent and other product use shows decreasing emissions, with a decrease of 35% from 1990 to 2012. The main driver is a decreasing use of solvents as a result of legal measures and decreasing N_2O use. From 2011 to 2012 emissions increased by about 4.6% due to an increased usage of solvents.

Figure 27 and Table 135 present the trend in total greenhouse gas emissions by subcategories.

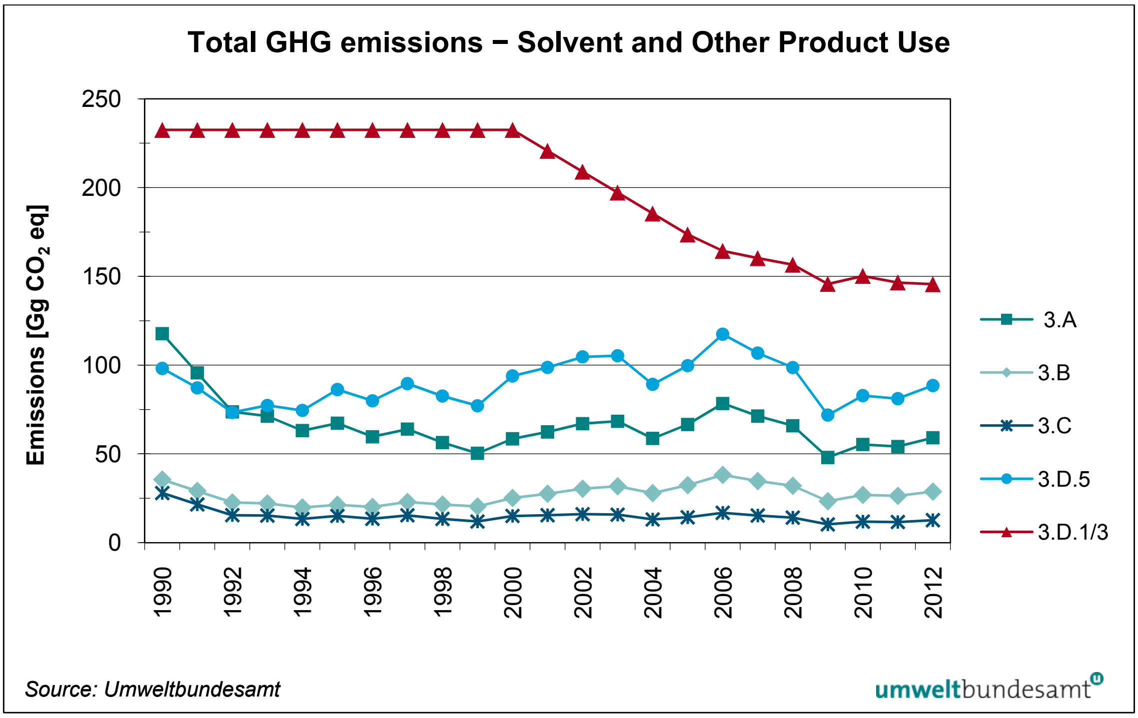

Figure 27: Total greenhouse gas emissions and trend from 1990–2012 by subcategories of Category 3 Solvent and Other Product Use.

Table 135: Total greenhouse gas emissions and trend from 1990–2012 by subcategories of Category 3 Solvent and Other Product Use.

GHG	Total 3	3.A	3.B	3.C	3.D	3.D.1	3.D.3	3.D.5
		Solvent	*Solvent*		*Solvent*	*Use of N_2O*	*Use of N_2O*	*Solvent*
					[Gg CO_2 equivalent]			
1990	511.80	117.70	35.51	27.94	330.65	108.50	124.00	98.15
1991	465.98	95.63	29.10	21.55	319.71	108.50	124.00	87.21
1992	417.65	73.70	22.63	15.48	305.84	108.50	124.00	73.34
1993	418.48	71.30	22.11	15.27	309.80	108.50	124.00	77.30
1994	403.26	63.13	19.79	13.37	306.97	108.50	124.00	74.47
1995	422.45	67.29	21.33	15.08	318.76	108.50	124.00	86.26
1996	405.66	59.65	20.12	13.48	312.41	108.50	124.00	79.91
1997	424.37	63.96	22.94	15.41	322.07	108.50	124.00	89.57
1998	406.32	56.38	21.49	13.38	315.08	108.50	124.00	82.58
1999	392.26	50.33	20.38	11.91	309.63	108.50	124.00	77.13
2000	425.12	58.52	25.17	15.03	326.40	108.50	124.00	93.90
2001	424.82	62.37	27.55	15.47	319.43	96.72	124.00	98.71
2002	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
2011	319.75	54.15	26.35	11.61	227.64	22.54	124.00	81.10
2012	334.56	59.09	28.75	12.67	234.05	21.56	124.00	88.50
Trend 1990–2012	***-34.6%***	***-49.8%***	***-19.0%***	***-54.6%***	***-29.2%***	***-80.1%***	***0.0%***	***-9.8%***

The significant reduction of greenhouse gas emissions in this sector between 1990 and 2012 is mainly due to decreasing solvent and N_2O use as well as due to the positive impact of the enforced laws and regulations in Austria:

- Commission Directive 2010/79/EU of 19 November 2010 on the adaptation to technical progress of Annex III to Directive 2004/42/EC of the European Parliament and of the Council on the limitation of emissions of volatile organic compounds.

  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 as well as the adaptation to technical progress of Annex III to Directive 2004/42/EC of the European Parliament and of the Council on the limitation of emissions of volatile organic compounds (Paints Directive 2004/42/EC).

The Paints Directive has amended the VOC Solvent Emissions Directive through its article 13.

Federal Law Gazette II Nr. 25/2013[55]; amendment of Federal Law Gazette II No. 398/2005[56], amendment of Federal Law Gazette 872/1995[57]; amendment of Federal Law Gazette 492/1991[58] (implementation of Council Directive 2004/42/CE);

- Council Directive 2004/42/CE[59] 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;
- Council Directive 1999/13/EC[60] of March 1999 on the limitation of emissions of volatile organic compounds due to the use of organic solvents in certain activities and installations;
- Ordinance for paint finishing system (surface technology systems): limitation of emission of volatile organic compounds due to the use of organic solvents by activities such as surface coating, painting or varnishing of different materials and products along the entire chain in the painting process in order to combat acidification and ground-level ozone

  Federal Law Gazette 873/1995[61], amendment of Federal Law Gazette 27/1990[62];
- Federal Ozone Law: establishes by various measures a reduction in emissions of ozone precursors NO_x and NMVOC

  Federal Law Gazette 309/1994, amendment of Federal Law Gazette 210/1992[63];

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[55] Verordnung des Bundesministers für Land- und Forstwirtschaft, Umwelt und Wasserwirtschaft über die Begrenzung der Emissionen flüchtiger organischer Verbindungen durch Beschränkungen des Inverkehrsetzens und der Verwendung organischer Lösungsmittel in bestimmten Farben und Lacken (Lösungsmittelverordnung 2005 – LMV 2005), BGBl. II Nr. 25/2013; Umsetzung der Richtlinie 2004/42/EG und der Richtlinie 2010/79/EU

[56] 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

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

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

[59] 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.

[60] 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.

[61] 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.

[62] 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.

[63] 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).

- Ordinance for industrial facilities and installations applying chlorinated hydrocarbon: for limitation of emission of chlorinated organic solvents from industrial facilities and installations applying chlorinated hydrocarbon

  Federal Law Gazette 865/1994[64]*;*
- Convention on Long-range Transboundary Air Pollution (LRTAP)[65], extended by eight protocols from which the following have relevance
  - The 1988 Protocol concerning the Control of Nitrogen Oxides or their Transboundary Fluxes[66];
  - The 1991 Protocol concerning the Control of Emissions of Volatile Organic Compounds or their Transboundary Fluxes[67];
  - The 1998 Protocol on Persistent Organic Pollutants (POPs)[68];
  - The 1999 Protocol to Abate Acidification, Eutrophication and Ground-level Ozone[69].
- Ordinance for volatile organic compounds (VOC) due to the use of organic solvents in certain activities and installations

  Federal Law Gazette II No. 301/2002[70]*, amended by Federal Law Gazette*[71]*;*
- Ordinance on the limitation of emission during the use of solvents containing lightly volatile halogenated hydrocarbons in industrial facilities and installations

  Federal Law Gazette II No. 411/2005[72]*.*

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,

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[64] 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.

[65] Entered into force 14 February 1991; ratified by Austria 16 December 1982; See for more information UMWELTBUNDESAMT (2013): Informative Inventory Report. Vienna.

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

[67] 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

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

[69] Entered into force on 17 May 2005; signed by Austria 1 December 2000.

[70] 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.

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

[72] 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.

  - 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.

But also the N_2O use has significantly decreased due to shorter duration of anaesthesia during operations and more local anaesthetics than general anaesthesia.

Table 136 presents the trend in total greenhouse gas emissions by gas.

Table 136: Trend in greenhouse gas emissions of solvent and other product use 1990–2012.

GHG	CO_2 emission [Gg CO_2 equivalent]	N_2O emission [Gg CO_2 equivalent]	Total [Gg CO_2 equivalent]
1990	279.30	232.50	511.80
1991	233.48	232.50	465.98
1992	185.15	232.50	417.65
1993	185.98	232.50	418.48
1994	170.76	232.50	403.26
1995	189.95	232.50	422.45
1996	173.16	232.50	405.66
1997	191.87	232.50	424.37
1998	173.82	232.50	406.32
1999	159.76	232.50	392.26
2000	192.62	232.50	425.12
2001	204.10	220.72	424.82
2002	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
2011	173.21	146.54	319.75
2012	189.00	145.56	334.56
Trend 1990–2012	***-32.3%***	***-37.4%***	***-34.6%***

5.1.2 Key Categories

The key category analysis is presented in Chapter 1.5. This chapter includes information about the key sources in the solvents sector. CO_2 emissions of this source have been identified as key category.

Table 137: Key sources of solvent and other product use (KCA including LULUCF).

IPCC Category	Source Categories	Key Sources*	
		GHG	KS-Assessment
3.D	Other	N_2O	LA 1990

LA = Level Assessment (if not further specified – for the years 1990 and 2012)

TA = Trend Assessment BY–2012

5.1.3 Completeness

Table 138 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 138: Overview of subcategories of solvents and other product use: transformation into SNAP Codes and status of estimation.

IPCC Category		SNAP		CO_2	N_2O
3.A	Paint application	0601	Paint application	✓	NA
3.B	Degreasing and Dry Cleaning	0602	Degreasing, dry cleaning and electronics	✓	NA
3.C	Chemical Products, Manufacture and Processing	0603	Chemical products manufacturing and processing	✓	NA
3.D	Other	0604	Other use of solvents and related activities	✓	NA
		0605	Use of HFC, N_2O, NH_3, PFC and SF_6	NA	✓

5.2 CO_2 Emissions from Solvent and other product use (Category 3.A, 3.B, 3.C and 3.D.5)

5.2.1 Methodology Overview

CO_2 emissions from solvent use were calculated from NMVOC emissions of this sector. As a first step the quantity of solvents used and the solvent emissions were calculated.

To determine the quantity of solvents used in Austria in the various applications, a bottom up and a top down approach were combined. Figure 28 to Figure 30 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.

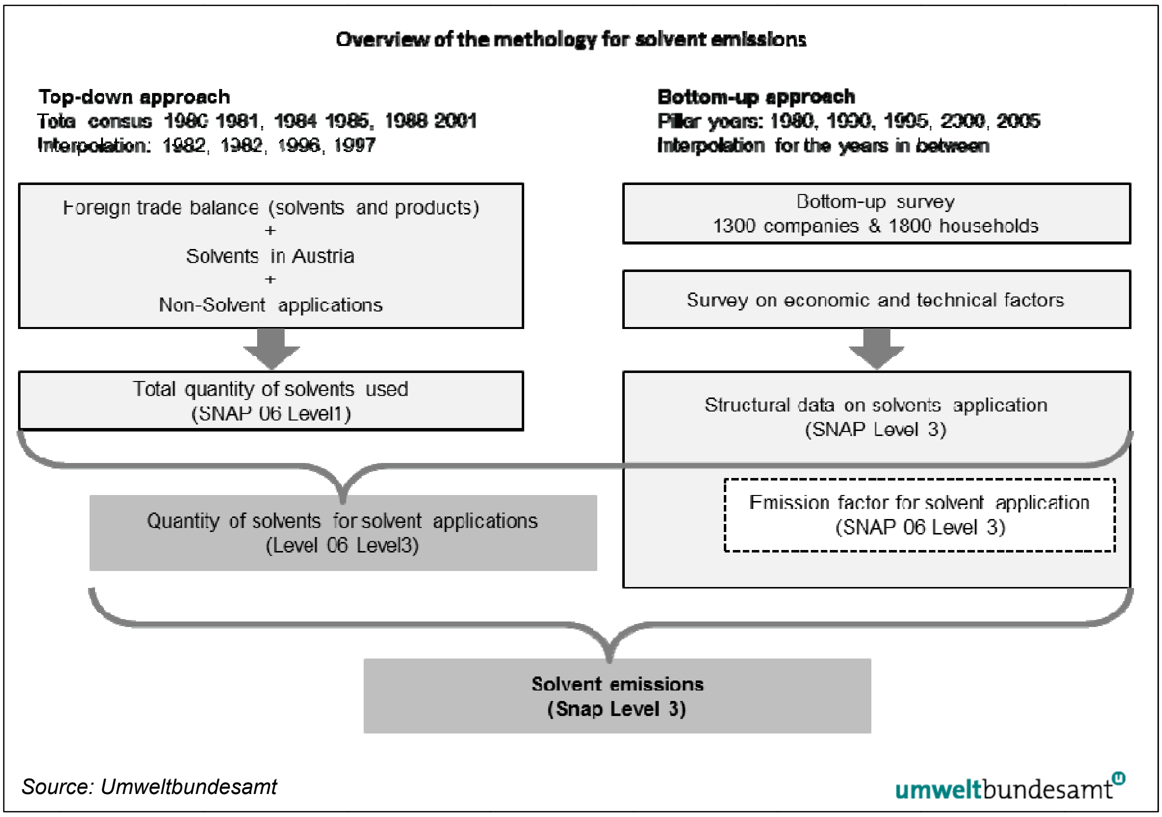


Figure 28: Overview of the methodology for solvent emissions.

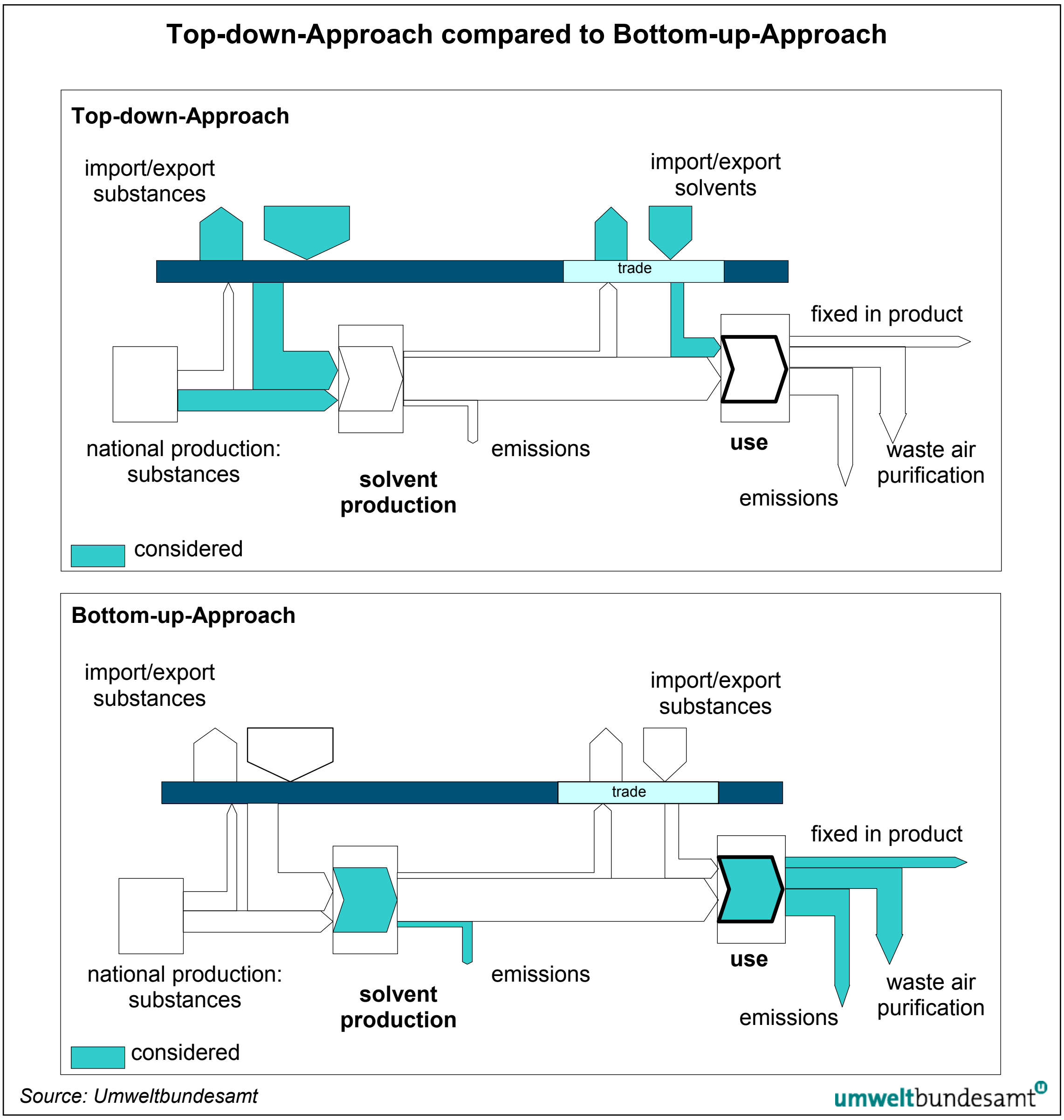


Figure 29: Top-down-Approach compared to Bottom-up-Approach.

Combination of Top-down-Approach compared to Bottom-up-Approach for 2012

Top-down (CRF Sector 3)

Top-down item	Value
Imp/Exp Solvent products	48
Inland Solvent production	283
Imp/Exp Organic Substances	135
Non-solvent applications	-329
Substances used as solvents	-194
Solvents in applications	89
Solvent Activity	137

Bottom-up / **Combination Top-down to Bottom-up**

CRF Sector 3A-3D	SNAP Level 3		Solvent Share CRF 3	Solvent Share CRF 3A-D	Solvent Share SNAP Lev 3	Solvent Emission Factor CRF 3	Solvent Emission Factor CRF 3A-D	Solvent Emission Factor SNAP Lev 3	Solvent Activity CRF 3	Solvent Activity CRF 3A-D	Solvent Activity SNAP Lev 3	Solvent Emissions CRF 3	Solvent Emissions CRF 3A-D	Solvent Emissions SNAP Lev 3
3 A, Paint application	060101	Manufacture of automobiles	**100%**	37%	1,7%	**58%**	43%	59%	**111,4**	41,5	1,8	**64,3**	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
3 B, Degreasing and Dry Cleaning	060201	Metal degreasing		14%	6,0%		55%	43%		15,9	6,7		8,8	2,9
	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
3 C, Chemical Products, Manufacture and Processing	060305	Rubber processing		10%	0,3%		51%	93%		10,7	0,4		5,5	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
3 D, Other	060403	Printing industry		39%	7,3%		74%	65%		43,2	8,1		31,9	5,3
	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

Figure 30: Combination of Top-down-Approach compared to Bottom-up-Approach for 2012 (in Gg).

A study (WINDSPERGER et al. 2002a) showed that emission estimates only based on the top down approach overestimate emissions because a large amount of solvent substances is used for „non-solvent-applications". „Non-solvent application" are applications where substances usually are used as feed stock in chemical, pharmaceutical or petrochemical industry (e.g. production of MTBE[73], ETBE[74], formaldehyde, polyester, biodiesel, pharmaceuticals etc.) and where therefore no emissions from „solvent use" arise. However, there might be emissions from the use of the produced products, such as MTBE and ETBE which is used as fuel additive and finally combusted, these emissions for example are considered in the transport sector.

[73] Methyl-tertiär-butylether

[74] Ethyl-*tert*-butylether

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 2012 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 2002–2012 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 139).

Table 139: 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 (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 140: 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 141: 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 142: Specific aspects and their development: changes in the number of employees compared to the year 2000.

SNAP		Changes in the number of employees compared to the year 2000				
		1980	1990	1995	2000	2005
0601	**Paint application**					
060101	manufacture of automobiles	88%	82%	72%	100%	131%
060102	car repairing	94%	98%	96%	100%	107%
060103	construction and buildings	96%	90%	102%	100%	106%
060104	domestic use	separate analysed				
060105	coil coating	99%	113%	107%	100%	96%
060107	wood coating	107%	109%	112%	100%	90%
060108	industrial paint application	122%	112%	106%	100%	101%
0602	**Degreasing, dry cleaning and electronics**					

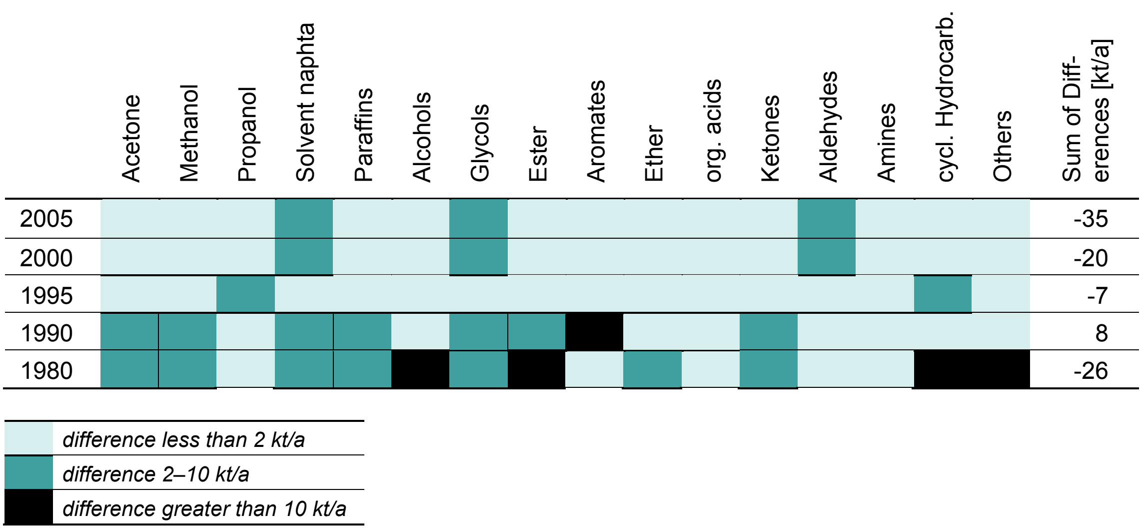
SNAP		Changes in the number of employees compared to the year 2000				
		1980	1990	1995	2000	2005
060201	Metal degreasing	151%	113%	83%	100%	104%
060202	Dry cleaning	63%	75%	88%	100%	103%
060203	Electronic components manufacturing	143%	122%	104%	100%	84%
060204	Other industrial cleaning	33%	77%	56%	100%	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 143). 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 143 shows the range of the differences in the considered pillar years broken down to the 15 substance categories.

Table 143: Differences between the results of the bottom up and the top down approach.



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 144 presents activity data and implied emission factors.

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

Table 144: Activity data for solvent and other product use [Mg] 1990–2012.

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
2011	46 864	2 077	903	3 989	1 763	4 301	3 887	29 945
2012	51 137	2 266	985	4 353	1 924	4 693	4 241	32 676

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
2011	18 002	7 564	454	1 296	8 689
2012	19 643	8 254	495	1 414	9 481

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

IPCC	3.C									
SNAP	Total	060305	060306	060307	060308	060309	060310	060311	060312	060314
Unit	Mg Solvent									
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
2011	12 101	417	7 174	1 012	246	525	602	4	36	2 085
2012	13 204	455	7 829	1 104	268	573	656	5	39	2 275

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
2011	48 770	9 149	131	308	611	166	20 119	5 572	12 714
2012	53 216	9 983	143	336	667	181	21 953	6 080	13 873

5.2.5 Calculation of CO_2 emissions from Solvent Emissions

The basis for the calculation of the carbon dioxide emissions were the quantities of solvent emissions differentiated by the 15 groups of substances (acetone, methanol, propanol, solvent naphtha, paraffins, alcohols, glycols, ester, aromates, ketones, aldehydes, amines, organic acids, cyclic hydrocarbons, and others). Substance specific carbon dioxide factors for these 15 substance groups have been created (see Table 145) on the basis of the carbon content and the stoichiometrically formed CO_2.

Table 145: Substance specific carbon dioxide emission factors.

Substances	CO_2 factor [kg CO_2/kg substance]	Substances	CO_2 factor [kg CO_2/kg substance]
Acetone	2.28	Glycols	1.82
Aldehydes	2.44	Ketones	2.45
Alcohols	1.91	Methanol	1.38
Alcohols/Propanols	2.20	Paraffins	3.14
Aromates	3.33	Residuals	0.92
Cydic Hydrocarbons	3.14	Solvent naphta	3.14
Ester	2.16	Glycols	1.82

The amount of carbon dioxide emissions was disaggregated to SNAP level 3 according to the share of solvents used and solvent emissions that were calculated in the context of the bottom up approach. In Table 146 the carbon dioxide emissions of Category 3 Solvent and Other Product Use for the years 1990 to 2012 are shown.

Table 146: CO_2 emission of Category 3 Solvent and Other Product Use 1990–2012.

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
2011	54.15	3.17	2.11	9.76	4.21	6.30	6.80	21.79
2012	59.09	3.46	2.30	10.65	4.59	6.88	7.42	23.78

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
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
2011	26.35	8.80	0.67	1.22	15.66
2012	28.75	9.61	0.73	1.33	17.08

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

IPCC	3.C									
SNAP	Total	060305	060306	060307	060308	060309	060310	060311	060312	060314
Unit	Gg									
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
2011	11.61	1.15	3.92	2.72	0.44	1.41	0.02	0.01	0.08	1.86
2012	12.67	1.26	4.28	2.97	0.48	1.54	0.02	0.01	0.09	2.03

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	82.82	13.11	0.09	0.58	1.66	0.34	37.30	12.24	17.51
2011	81.10	12.84	0.09	0.57	1.62	0.34	36.53	11.98	17.14
2012	88.50	14.01	0.09	0.62	1.77	0.37	39.86	13.08	18.71

Table 147: Implied CO_2 Emission factors for Category 3 Solvent and Other Product Use 1990–2012.

IPCC	3.A						
SNAP	**060101**	**060102**	**060103**	**060104**	**060105**	**060107**	**060108**
Unit	**[tCO₂/t]**						
1990	2.61	2.57	2.61	2.36	2.39	2.50	1.91
1991	2.42	2.58	2.58	2.29	2.21	2.36	1.66
1992	2.22	2.56	2.52	2.23	2.03	2.21	1.43
1993	2.02	2.52	2.44	2.19	1.86	2.06	1.22
1994	1.82	2.45	2.33	2.19	1.68	1.91	1.03
1995	1.70	2.47	2.30	2.35	1.59	1.84	0.90
1996	1.59	2.33	2.23	2.26	1.50	1.74	0.82
1997	1.60	2.37	2.31	2.32	1.51	1.77	0.81
1998	1.57	2.35	2.35	2.34	1.49	1.76	0.78
1999	1.54	2.33	2.39	2.35	1.47	1.74	0.75
2000	1.53	2.34	2.45	2.39	1.47	1.75	0.73
2001	1.53	2.34	2.45	2.39	1.47	1.75	0.73
2002	1.53	2.34	2.45	2.39	1.47	1.75	0.73
2003	1.53	2.34	2.45	2.39	1.47	1.75	0.73
2004	1.53	2.34	2.45	2.39	1.47	1.75	0.73
2005	1.53	2.34	2.45	2.39	1.47	1.75	0.73
2006	1.53	2.34	2.45	2.39	1.47	1.75	0.73
2007	1.53	2.34	2.45	2.39	1.47	1.75	0.73
2008	1.53	2.34	2.45	2.39	1.47	1.75	0.73
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
2011	1.53	2.34	2.45	2.39	1.47	1.75	0.73
2012	1.53	2.34	2.45	2.39	1.47	1.75	0.73

IPCC	3.B			
SNAP	**060201**	**060202**	**060203**	**060204**
Unit	**[tCO₂/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

IPCC	3.B			
SNAP	060201	060202	060203	060204
Unit	[tCO_2/t]			
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
2011	1.16	1.47	0.94	1.80
2012	1.16	1.47	0.94	1.80

IPCC	3.C								
SNAP	060305	060306	060307	060308	060309	060310	060311	060312	060314
Unit	[tCO_2/t]								
1990	2.88	0.99	2.77	1.78	2.68	0.03	2.18	2.11	1.40
1991	2.88	0.90	2.46	1.61	2.45	0.03	2.23	2.11	1.32
1992	2.85	0.80	2.09	1.38	2.11	0.03	2.22	2.09	1.23
1993	2.81	0.71	2.24	1.49	2.27	0.03	2.19	2.07	1.15
1994	2.75	0.61	2.23	1.47	2.24	0.03	2.12	2.05	1.06
1995	2.79	0.54	2.71	1.76	2.65	0.03	2.13	2.14	1.02
1996	2.66	0.52	2.49	1.62	2.45	0.03	2.05	2.04	0.95
1997	2.71	0.54	2.77	1.80	2.72	0.03	2.12	2.09	0.95
1998	2.72	0.54	2.53	1.65	2.50	0.03	2.14	2.11	0.93
1999	2.73	0.54	2.34	1.53	2.32	0.03	2.15	2.13	0.91
2000	2.77	0.55	2.69	1.78	2.68	0.03	2.18	2.19	0.89
2001	2.77	0.55	2.69	1.78	2.68	0.03	2.18	2.19	0.89
2002	2.77	0.55	2.69	1.78	2.68	0.03	2.18	2.19	0.89
2003	2.77	0.55	2.69	1.78	2.68	0.03	2.18	2.19	0.89
2004	2.77	0.55	2.69	1.78	2.68	0.03	2.18	2.19	0.89
2005	2.77	0.55	2.69	1.78	2.68	0.03	2.18	2.19	0.89
2006	2.77	0.55	2.69	1.78	2.68	0.03	2.18	2.19	0.89
2007	2.77	0.55	2.69	1.78	2.68	0.03	2.18	2.19	0.89
2008	2.77	0.55	2.69	1.78	2.68	0.03	2.18	2.19	0.89
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
2011	2.77	0.55	2.69	1.78	2.68	0.03	2.18	2.19	0.89
2012	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

IPCC	3.D.5							
SNAP	**060403**	**060404**	**060405**	**060406**	**060407**	**060408**	**060411**	**060412**
Unit	**[tCO_2/t]**							
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
2011	1.40	0.66	1.84	2.65	2.03	1.82	2.15	1.35
2012	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 2007) (see Chapter 1.7) the uncertainties of solvent emissions in Austria were determined, and were compared with the results of the detailed analysis of solvent emissions in Austria (WINDSPERGER et al. 2004) (see also NIR 2006). Differences between bottom-up and top-down methodology to estimate emissions were calculated at less than 10%, which is compatible with expert estimates on the uncertainties presented for national statistics. Additional uncertainty has been attributed to the released fraction of solvents employed, reflecting an emission factor (solvents are released as volatile organic compounds, which eventually are converted into CO_2 in the atmosphere).

Using the WINDSPERGER et al. (2004) data, an uncertainty of 5% is attributed to the activity data, and 10% to the emission factor of solvents. According to WINDSPERGER et al. (2004), the uncertainty should decrease and the overall quality improve between 1990 and current data. But according to WINIWARTER (2007) 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.

Table 149 the results of the studies are presented whereas the results of WINIWARTER (2007) are used for calculating the total uncertainty of the Austrian GHG inventory.

Table 148: 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 149: Uncertainties of Sector 3 Solvent and other product use (WINIWARTER 2007).

IPCC Source category	Gas	AD	EF	Combined
			Uncertainty [%]	
3: Solvent and other product use	CO_2	5.0	10.0	11.2

5.3 N_2O Emissions from Solvent and Other Product Use (IPCC Sector 3.D.1, 3.D.2 and 3.D.3)

<table>
<tr><th></th><th>3.D.1
Use of N₂O for anaesthesia</th><th>3.D.3
Use of N2O in aerosol cans</th><th>3.D.2
Use of N2O in fire extinguishers</th></tr>
<tr><td>GHG key category</td><td>no</td><td>no</td><td>not occurring</td></tr>
<tr><td>Gas</td><td>N2O emission from the use of anaesthesia</td><td>N2O emission from the use of aerosol cans</td><td>–</td></tr>
<tr><td rowspan="2">Activity</td><td>N2O consumption of anaesthesia</td><td>N2O consumption in aerosol cans</td><td rowspan="2">N2O is not flammable, but has oxidising properties. There is no evidence of this gas being used in fire extinguishers in Austria.</td></tr>
<tr><td>Due to new industry inquiries (ÖIGV 2013) the amount of N2O used for anaesthesia was updated for the years 2001–2012.</td><td>It is assumed that the use of N2O for aerosol cans is constant at 400 tons per year. This estimate is based on expert judgement and industry inquiries (ÖIGV 2013).</td></tr>
<tr><td rowspan="2">Method</td><td colspan="2">A specific methodology for these activities has not been prepared yet.[75]</td><td rowspan="2">–</td></tr>
<tr><td>100% of N2O used for anaesthesia is released into atmosphere</td><td>100% of N2O used for aerosol cans is released into atmosphere</td></tr>
<tr><td>emission factor</td><td colspan="2">activity data = emission
1.00 Mg N2O/Mg product use</td><td>–</td></tr>
</table>

Table 150: N_2O-consumption of anaesthesia and N_2O-consumption in aerosol cans.

	3.D	3.D.1	3.D.3
	Total (use of N_2O)	use of N_2O for anaesthesia	use of N_2O in aerosol cans
Unit		Gg	
1990	0.750	0.350	0.400
1991	0.750	0.350	0.400
1992	0.750	0.350	0.400
1993	0.750	0.350	0.400
1994	0.750	0.350	0.400
1995	0.750	0.350	0.400
1996	0.750	0.350	0.400
1997	0.750	0.350	0.400
1998	0.750	0.350	0.400
1999	0.750	0.350	0.400
2000	0.750	0.350	0.400
2001	0.712	0.312	0.400
2002	0.674	0.274	0.400
2003	0.636	0.236	0.400
2004	0.598	0.198	0.400

[75] 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_2O)	**use of N_2O for anaesthesia**	**use of N_2O in aerosol cans**
Unit		**Gg**	
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
2011	0.473	0.073	0.400
2012	0.470	0.070	0.400
Trend 1990–2012	***-37.4%***	***-80.1%***	***0.0%***

5.3.1 Uncertainty Assessment for N_2O Emissions from Solvent and Other Product Use

Direct use of N_2O has been specifically collected from industry experts in Austria. According to (WINIWARTER 2007) pursuant to (RAMIREZ et al. 2006) an uncertainty of 20% for the amount of N_2O is used. In contrast to Ramirez, it is assumed that virtually all of the N_2O actually used is also fully released thus no additional uncertainty is applied.

Table 151: Uncertainties of Sector 3.D Solvent and other product use.

IPCC Source category	Gas	AD	EF	Combined
			Uncertainty [%]	
3 Solvent and other product use	N_2O	20.0	0	20.0

5.4 Recalculations

Update of activity data

3.A Paint application, 3.B Degreasing and dry cleaning, 3.C Chemical products, 3.D OTHER including containing HMs and POPs – CO_2 emissions

The usage of the latest production statistics data (special reporting of solvent containing substances and products) slightly changed the CO_2 emissions 2011 (+0.03 Gg).

3.D.1 Use of N_2O for anesthesia – N_2O emissions

Updated information for the usage of N_2O for medical purpose leads to a reduction of N_2O emissions (−4.5 Gg CO_2eq in 2011).

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 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). Data on AWMS was taken from the research project „Animal husbandry and manure management systems in Austria" (AMON et al. 2007), a comprehensive survey on the agricultural practice in Austria.

Emission calculations follow the methodologies according to the Revised 1996 IPCC Guidelines and the IPCC Good Practice Guidance 2000.

Austria follows the N-flow approach by using country specific methodologies for the calculation of direct N_2O emissions from animal manure applied to soils (4.D.1.2) and indirect N_2O emissions from leaching and run-off (4.D.3.2). In response to a recommendation of the ERT (ARR 2013, para 51 and 52) additional descriptions have been included in the NIR 2014, Annex 6. Methodological details regarding the calculation of gaseous N losses of NH_3 and NO_X are extensively described in Austria's Informative Inventory Report 2014 (UMWELTBUNDESAMT 2014a).

To give an overview of Austria's agricultural sector some information is provided below (BMLFUW 2000–2013):

Agriculture in Austria is small-structured: 173 317 farms are managed, 56.3% of these farms manage less than 20 ha, whereas only 4.2% of the Austrian farms manage more than 100 ha cultivated area. 129 117 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 2.88 million hectares that is a share of ~ 39% of the total territory (forestry ~ 46%, other area ~ 14%). The shares of the different agricultural activities are as follows:

- 48% arable land,
- 20% grassland (meadows mown several times and seeded grassland),
- 30% 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 2012 the sector agriculture contributed 9.4% to the total of Austria's greenhouse gas emissions (without LULUCF). The trend of GHG emissions from 1990 to 2012 shows a decrease of 12.4% for this sector (see Figure 31 and Table 153) due to a decrease in activity data.

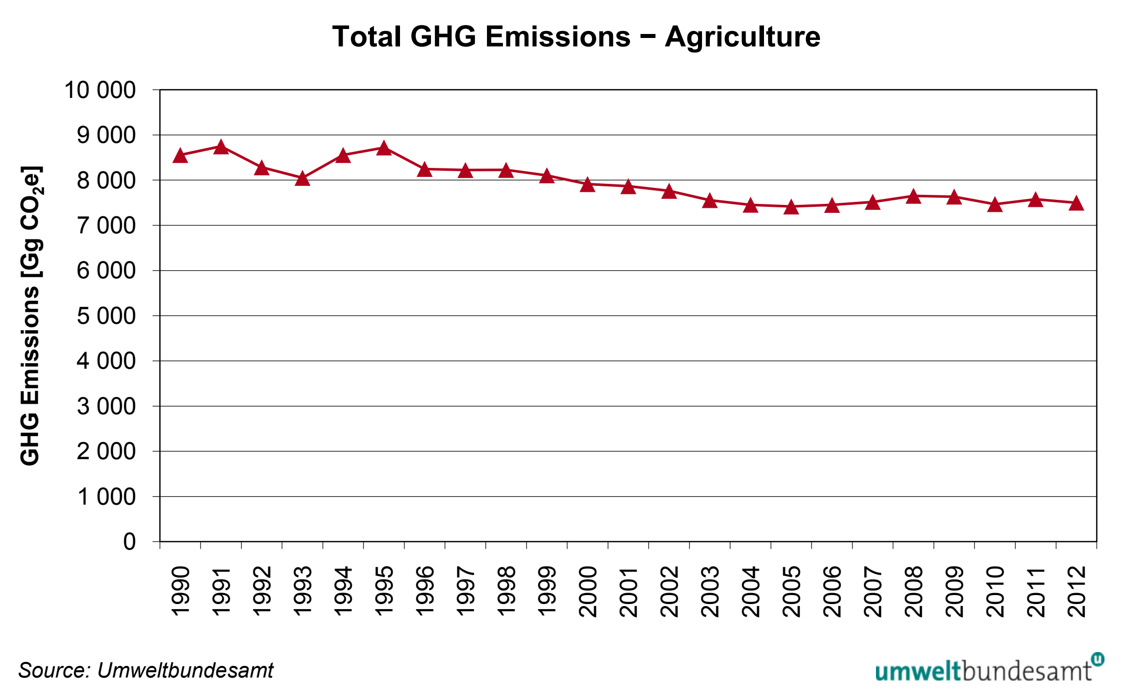


Figure 31: Trend of total GHG emissions from agriculture.

The main drivers for the trend shown in Figure 31 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 2011 to 2012 emissions decreased by 1.0% due to decreased livestock numbers of cattle and swine.

Emission trends per gas

From 1990 to 2012 CH_4 emissions from agriculture decreased by 15.9%, N_2O emissions decreased by 9.0%. The trends are presented in Table 152.

Table 152: Emissions of greenhouse gases from 1990–2012 from agriculture.

Year	GHG emissions [Gg]	
	CH_4	N_2O
1990	199.63	14.08
1991	196.68	14.89
1992	188.75	13.94
1993	188.92	13.17
1994	188.82	14.81
1995	192.07	15.12
1996	188.84	13.81
1997	185.59	13.96
1998	184.22	14.06
1999	182.09	13.81
2000	180.66	13.28
2001	178.33	13.29
2002	174.49	13.22

Year	GHG emissions [Gg]	
	CH_4	N_2O
2003	172.72	12.68
2004	172.36	12.37
2005	170.30	12.39
2006	169.65	12.54
2007	170.34	12.71
2008	169.66	13.19
2009	171.82	12.99
2010	171.47	12.48
2011	169.17	12.99
2012	167.92	12.82
Trend 1990–2012	***-15.9%***	***-9.0%***

Emission trends per sub category

Table 153 presents total GHG emissions and trend 1990–2012 from agriculture by sub-categories as well as the contribution to the overall inventory emissions. Important categories are *4.A enteric fermentation* (4.0%) and *4.D agricultural soils* (3.8%) followed by *4.B manure management* (1.6%).

Table 153: GHG emissions 1990–2012 of agriculture by categories.

Year	GHG emissions [Gg CO_2 equivalent] by categories				
	4	4.A	4.B	4.D	4.F
1990	8 556.71	3 753.35	1 364.88	3 437.02	1.47
1991	8 746.36	3 698.38	1 357.82	3 688.73	1.43
1992	8 283.60	3 544.26	1 319.90	3 418.00	1.45
1993	8 049.85	3 542.65	1 332.13	3 173.76	1.31
1994	8 555.85	3 546.97	1 333.77	3 673.69	1.42
1995	8 719.98	3 613.63	1 364.04	3 740.91	1.40
1996	8 245.83	3 555.65	1 343.30	3 345.56	1.32
1997	8 223.61	3 492.76	1 337.43	3 392.04	1.39
1998	8 227.18	3 466.50	1 335.92	3 423.40	1.36
1999	8 104.83	3 436.75	1 316.03	3 350.66	1.39
2000	7 912.11	3 416.88	1 292.87	3 201.12	1.23
2001	7 865.46	3 370.08	1 288.65	3 205.36	1.38
2002	7 763.42	3 301.14	1 265.00	3 195.98	1.31
2003	7 557.19	3 269.81	1 261.01	3 025.16	1.21
2004	7 453.77	3 269.55	1 256.63	2 925.75	1.84
2005	7 415.93	3 228.63	1 247.40	2 938.73	1.18
2006	7 451.60	3 217.91	1 245.10	2 987.49	1.10
2007	7 516.97	3 230.73	1 254.46	3 030.66	1.12
2008	7 652.61	3 223.99	1 247.69	3 179.81	1.12
2009	7 633.61	3 265.35	1 262.07	3 105.14	1.05
2010	7 468.13	3 256.24	1 267.32	2 943.59	0.98
2011	7 578.42	3 214.66	1 251.21	3 111.75	0.79
2012	7 499.03	3 192.73	1 241.56	3 064.12	0.62
Share in Austrian Total 2012	*9.4%*	*4.0%*	*1.6%*	*3.8%*	*0.0%*
Trend 1990–2012	***-12.4%***	***-14.9%***	***-9.0%***	***-10.8%***	***-58.1%***

As can be seen in Figure 32 and Table 153 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).

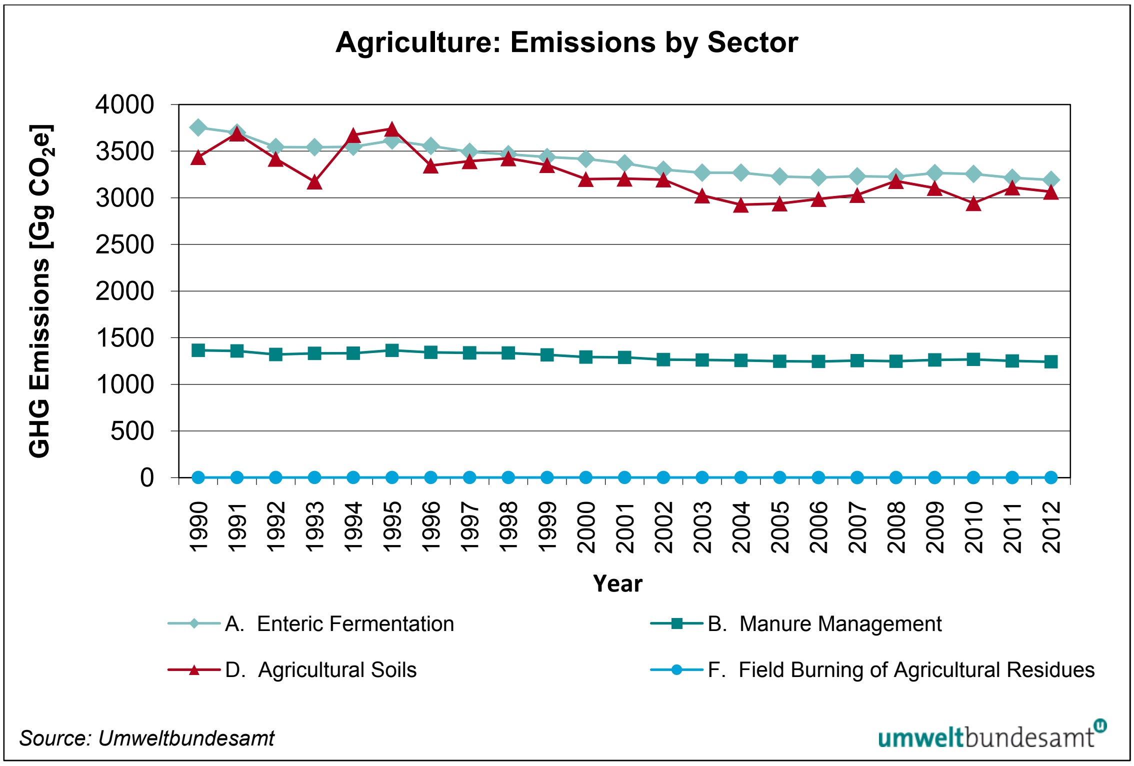


Figure 32: Emission trends of agriculture by categories.

As can be seen in Table 154, in 2012 about 43% of emissions from agriculture originate from enteric fermentation and 41% from agricultural soils. Manure management contributes 17% and field burning of agricultural wastes contributes only a negligible part (0.01% in 2012).

Table 154: Share of categories of agriculture, 1990 and 2012.

	GHG emissions [%] by sub categories				
Year	**4**	**4.A**	**4.B**	**4.D**	**4.F**
1990	100.0%	43.9%	16.0%	40.2%	0.0%
2012	100.0%	42.6%	16.6%	40.9%	0.0%

6.1.2 Key Categories

The key category analysis is presented in Chapter 1.5. This chapter includes information about the agriculture sector. Key sources within this category are presented in Table 155.

Table 155: Key categories of agriculture (KCA including LULUCF).

IPCC Category	Source Categories	Key Categories	
		GHG	**KS-Assessment***
4.A.1	Cattle	CH_4	LA; TA
4.B.1	Cattle	N_2O	LA
4.B.1	Cattle	CH_4	LA
4.D.1	Direct Soil Emissions	N_2O	LA
4.D.3	Indirect Emissions	N_2O	LA; TA

LA = Level Assessment (if not further specified – for the years 1990 and 2012)

TA = Trend Assessment BY–2012

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 for manure management) 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, Tier 2 emission factors from Switzerland (gross energy intake, methane conversion rate) were used as Tier 1. Farming practices in Switzerland are very similar to the Austrian ones.

In response to a recommendation of the ERT, Austria revised its figures on AWMS distribution within the inventory 2009 (submission 2010). Updated AWMS data are 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) were 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).

Except for the housing system 'deep litter', which was introduced in the inventory revision 2009, the emission factors of the IPCC good practice guidance were used. For deep litter emission factors of the latest scientific literature available were 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.

The following table presents an overview of the country specific data used in the agriculture inventory including a short indication on the sources for this data as recommended in the ARR 2013, Table 8 (para 49).

Table 156: Information on country specific data.

Category	Parameter	Source
4.A Enteric Fermentation		
4.A.1 Cattle	GE-Intake	PÖTSCH (2005), GRUBER & PÖTSCH (2006), GRUBER & STEINWIDDER (1996)
4.A.9 Poultry	CH_4 EF	SBV (2007), HADORN & WENK (1996)
4.B Manure Management		
4.B (all livestock)	AWMS distribution	AMON & HÖRTENHUBER (2010)
4.B (cattle, swine, chicken, horses)	Amount of digested manure	AMON (2002), E-CONTROL (2013)
4.B.1 Cattle	VS e xcretion	PÖTSCH (2005), GRUBER & STEINWIDDER (1996)
4.B.8 Swine	VS excretion	SCHECHTNER (1991)
4.B.1 Cattle, 4.B.8 Swine	MCF liquid systems	AMON et al. (2006), AMON et al. (2007a)
4.B (cattle, swine, chicken, horses)	MCF anaerobic digestion	FNR (2010); AMON, T. (2011)
4.B (all livestock)	N excretion	PÖTSCH (2005), GRUBER & PÖTSCH (2006), STEINWIDDER & GUGGENBERGER (2003), UNTERARBEITSGRUPPE N-ADHOC (2004) UND ZAR (2004)
4.D. Agricultural Soils		
Austria's N-flow model	Country-specific consideration of N-losses	(AMON et al. 2002, 2008 & 2010)
4.D.1 Direct Soil Emissions		
N-fixing crops	N fixation rate	UMWELTBUNDESAMT (1998a)
Crop residues	$Frac_{NCRO}$, $Frac_{NCRBF}$, $Frac_R$	UMWELTBUNDESAMT (1998a)
Sewage sludge spreading	CH_4 EF	DETZEL et al. (2003), SCHÄFER (2002)
4.D.3 Indirect Soil Emissions		
Austria's N-flow model	Country-specific consideration of N-losses	(AMON et al. 2002, 2008 & 2010)

Background information on the parameters listed above is provided in the methodological descriptions of the respective chapters of NIR.

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 2000–2013),
- ✓ 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).

In the Austrian QMS regularly extensive QA and verification activities are carried out (Tier 2 QA). In 2012 Agriculture was validated. Some minor inconsistencies with respect to the AWMS data have been found and corrected.

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

6.1.5 Uncertainty Assessment

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

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

Animal waste management systems distribution (AWMS)

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

Country specific MCF for liquid manure systems:

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). Published results have been integrated into the revised GHG inventory. The country specific MCFs reflect the agricultural practice and the climate conditions in Austria better than the default values. Thus, uncertainties could be reduced to ± 20% (AMON & HÖRTENHUBER 2010).

Activity data and emission factors

Animal numbers have been estimated at 10% uncertainty and have been considered statistically independent (WINIWARTER 2007). 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 2007) 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 157 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 157: Uncertainties of emissions and emission factors (key categories agriculture).

Categories		**CH_4 Emissions**	**N_2O Emissions**	**EF CH_4**	**EF N_2O**
4.A.1	Cattle	+/-22.4%	–	+/-20%	–
4.B.1	Cattle	+/-51.0%	+/- 100,5%	+/-50%	+/-100%
4.D.1	Direct 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

Improvements of methodologies and emission factors

4.B Manure Management

The amount of anaerobic digested manure has been updated on the basis of a new feedstock balance provided by the Austrian Energy Regulator E-Control. The revision caused slightly higher methane emissions in previous years and minor changes in N_2O emissions.

6.1.7 Completeness

Table 158 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 158: Overview of sub-categories of agriculture: transformation into SNAP codes and status of estimation.

IPCC Category		SNAP		CH_4	N_2O
4.A	**ENTERIC FERMENTATION**	**1004**	**ENTERIC FERMENTATION**	✓	**NA**
4.A.1	Cattle	–	–	✓	NA
4.A.1.a	Dairy Cattle	100401	Dairy cows	✓	NA
4.A.1.b	Non-Dairy Cattle	100402	Other cattle	✓	NA
4.A.2	Buffalo	100414	Buffalos	NO	NO
4.A.3	Sheep	100403	Ovines	✓	NA
4.A.4	Goats	100407	Goats	✓	NA
4.A.5	Camels and Lamas	100413	Camels	NO	NO
4.A.6	Horses	100405	Horses	✓	NA
4.A.7	Mules and Asses	100406	Mules and asses	IE[1)]	NA
4.A.8	Swine	100404	Fattening pigs	✓	NA
4.A.9	Poultry	100408 /09/10	Laying hens, broilers, other poultry	✓	NA
4.A.10	Other	100415	Deer	✓	NA
4.B.	**MANURE MANAGEMENT**	**1005** **1009**	**MANURE MANAGEMENT REGARDING ORGANIC COMPOUNDS** **MANURE MANAGEMENT REGARDING NITROGEN COMPOUNDS**	✓ **NO**	**NO** ✓
4.B.1	Cattle	–	–	✓	✓
4.B.1.a	Dairy Cattle	100501	Dairy cows	✓	✓
4.B.1.b	Non-Dairy Cattle	100502	Other cattle	✓	✓
4.B.2	Buffalo	100514	Buffalos	NO	NO
4.B.3	Sheep	100505	Ovines	✓	✓
4.B.4	Goats	100511	Goats	✓	✓
4.B.5	Camels and Lamas	100513	Camels	NO	NO
4.B.6	Horses	100506	Horses	✓	✓
4.B.7	Mules and Asses	100506	Mules and asses	IE[2)]	IE[2)]
4.B.8	Swine	100503	Fattening pigs	✓	✓
4.B.9	Poultry	100507 /08/09	Laying hens, broilers, Other poultry (ducks, gooses,…)	✓	✓
4.B.10	Other Livestock	100515	Deer	✓	✓
4.B.11	Anaerobic	–	Anaerobic	NO	NO
4.B.12	Liquid Systems	–	Liquid Systems	IE[3)]	✓
4.B.13	Solid Storage	–	Solid Storage and Dry Lot	IE[3)]	✓
4.B.14	Other	–	Other management	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.1	Cultivation of Histosols	–	–	NO[5)]	NO[5)]
4.D.2	Pasture, Range and Paddock Manure	1002	Cultures without fertilizers	NO	✓

IPCC Category		SNAP		CH_4	N_2O
4.D.3	Indirect Emissions	1001/10 02	Cultures with and without fertilizers	NO	✓
4.E	**PRESCRIBED BURNING OF SAVANNAS**	**–**	**–**	**NO**	**NO**
4.F	**FIELD BURNING OF AGRICULTURAL RESIDUES**	**1003**	**ON-FIELD BURNING OF STUBBLE, STRAW, …**	✓	✓
4.F.1	Cereals	100301	Cereals	✓	✓
4.F.2	Pulses	100302	Pulse	NO	NO
4.F.3	Tubers and Roots	100303	Tuber and Root	NO	NO
4.F.4	Sugar Cane	100304	Sugar Cane	NO	NO
4.F.5	Other: Vine	100305 [0907]	Other: Open burning of agricultural wastes (except 1003)	✓	✓

1) *included in 4.A.6 Horses, SNAP 100406*

2) *included in 4.B.6 Horses, SNAP 100506*

3) *CH_4 emissions included in 4.B.1 to 4.B.10*

4) *CH_4 emissions from sewage sludge spreading*

5) *4.D.1.5 Cultivation of Histosols is not occurring in Austria („NO"): There are no annually cultivated organic soils in the Austrian grassland area. Furthermore, assessments of the Austrian agricultural soil inventories showed that there is no cropland on organic soils in Austria.*

6.1.8 Planned Improvements

Indirect N_2O emissions from leaching and run-off

At present specific research activities are going on at the Institute for Land & Water Management Research Petzenkirchen (Federal Agency for Water Management) in cooperation with the Institute of Hydraulic Engineering and Water Resources Management (Vienna University of Technology). Within the national research project a CS value of $Frac_{LEACH}$ will be derived in consistency with the requirements of the IPCC 2006 guidelines, equation 11.10. Additionally, study results will allow an assessment for $Frac_{LEACH}$ based on formula 4.36 from the IPCC good practice guidance. First results indicate that this factor is considerable smaller than the IPCC default value of 0.3 currently used in the Austrian inventory. The final report is expected for autumn 2014.

6.2 Enteric fermentation (CRF category 4.A)

This chapter describes the estimation of CH_4 emissions from enteric fermentation. In 2012 90.5% of agricultural CH_4 emissions arose from this category.

6.2.1 Source Category Description

CH_4 emissions amounted to 178.7 Gg in the 'Kyoto' base year and have decreased by 14.9% to 152.0 Gg in 2012. Almost all emissions of category 4.A (93.5% in 2012) are caused by cattle farming, thus CH_4 emissions from *Cattle (4.A.1)* are a key source. The contribution of *Dairy Cattle (4.A.1.a)* decreased from 49.1% in 1990 to 40.9% in 2012.

Table 159: Greenhouse gas emissions from enteric fermentation by sub-categories 1990–2012.

Year	CH₄ 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**
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
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	155.06	61.78	83.22	2.87	0.36	1.47	4.70	0.28	0.38
2011	153.08	61.79	81.40	2.89	0.36	1.47	4.51	0.28	0.38
2012	152.03	62.25	79.89	2.92	0.37	1.47	4.47	0.28	0.38
Share 2012	*100%*	*40.9%*	*52.5%*	*1.9%*	*0.2%*	*1.0%*	*2.9%*	*0.2%*	*0.3%*
Trend 1990–2012	***-14.9%***	***-29.1%***	***-1.7%***	***17.7%***	***96.1%***	***65.9%***	***-19.1%***	***6.0%***	***28.2%***

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 CH_4 emissions from *Non-Dairy Cattle* are reported separately:

Table 160: Greenhouse gas emissions from non-dairy cattle (4.A.1.b) by sub-categories 1990–2012.

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
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
2011	81.40	24.51	20.18	11.91	15.89	8.91
2012	79.89	23.71	20.36	11.96	15.45	8.41
Share 2012	*100%*	*29.7%*	*25.5%*	*15.0%*	*19.3%*	*10.5%*
Trend 1990–2012	***-1.7%***	***444.8%***	***-33.6%***	***-28.7%***	***-22.9%***	***-10.6%***

The rise in suckling cow numbers (see Table 161) counterbalances the decreasing emission trend of all the other non-dairy cattle sub-categories. 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 CH_4 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 2012) provides national data of annual livestock numbers on a very detailed level. These data are based on livestock counts held in December each year[76].

In Table 161 and Table 162 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.

[76] For cattle livestock counts are also held in June, but seasonal changes are very small (between 0% and 2%). Livestock counts of sheep are only held in December (sheep is only a minor source for Austria and seasonal changes of the population are not considered relevant).

1998–2000; 2006–2008: increasing/decreasing swine numbers: The production of swine has a high elasticity to prices: Swine numbers are changing due to changing market prices very rapidly. Market prices change due to changes in consumer behavior, saturation of swine production, epidemics, etc.

Table 161: Domestic livestock population and its trend 1990–2012 (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
2011	527 393	1 449 134	256 831	623 364	184 160	245 770	139 009
2012	523 369	1 432 249	248 438	628 715	184 932	238 968	131 196
Trend 1990–2012	***-42.1%***	***-14.7%***	***428.4%***	***-32.0%***	***-27.6%***	***-21.7%***	***-10.3%***

* *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 162: Domestic livestock population and its trend 1990–2012 (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
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
2011	3 004 907	2 011 138	275 874	717 895	361 183	72 358
2012	2 983 158	2 001 150	263 200	718 808	364 645	73 212
Trend 1990–2012	***-19.1%***	***-14.7%***	***-31.2%***	***-25.0%***	***17.7%***	***96.1%***

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

Table 163: Domestic livestock population and its trend 1990–2012 (III).

Year	Population size [heads] * Livestock category				
	Poultry	**Chicken**	**Other Poultry**	**Horses**	**Other ****
1990	13 820 961	13 139 151	681 810	49 200	37 100
1991	14 397 143	13 478 820	918 323	57 803	37 100
1992	13 683 900	12 872 100	811 800	61 400	37 100
1993	14 508 473	13 588 850	919 623	64 924	37 100
1994	14 178 834	13 265 572	913 262	66 748	37 736
1995	13 959 316	13 157 078	802 238	72 491	40 323
1996	12 979 954	12 215 194	764 760	73 234	41 526
1997	14 760 355	13 949 648	810 707	74 170	56 244
1998	14 306 846	13 539 693	767 153	75 347	50 365

Year	Population size [heads] * Livestock category				
	Poultry	Chicken	Other Poultry	Horses	Other **
1999	14 498 170	13 797 829	700 341	81 566	39 086
2000	11 786 670	11 077 343	709 327	81 566	38 475
2001	12 571 528	11 905 111	666 417	81 566	38 475
2002	12 571 528	11 905 111	666 417	81 566	38 475
2003	13 027 145	12 354 358	672 787	87 072	41 190
2004	13 027 145	12 354 358	672 787	87 072	41 190
2005	13 027 145	12 354 358	672 787	87 072	41 190
2006	13 027 145	12 354 358	672 787	87 072	41 190
2007	13 027 145	12 354 358	672 787	87 072	41 190
2008	13 027 145	12 354 358	672 787	87 072	41 190
2009	13 027 145	12 354 358	672 787	87 072	41 190
2010	14 644 413	13 918 813	725 600	81 637	47 575
2011	14 644 413	13 918 813	725 600	81 637	47 575
2012	14 644 413	13 918 813	725 600	81 637	47 575
Trend 1990–2012	***6.0%***	***5.9%***	***6.4%***	***65.9%***	***28.2%***

** 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 INVEKOS[77] 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 2000–2013). 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 2000–2013) 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 164 shows the results of the shares of organic farming in the relevant livestock categories for 1990 and 2012.

[77] 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 164: Share of cattle population under organic farming systems 1990 and 2012.

IPCC Category	% organic 1990	% organic 2012
CATTLE	1%	19%
Dairy Cattle > 2 yr	1%	18%
Suckling Cows > 2 yr	2%	34%
Other Cattle > 2 yr	1.5%	17%
Young Cattle < 1 yr	1%	17%
Young Cattle 1–2 yr	1%	17%

6.2.2.1 Cattle (4.A.1)

Key Source: Yes (CH_4)

CH_4 emissions from enteric fermentation – cattle (sum of dairy and non-dairy cattle) are a key source due to the contribution to total greenhouse gas emissions in Austria and also due to its contribution to the total inventory's trend. In the year 2012, emissions from enteric fermentation – cattle contributed 3.7% to total greenhouse gas emissions in Austria.

CH_4 emissions were calculated using the IPCC Tier 2 methodology. Activity data were obtained from national statistics and are presented in Table 161 and Table 162.

Emission factors

Country specific emission factors were used. They were calculated from the specific gross energy intake and the methane conversion rate (GPG, Equation 4.14).

$EF = (GE * Y_m * 365 \text{ days/yr})/55.65$ MJ/kg

Y_m *Methane conversion rate*

The methane conversion rate (Y_m) was taken from the IPCC recommended value for „all other cattle" (0.06 +/-8.3%) because there are few if any feedlot cattle with a high-energy diet (i.e. with 90% or more of the diet in form of concentrates) in Austria.

Country specific values for the Gross Energy Intake were applied. The estimation was done separately for dairy and non-dairy cows.

GEGross 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 165: 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
animal weight	kg/cow/yr	700	700	700	700	700	700	700	700
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}	235.3	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 6 418 kg/cow (2012). The time series of average milk yields per dairy cow was taken from national statistics and are presented in Table 166. For dairy cattle there was a 22.5% increase of GE intake between 1990 and 2012 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 166: Annual milk yield, gross energy intake and emission factors of dairy cattle 1990–2012.

Year	Milk Yield	Gross Energy Intake	Emission Factor
	[kg/cow*yr]	[MJ/head*day]	[kg CH_4/head*yr]
1990	3 791	246.75	97.10
1991	3 800	246.88	97.16
1992	3 905	248.39	97.75
1993	3 948	248.79	97.91
1994	4 076	251.21	98.86
1995	4 619	261.47	102.90
1996	4 670	262.44	103.28
1997	4 787	264.65	104.15
1998	4 924	267.25	105.17
1999	5 062	270.17	106.32
2000	5 210	273.73	107.72
2001	5 394	278.17	109.47
2002	5 487	280.41	110.35
2003	5 638	283.92	111.73
2004	5 802	287.72	113.23
2005	5 783	287.28	113.05
2006	5 903	290.07	114.15
2007	5 997	292.26	115.01
2008	6 059	293.73	115.59
2009	6 068	293.93	115.67
2010	6 100	294.69	115.97
2011	6 227	297.72	117.16
2012	6 418	302.26	118.95

[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 breeds. 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. Anyhow, the traditional Austrian breed "Fleckvieh" still dominates the herd.

In the CRF tables 4.A and 4.B(a) Austria reports for the typical animal mass of dairy cattle a constant value of 700kg over the entire time series. This value is in line with the Austrian calculation model which applies for all reported years the average weight of the dominant Austrian breed "Fleckvieh" (700kg). Following the Austrian nutrition expert Dr. Erich Pötsch, the calculation with average animal masses of 700kg is the best approach for average milk yields lower than 7 000kg/hd/yr in Austria. Lower animal weights of high-yield breeds (e.g. Holstein Friesian: 640kg) will be considered for average milk yields from 7 000kg onwards. The chosen approach prevents emissions from being underestimated (ARR 2013, para 50).

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 235.21 MJ per suckling cow and day (see Table 167).

In a study 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 (STEINWIDDER et al. 2006). 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 242.53 MJ per suckling cow and day. Values between 1990 and 2004 have been derived by interpolation (see Table 167).

Table 167: Annual milk yield, gross energy intake and emission factors of suckling cows 1990–2012.

Year	Milk Yield	Gross Energy Intake	Emission Factor
	[kg/cow*yr]	[MJ/head*day]	[kg CH_4/head*yr]
1990	3 000	235.21	92.56
1991	3 036	235.73	92.77
1992	3 071	236.25	92.97
1993	3 107	236.78	93.18
1994	3 143	237.30	93.38
1995	3 179	237.82	93.59
1996	3 214	238.35	93.80
1997	3 250	238.87	94.00
1998	3 286	239.39	94.21
1999	3 321	239.92	94.41
2000	3 357	240.44	94.62
2001	3 393	240.96	94.83
2002	3 429	241.48	95.03
2003	3 464	242.01	95.24
2004	3 500	242.53	95.44
2005	3 500	242.53	95.44
2006	3 500	242.53	95.44
2007	3 500	242.53	95.44
2008	3 500	242.53	95.44
2009	3 500	242.53	95.44
2010	3 500	242.53	95.44
2011	3 500	242.53	95.44
2012	3 500	242.53	95.44

Other non-dairy cattle categories:

Gross energy intake for all other cattle categories were calculated from typical Austrian diets. Animal nutrition expert Andreas Steinwidder worked out animal diets as shown in Table 168 and Table 169 (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 168: 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 169: 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 1990–2012, 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 170: 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]
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 159, CH_4 emissions from sheep, goats, horses, swine, poultry and 'other' (furred game) are only minor emission sources of enteric fermentation. Together they contributed 6.5% to total emissions from this category in 2012. The most important sub-category is swine, with a contribution of 2.9%, followed by sheep (1.9%), horses (1.0%), 'other' (furred game/deer) (0.3%) as well as goats and poultry with each about 0.2% (figures are also presented in Table 159).

The IPCC Tier 1 methodology and default emission factors have been used (see Table 171):

Table 171: 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 furred game were estimated applying the default emission factor of sheep which 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 Ym value is based on an in vivo trial with broilers (HADORN & WENK 1996). Activity data were obtained from national statistics and are presented in Table 161 and Table 162.

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.

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;
- ✓ Expanded QA and verification activities in 2012: in-depth review of the agriculture model.

Sector specific routine control procedures are provided in chapter 6.1.4

6.2.4 Uncertainties

Uncertainties are presented in Table 157.

6.2.5 Recalculations

No recalculations have been carried out since last years´ submission.

6.3 Manure management (CRF category 4.B)

This chapter describes the estimation of CH_4 and N_2O emissions from animal manure. In 2012 9.2% of the agricultural CH_4 emissions and 23.1% of the agricultural N_2O emissions were caused by this category.

6.3.1 Source Category Description

From 1990 to 2012 CH_4 emissions from manure management decreased by 24.8% to 15.44 Gg.

Table 172: CH_4 emissions from manure management 1990–2012.

Year	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	20.52	7.90	5.57	0.06	0.00	0.07	5.84	1.08	0.01
1991	20.18	7.65	5.58	0.06	0.00	0.08	5.68	1.12	0.01
1992	19.61	7.37	5.28	0.06	0.00	0.09	5.73	1.06	0.01
1993	19.70	7.27	5.33	0.06	0.01	0.09	5.80	1.13	0.01
1994	19.46	7.12	5.47	0.07	0.01	0.09	5.61	1.09	0.01
1995	19.50	6.25	6.45	0.07	0.01	0.10	5.54	1.08	0.01
1996	19.03	6.17	6.29	0.07	0.01	0.10	5.38	1.00	0.01
1997	18.77	6.38	5.74	0.07	0.01	0.10	5.32	1.13	0.01
1998	18.65	6.46	5.51	0.07	0.01	0.10	5.40	1.09	0.01
1999	17.93	6.20	5.65	0.07	0.01	0.11	4.79	1.10	0.01
2000	17.46	5.53	6.28	0.06	0.01	0.11	4.57	0.88	0.01
2001	17.37	5.35	6.24	0.06	0.01	0.11	4.65	0.94	0.01
2002	16.87	5.28	6.04	0.06	0.01	0.11	4.43	0.94	0.01
2003	16.56	5.01	6.08	0.06	0.01	0.12	4.30	0.97	0.01

Year	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
2004	16.23	4.85	6.22	0.06	0.01	0.12	4.01	0.96	0.01
2005	16.15	4.81	6.14	0.06	0.01	0.12	4.04	0.96	0.01
2006	15.97	4.75	6.14	0.06	0.01	0.12	3.92	0.96	0.01
2007	16.03	4.73	6.14	0.07	0.01	0.12	4.01	0.95	0.01
2008	15.69	4.79	6.08	0.06	0.01	0.12	3.67	0.95	0.01
2009	15.87	4.82	6.18	0.07	0.01	0.12	3.73	0.95	0.01
2010	15.91	4.82	6.13	0.07	0.01	0.11	3.69	1.07	0.01
2011	15.62	4.80	6.00	0.07	0.01	0.11	3.56	1.06	0.01
2012	15.44	4.79	5.88	0.07	0.01	0.11	3.50	1.06	0.01
Share 2012	*100%*	*31.1%*	*38.1%*	*0.4%*	*0.1%*	*0.7%*	*22.7%*	*6.9%*	*0.1%*
Trend 1990–2012	***-24.8%***	***-39.3%***	***5.7%***	***17.7%***	***96.1%***	***66.3%***	***-40.1%***	***-1.3%***	***28.2%***

From 1990 to 2012 the N_2O emissions from manure management decreased by 1.8% to 2.96 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 173: N_2O Emissions from manure management 1990–2012.

Year	N₂O emissions from manure management [Gg]								
	Livestock categories								
	4.B	4.B.1.a	4.B.1.b	4.B.3	4.B.4	4.B.6	4.B.8	4.B.9	4.B.10
	Total	Dairy	Non Dairy	Sheep	Goats	Horses	Swine	Poultry	Other
1990	3.01	1.25	1.20	0.06	0.01	0.06	0.28	0.15	0.01
1991	3.01	1.22	1.20	0.07	0.01	0.07	0.27	0.16	0.01
1992	2.93	1.19	1.15	0.06	0.01	0.07	0.28	0.16	0.01
1993	2.96	1.19	1.15	0.07	0.01	0.08	0.28	0.17	0.01
1994	2.98	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	0.27	0.18	0.01
1996	3.04	1.11	1.32	0.08	0.01	0.09	0.27	0.17	0.01
1997	3.04	1.17	1.24	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	0.10	0.24	0.19	0.01
2000	2.99	1.07	1.34	0.07	0.01	0.10	0.23	0.16	0.01
2001	2.98	1.06	1.33	0.07	0.01	0.10	0.23	0.17	0.01
2002	2.94	1.06	1.30	0.06	0.01	0.09	0.22	0.18	0.01
2003	2.95	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	0.10	0.21	0.19	0.01
2005	2.93	1.01	1.34	0.07	0.01	0.10	0.21	0.19	0.01
2006	2.93	1.01	1.34	0.06	0.01	0.10	0.20	0.20	0.01

Year	N_2O emissions from manure management [Gg]								
	Livestock categories								
	4.B	4.B.1.a	4.B.1.b	4.B.3	4.B.4	4.B.6	4.B.8	4.B.9	4.B.10
	Total	Dairy	Non Dairy	Sheep	Goats	Horses	Swine	Poultry	Other
2007	2.96	1.02	1.34	0.07	0.01	0.10	0.21	0.20	0.01
2008	2.96	1.05	1.33	0.07	0.01	0.10	0.19	0.20	0.01
2009	3.00	1.05	1.35	0.07	0.01	0.10	0.19	0.20	0.01
2010	3.01	1.05	1.34	0.07	0.01	0.10	0.19	0.23	0.01
2011	2.98	1.06	1.32	0.07	0.01	0.10	0.18	0.23	0.01
2012	2.96	1.07	1.29	0.08	0.01	0.10	0.18	0.23	0.01
Share 2012	*100%*	*36.0%*	*43.6%*	*2.5%*	*0.5%*	*3.3%*	*6.0%*	*7.7%*	*0.3%*
Trend 1990–2012	***-1.8%***	***-14.6%***	***7.7%***	***17.7%***	***96.1%***	***66.4%***	***-36.8%***	***54.3%***	***28.2%***

6.3.2 Methodological Issues

The IPPC-Tier 2 methodology has been applied to estimate CH_4 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 CH_4 emissions of these livestock categories are estimated with the Tier 1 approach. For poultry and horses in addition the treatment of manure in anaerobic digesters has been considered.

The inventory update carried out within submission 2010 concentrated on the following improvements:

- implementation of more accurate data on manure management system distribution gathered through an Austrian survey (Amon et al. 2007);
- improved consideration of the amount of slurry stored under cool and under warm conditions;
- new country specific emission factors for slurry storage;
- introduction of deep litter systems with best available emission factors.

For the estimation of N_2O emissions a Tier 1 methodology is used. N_2O emissions are calculated on the basis of N excretion per animal and waste management system.

Animal Waste Management Systems (AWMS)

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).

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 was available. For the year 1990 AWMS data based on (KONRAD 1995) was used. 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 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. Information on anaerobic digestion is based on data published by the Austrian Energy Regulator (E-CONTROL 2013). 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 chicken, where a time series has been generated, the AWMS distribution of these animal categories has been kept constant over the entire time series.

The updated AWMS data (see Table 174 and Table 175) 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 174: Manure Management System distribution in Austria 2012.

Livestock category	Liquid/Slurry	Solid Storage	Pasture/Range/ Paddock	Other Systems
	[%]	[%]	[%]	[%]
Dairy cattle	32.2	49.0	2.9	15.9
Non-dairy cattle	24.5	43.0	6.3	26.3
Suckling cows	14.7	40.0	14.3	31.0
Cattle < 1 year	15.3	48.0	1.9	34.7
Breeding heifers 1–2 years	30.5	44.4	5.8	19.3
Fattening heifers, bulls and oxen 1–2 years	43.5	38.8	0.2	17.4
Other cattle > 2 years	27.0	44.1	7.1	21.8
Sheep	0.0	50.0	50.0	0.0
Goats	0.0	50.0	50.0	0.0
Horses	0.0	80.0	20.0	0.0
Swine (Total)	75.2	7.2	0.0	17.6
Breeding sows	51.1	21.8	0.0	27.1
Young and fattening pigs	84.2	1.8	0.0	14.0
Chicken	3.8	88.7	0.0	7.5
Other poultry	0.0	100.0	0.0	0.0
Other animals	0.0	50.0	50.0	0.0

Table 175: Other systems 2012 in detail.

Livestock category	Yard	Composting	Deep Litter	Aerobic Treatment	Anaerobic Digestion
	[%]	[%]	[%]	[%]	[%]
Dairy cattle	2.0	7.4	1.4	4.6	0.5
Non-dairy cattle	1.9	6.3	14.4	3.4	0.5
Suckling cows	2.3	6.0	20.0	2.2	0.5
Cattle < 1 year	1.8	7.2	22.5	2.7	0.5
Breeding heifers 1–2 years	1.7	6.5	7.5	3.0	0.5
Fattening heifers, bulls and oxen 1–2 years	1.7	4.2	6.8	4.3	0.5
Other cattle > 2 years	2.1	6.3	7.0	5.9	0.5
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	0.0
Swine (Total)	1.6	1.1	7.5	3.6	3.8
Breeding sows	2.5	3.5	14.0	3.3	3.8
Young and fattening pigs	1.2	0.2	5.1	3.7	3.8
Chicken	0.0	0.0	0.0	0.0	7.5
Other poultry	0.0	0.0	0.0	0.0	0.0
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' (see Annex 6). Deep litter dominates the other system category for non-dairy cattle and breeding sows. 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. The rearing of sheep, goats, horses and other animals is of minor importance in Austria. In general, these livestock categories are pastured and their housings are based on solid systems (straw). In response to the in-country review 2013 (ARR, para 53) Austria's AWMS distribution for sheep, goats, horses and other animals will be investigated within inventory preparation for submission 2015.

As recommended by the ERT (ARR 2013, para 49), Annex 6 presents fractions of livestock manure per animal categories handled in different AWMS for all reporting years.

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 176: 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

Derivation of the share of manure digested in biogas plants

Data basis for the estimation are published numbers of biogas plants under contract for electricity supply and average amounts of manure digested in Austrian biogas plants derived from official Austrian reports. Below additional information on the derivation of the share of manure digested in biogas plants is provided as recommended in the ARR 2013, para 49.

Biogas plant numbers have been obtained from (AMON et al 2002) for the years 1990 to 2000 and from the annual reports of the Austrian Energy Regulator E-Control for the years from 2005 onwards (E-CONTROL, Ökostromberichte 2006-2012). Plant numbers between the years 2000 and 2005 have been derived by interpolation.

Data on the average amounts of digested manure for 1990 was obtained from (AMON et al 2002). Data for 2007 and 2011 was derived from feedstock balances provided by E-CONTROL 2009 and E-CONTROL 2011 (Ökostrombericht 2009 & Rohstoffbilanz 2011). Data for the years in between were derived by interpolation. For 2012 the average amounts of 2011 have been used.

In Austrian biogas plants the most important feedstock is corn-based silage and grass-based silage. Only a comparatively small part of the energy production is based on animal manures (mainly cattle, swine and chicken). Information on energy production per ton fresh matter has been obtained from KTBL (2005) and FNR (2006).

The shares of anaerobic digested manure have been calculated from the total manure excretion per relevant animal category (cattle, swine, chicken, horses). Data on average animal manure excretion has been obtained from national peer reviewed studies (GRUBER & STEINWIDDER 1996, GRUBER & PÖTSCH 2006) and Richtlinien Sachgerechter Düngung (BMLFUW 2006c).

Table 177: Numbers of biogas plants and amounts of digested manure 1990–2012.

Year	Biogas plant	Digested manure/plant	Annualy digested manure
	[number]	[t /yr]	[t /yr]
1990	5	2 070	10 350
1991	7	2 013	14 091
1992	8	1 956	15 649
1993	11	1 899	20 891
1994	32	1 842	58 953
1995	38	1 785	67 843

Year	Biogas plant	Digested manure/plant	Annualy digested manure
	[number]	[t /yr]	[t /yr]
1996	43	1 728	74 322
1997	57	1 671	95 274
1998	70	1 615	113 018
1999	100	1 558	155 761
2000	120	1 501	180 081
2001	142	1 444	205 301
2002	164	1 387	227 992
2003	187	1 330	248 156
2004	209	1 273	265 792
2005	231	1 216	280 900
2006	253	1 159	293 249
2007	294	1 102	324 033
2008	293	1 122	328 774
2009	291	1 142	332 333
2010	289	1 162	335 812
2011	288	1 182	340 393
2012	291	1 182	343 938

Table 177 shows an increase in plant numbers and a decrease in the average amounts of digested manure. This trend can be explained by the provisions of the Austrian Ökostromgesetz (Eco Electricity Act) which promotes the use of feedstock with high energy content (corn) in order to enable the operators a cost effective operation of the plants.

Activity data

(STATISTIK AUSTRIA 2012) provides national data of annual livestock numbers on a very detailed level (see Table 161, Table 162, Table 163). 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 CH_4 Emissions

CH_4 emissions of cattle and swine are estimated with the Tier 2 approach. This method requires detailed information on animal characteristics and the manner in which manure is managed. The following formula has been used (GPG, Equation 4.17):

$$EF_i = VS_i * 365\ [days\ yr^{-1}] * B_{0i} * 0.67\ [kg\ m^{-3}] * \Sigma_{jK}\ MCF_{jK} * MS\%_{ijK}$$

EF_i = *annual emission factor (kg) for animal type i (e.g. dairy cows)*

VS_i = *Average daily volatile solids excreted (kg) for animal type i*

B_{0i} = *maximum methane producing capacity (m³ per kg of VS) for manure produced by animal type I*

MCF_{jK} = *methane conversion factors for each manure management system j by climate region K*

$MS\%_{ijK}$ = *fraction of animal type i`s manure handled using manure systems j in climate region K*

Methane conversion factors (MCF)

The default MCF values for 'cool climate regions' presented in the IPCC GPG 2000 (Table 4.10) were used for the following systems:

- Pasture, Range, Paddock (MCF: 1%),
- Solid Storage (MCF: 1%),
- Anaerobic digester (MCF: 2%),
- Composting (MCF: 0.5%),
- Aerobic Treatment (MCF: 0.1%),
- Yard: the MCF of Pasture, Range, Paddock was applied (MCF: 1%).

According the guidelines, cool climates have an average temperature below 15 °C. The average temperature in Austria varies from 8.4 °C in Klagenfurt to 10.5 °C in Vienna (ZAMG, Jahrbuch 2004).

Country specific MCF for 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 proofs 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 CH_4 losses through leakage.

Anyhow, there is no national study available that estimates CH_4 leakage losses from Austrian biogas plants. A study worked out in Germany (FNR 2010) shows that CH_4 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 CH_4 emissions.

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 178: 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 178). 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 2012.

Table 179: average MCFs for liquid systems 1990 and 2012.

Animal Category	1990 [%]	2012 [%]
Dairy Cattle	8.7	8.7
Other Cattle	8.7	8.5
Swine	3.4	3.4

The following table presents the average MCFs for other systems for the years 1990 and 2012.

Table 180: average MCFs for other systems 1990 and 2012.

Animal Category	1990 [%]	2012 [%]
Dairy Cattle	3.3	1.9
Other Cattle	12.4	9.9
Swine	14.6	7.8

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.

In Austria manure from deep litter systems is usually removed twice a year – in spring and in autumn. The bedding is continuously added, there is no mixing.

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 CH_4 emissions from farmyard manure were always lower than CH_4 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.

MCF used for yards

In yards aerobic processes are predominant, the dung dries after excretion. Thus, seen from the microbiological point of view, conditions for methane production from dung excreted on yards are unfavourable: CH_4 is only formed under anaerobic and wet conditions. The creation of methane in yards is best reflected in the IPCC MCF of 1%.

Maximum methane producing capacity (B_{0i})

IPCC default values were used (Appendix B, IPCC Guidelines, Reference Manual)

6.3.2.1.1 Cattle (4.B.1)

Key Source: Yes (CH_4, N_2O)

Volatile solid (VS) excretion – dairy cows

Austrian specific values for dairy cows are calculated dependent on annual milk yields and corresponding feed intake data (gross energy intake, feed digestibility, ash content, see Table 165 and Table 181). 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 181: 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 182).

Table 182: VS excretion of Austrian dairy cows for the period 1990–2012.

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	2002	5 487	4.18
1991	3 800	4.03	2003	5 638	4.20
1992	3 905	4.04	2004	5 802	4.21
1993	3 948	4.06	2005	5 783	4.21
1994	4 076	4.06	2006	5 903	4.22
1995	4 619	4.10	2007	5 997	4.23
1996	4 670	4.10	2008	6 059	4.24
1997	4 787	4.11	2009	6 068	4.24
1998	4 924	4.12	2010	6 100	4.25
1999	5 062	4.13	2011	6 227	4.27
2000	5 210	4.15	2012	6 418	4.30
2001	5 394	4.17			

[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. 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. Values between 1990 and 2004 have been derived by interpolation (see Table 183).

Table 183: VS excretion of Austrian suckling cows for the period 1990–2012.

Year	Milk yield *[kg yr^{-1}]*	*VS excretion* [kg/cow*day]	Year	Milk yield *[kg yr^{-1}]*	*VS excretion* [kg/cow*day]
1990	3 000	3.90	2002	3 429	3.97
1991	3 036	3.90	2003	3 464	3.97
1992	3 071	3.91	2004	3 500	3.98
1993	3 107	3.91	2005	3 500	3.98
1994	3 143	3.92	2006	3 500	3.98
1995	3 179	3.93	2007	3 500	3.98
1996	3 214	3.93	2008	3 500	3.98
1997	3 250	3.94	2009	3 500	3.98
1998	3 286	3.94	2010	3 500	3.98
1999	3 321	3.95	2011	3 500	3.98
2000	3 357	3.95	2012	3 500	3.98
2001	3 393	3.96			

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 168).

As no major changes in diets of *Non-Dairy Cattle* occurred in the period from 1990–2012, 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 184 presents data for the calculation of VS excretion of the livestock categories *Non-Dairy Cattle*.

Table 184: 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 185: 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

CH_4 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). CH_4 emissions were estimated multiplying these emission factors by national animal numbers.

Table 186: IPCC default CH_4 emission factors 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, CH_4 emissions from manure of horses and other soliped were estimated with the default emission factors for horses.

The 'other animal' category is very inhomogeneous including roe deer, red deer, fallow deer and to some extent wild boars. As no further data on the exact composition of this animal category is available and the contribution to the overall emissions is very small, a simple conservative approach has been chosen: emissions from 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).

Part of manure from chicken and horses is digested in biogas plants. Following (FNR 2010) and expert judgement (AMON 2011), about 2% of CH_4 emissions from anaerobic digestion are lost. CH_4 emissions from anaerobic digestion were considered as follows:

$$CH_4\ emissions_{4.B(i)} = Population_{(i)} * EF_{IPCC\ default\ (i)} * (1\text{-}share_{dig\ (i)}) + Population_{(i)} * EF_{IPCC\ default\ (i)} * share_{dig\ (i)} * leakage(\%)$$

(i) = *horses (4.B.6) and poultry (4.B.9)*

$share_{dig}$ =*% of manure digested*

leakage = *2%, see also chapter 6.3.2.1.*

Different shares of AWMS are presented in Table 175 and Annex 6.

6.3.2.2 Estimation of N_2O Emissions

Key Source: 4.B.1

Following the guidelines, all emissions of N_2O taking place before the manure is applied to soils are reported under manure management.

For the estimation of N_2O emissions from manure management systems only a Tier 1 approach is available. The IPCC Guidelines method for estimating N_2O emissions from manure management entails multiplying the total amount of N excretion (from all animal species/categories) in each type of manure management system by an emission factor for that type of manure management system. Emissions are then summed over all manure management systems (see formulas below).

<u>N excretion per animal waste management system:</u>

$$Nex_{(AWMS)} = \sum_{(T)}[N_{(T)} \times Nex_{(T)} \times AWMS_{(T)}]$$

$Nex_{(AWMS)}$ = *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*

<u>N_2O emission per animal waste management system:</u>

$$N_2O_{(AWMS)} = \sum[Nex_{(AWMS)} \times EF_{3(AWMS)}]$$

$N_2O_{(AWMS)}$= *N_2O emissions from all animal waste management systems in the country [kg N yr^{-1}]*

$Nex_{(AWMS)}$= *N excretion per animal waste management system [kg yr^{-1}]*

$EF_{3(AWMS)}$= *N_2O emissions factor for an AWMS [kg N_2O-N per kg of Nex in AWMS]*

AWMS

The animal waste management systems distribution data applied to estimate N_2O emissions from *Manure Management* is the same as used for the estimation of CH_4 emissions from *Manure Management* (see Table 175).

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 187).

Table 187: Austria specific N excretion values of dairy cows for the period 1990–2012.

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	2002	5 487	91.89
1991	3 800	76.70	2003	5 638	93.24
1992	3 905	77.64	2004	5 802	94.72
1993	3 948	78.03	2005	5 783	94.55
1994	4 076	79.18	2006	5 903	95.63
1995	4 619	84.07	2007	5 997	96.48
1996	4 670	84.53	2008	6 059	97.03
1997	4 787	85.58	2009	6 068	97.11
1998	4 924	86.82	2010	6 100	97.40
1999	5 062	88.06	2011	6 227	98.54
2000	5 210	89.39	2012	6 418	100.26
2001	5 394	91.05			

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

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

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

Cattle: Feed rations represent data of commercial farms consulting representatives of the working groups „Dairy production". These groups are managed by well-trained advisors. Their members, i.e. farmers, regularly exchange their knowledge and experience. Forage quality is based on field studies, carried out in representative grassland and dairy farm areas. The calculations depend on feeding ration, gain of weight, nitrogen and energy uptake, efficiency, duration of livestock keeping etc.

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 188: 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)] (2012)	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, gooses)*

[5)] *N-ex value of sheep applied*

Livestock numbers per category can be found in Table 161, Table 162 and Table 163. Data on manure management system distribution is presented in Table 174 and Table 175.

Emission factors

N_2O emission factors of the IPCC GPG have been used for all AWMS except for the new implemented system 'deep litter': in consistency with the applied MCF, for deep litter the best available emission factor has been used (IPCC 2006).

Emission factors applied in the Austrian inventory are listed in the following table:

Table 189: Emission factors for N_2O from manure management

Animal Waste Management System	Emission factor [kg N_2O-N per kg N excreted]	Reference
Liquid/Slurry	0.001	IPCC GPG, Table 4.12
Solid Storage	0.020	IPCC GPG, Table 4.12
Pasture/Range/Paddock	0.020	IPCC GPG, Table 4.12
Composting	0.020	IPCC GPG, Table 4.13
Aerobic Treatment	0.020	IPCC GPG, Table 4.13
Anaerobic Digester	0.001	IPCC GPG, Table 4.12
Deep Litter	0.010	IPCC 2006, Table 10.21

Yard

In the IPCC guidelines no emission factor for yard is available. It is assumed, that the storage of the yard manure equals the average waste management systems distribution in Austria (see Table 174 and Table 175). Thus, the implied N_2O emission factor of all systems (except pasture) has been used.

Scientific background for this approach:

N_2O emissions result from the interaction of manure N with organic carbon that is present in soils and in straw. This explains the higher IPCC N_2O EFs of pasture, solid systems or composting compared to liquid slurry EF or the EF of slurry from anaerobic digesters. The presence of organic carbon favours N_2O formation. Applying the N_2O EF of pasture or solid systems for N_2O emissions from yards would result in an overestimation of N_2O emissions, as there is neither soil-C nor straw-C in the yard.

Manure excreted in yards regularly (daily) enters the storage, urine is continuously discharged to the storage. Keeping the high uncertainties of N_2O emissions in mind, the weighted implied N_2O EFs of all systems (except pasture) per animal category are a conservative approach that tends to overestimate yard emissions, as these values include high shares of solid storage systems.

Table 190: N_2O emission factors used for the calculation of N_2O from yards 1990–2012.

Year	Dairy	Non-Dairy	Swine
	[kg N_2O-N per kg N excreted]		
1990	0.011	0.011	0.005
1991	0.012	0.011	0.005
1992	0.012	0.011	0.005
1993	0.012	0.011	0.005
1994	0.012	0.011	0.005
1995	0.012	0.011	0.005
1996	0.012	0.011	0.005
1997	0.012	0.012	0.005
1998	0.012	0.012	0.005
1999	0.012	0.012	0.005
2000	0.012	0.012	0.005
2001	0.012	0.012	0.005
2002	0.012	0.012	0.005
2003	0.013	0.012	0.005
2004	0.013	0.012	0.005
2005	0.013	0.012	0.005
2006	0.013	0.012	0.005
2007	0.013	0.012	0.005
2008	0.013	0.012	0.005
2009	0.013	0.012	0.005
2010	0.013	0.012	0.005
2011	0.013	0.012	0.005
2012	0.013	0.012	0.005

For the calculation of the losses of gaseous N species (NH_3-N and NO_x-N) the mass-flow procedure pursuant to EMEP/CORINAIR (EEA 2007) has been applied. In 2009 new data on agricultural practice in Austria (AMON et al. 2007) has been integrated to the ammonia emission model (AMON & HÖRTENHUBER 2008). A brief description of methodologies and emission factors applied in the Austrian NH_3 and NO_x inventory under the UNECE/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),
- ✓ expanded QA and verification activities in 2012: in-depth review of the agriculture model.

Sector specific routine control procedures are provided in chapter 6.1.4.

6.3.4 Uncertainties

Uncertainties are presented in Table 157.

6.3.5 Recalculations

The updated feedstock balance provided by the Austrian energy regulator E-Control showed smaller amounts of digested manure. The revision caused slightly higher methane emissions and minor changes in N_2O emissions in recent years.

6.4 Agricultural soils (CRF category 4.D)

6.4.1 Source Category Description

N_2O emissions from the source categories *4.D.1 direct soil emissions* and *4.D.3 indirect soil emissions* are key categories.

In 2012 76.9% of total N_2O emissions from agriculture (58.5% of total Austrian N_2O emissions) originated from agricultural soils, the rest originates from manure management and a very small share from field burning of agricultural residues.

Emissions from this category (N_2O and CH_4) contributed 3.8% (3 064.12 Gg CO_2 equivalents) to Austria's total greenhouse gas emissions in the year 2012. This is 40.9% of total GHG emissions of the sector agriculture.

The trend of N_2O emissions from this category is decreasing: in 2012 emissions were 10.9% below 1990 levels.

Table 191 presents N_2O emissions of agricultural soils by sub-category as well as their trends and their share in total N_2O emissions.

Table 191: N_2O emissions from agricultural soils, 1990–2012.

	N_2O emissions [Gg]										
Year	**4 D Total**	**4 D 1 Direct Soil Emissions**	**Synthetic Fertilisers**	**Organic Fertiliser**	**Crop Residue**	**N-fixing Crops**	**Sewage Sludge**	**4 D 2 Pasture**	**4 D 3 Indir. Soil Emissions**	**Nitrogen Leaching**	**Athm. Deposition**
1990	11.06	6.16	2.62	2.37	0.82	0.33	0.02	0.54	4.36	3.55	0.81
1991	11.88	6.72	3.07	2.35	0.92	0.36	0.02	0.53	4.63	3.81	0.82
1992	11.00	6.25	2.60	2.29	0.88	0.46	0.02	0.50	4.26	3.46	0.80
1993	10.21	5.76	2.05	2.32	0.91	0.45	0.03	0.49	3.95	3.15	0.80
1994	11.82	6.87	2.88	2.32	1.19	0.45	0.02	0.48	4.47	3.65	0.82
1995	12.04	6.99	2.92	2.37	1.36	0.32	0.03	0.50	4.55	3.72	0.83
1996	10.76	6.09	2.42	2.34	0.96	0.34	0.03	0.48	4.19	3.38	0.81
1997	10.91	6.23	2.45	2.33	1.02	0.40	0.03	0.47	4.21	3.40	0.82
1998	11.01	6.35	2.47	2.34	1.08	0.43	0.03	0.44	4.22	3.40	0.82
1999	10.78	6.26	2.35	2.29	1.20	0.39	0.03	0.43	4.09	3.29	0.80
2000	10.30	5.88	2.30	2.25	0.92	0.37	0.03	0.42	4.00	3.22	0.78
2001	10.31	5.94	2.28	2.25	1.02	0.36	0.03	0.40	3.97	3.20	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	9.46	5.61	1.67	2.20	1.26	0.46	0.03	0.31	3.55	2.76	0.78
2011	10.01	6.01	1.96	2.17	1.39	0.46	0.03	0.31	3.69	2.92	0.78
2012	9.86	5.83	2.02	2.15	1.17	0.46	0.03	0.30	3.72	2.95	0.78
Share 2012	*100%*	*59.1%*	*20.5%*	*21.8%*	*11.9%*	*4.6%*	*0.3%*	*3.1%*	*37.8%*	*29.9%*	*7.9%*
Trend 1990–2012	***-10.9%***	***-5.4%***	***-22.8%***	***-9.0%***	***42.2%***	***38.7%***	***28.2%***	***-44.3%***	***-14.6%***	***-17.0%***	***-4.5%***

CH_4 emissions from agricultural soils originate from sewage sludge spreading on agricultural soils. They contribute only a negligible part of Austria's total methane emissions (0.17% or 0.42 Gg CH_4 2012). This is about 0.25% of total CH_4 from the agriculture sector.

Table 192: CH_4 emissions from agricultural soils, 1990–2012.

	CH_4 emissions [Gg] IPCC Category	
Year	**4.D total**	**Other direct emissions (sewage sludge)**
1990	0.33	0.33
1991	0.33	0.33
1992	0.31	0.31
1993	0.47	0.47
1994	0.40	0.40
1995	0.44	0.44
1996	0.45	0.45
1997	0.45	0.45
1998	0.45	0.45
1999	0.45	0.45
2000	0.45	0.45
2001	0.43	0.43
2002	0.38	0.38
2003	0.41	0.41
2004	0.37	0.37
2005	0.37	0.37
2006	0.41	0.41
2007	0.42	0.42
2008	0.41	0.41
2009	0.42	0.42
2010	0.46	0.46
2011	0.44	0.44
2012	0.42	0.42
Share 2012	*100.0%*	*100.0%*
Trend 1990–2012	***28.2%***	***28.2%***

6.4.2 Methodological Issues

Austria uses IPCC Tier 1a, IPCC Tier 1b and country specific methodologies for the calculation of N_2O emissions from agricultural soils. In response to recommendations of the ERT (ARR 2013, para 51 and 52) additional descriptions of the Austrian N-flow model have been included in the NIR 2014 (see Annex 6).

Table 193: N_2O emission factors for agricultural soils.

Category	Emission Factor [t N_2O-N/t N]	Source
4.D.1 Direct Soil Emissions		
Synthetic fertilizers (mineral fert.)	0.0125	IPCC GPG (Table 4.17)
Animal waste applied to soils		
N-fixing crops		
Crop residue		
Sewage sludge spreading		
4.D.2 Pasture, range and paddock manure		
Grazing animals	0.02/t N_{exGRAZ}	IPCC Guidelines (Table 4.22)
4.D.3 Indirect soil emissions		
Atmospheric deposition	0.01/t of volatized nitrogen	IPCC GPG (Table 4.18)
Nitrogen leaching (and run-off)	0.025/t N-loss by leaching	IPCC GPG (Table 4.18)

4.D.1.5 Cultivation of Histosols

Cultivation of Histosols is not occurring in Austria („NO"). There are no annually cultivated organic soils in the Austrian grassland area. Assessments of the Austrian agricultural soil inventories showed that there is no cropland on organic soils in Austria.

Activity Data

Data for necessary input parameters (activity data) were taken from the following sources:

Table 194: 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 2000–2013) [1]; urea application in Austria: expert judgement based on sales data (RWA 2006–2013) [2]
Animal waste applied to soils	Calculations within source category *4.B*
N-fixing crops	Cropped area legume production: (BMLFUW 2000–2013) [1]
Crop residue	Harvested amount of agricultural crops: (BMLFUW 2000–2013) [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), Data deliveries from Austria's federal provinces (UMWELTBUNDESAMT 2011b, 2013a)
4.D.2 Pasture, range and paddock manure	
Grazing Animals	Calculations within source category 4.B
4.D.3 Indirect soil emissions	
Atmospheric deposition	The amount of manure left for spreading was calculated within source category *4.B*. Mineral fertilizer data: (BMLFUW 2000–2013)
Nitrogen leaching (and Run-off)	see above (synthetic fertilizers, animal waste, sewage sludge)

[1] *www.gruenerbericht.at and http://www.awi.bmlf.gv.at*

[2] *RWA: Raiffeisen Ware Austria*

Mineral fertilizer application

Detailed data about the use of different kind of fertilizers are available until 1994, because until then, a fertilizer tax („Düngemittelabgabe“) had been collected. Data about the total mineral fertilizer consumption are available for amounts (but not for fertilizer types) from the statistical office (Statistik Austria) and from an agricultural marketing association (Agrarmarkt Austria, AMA). Annual sales figures about urea are available for the years 1994 onwards from a leading fertilizer trading firm (RWA). These sources were used to get a time series of annual fertilizer application distinguishing urea fertilizers and other N-fertilizers („mineral fertilizers”).

The S & A report 2004 noticed high inter-annual variations in N_2O emissions of sector 4.D mineral fertilizer use. These variations are caused by the effect of storage: Fertilizers have a high elasticity to prices. Sales data are changing very rapidly due to changing market prices. Not the whole amount purchased is applied in the year of purchase. The fertilizer tax intensified this effect at the beginning of the 1990ies. Considering this effect, the arithmetic average of each two years is used as fertilizer application data.

In the in-country review 2007 it was recommended to consider revising the time series by determining actual fertilizer use in accordance with the IPCC good practice guidance. However, investigations showed that data on the actual fertilizer use are not available in Austria. Therefore it has been decided to continue to use the official fertilizer sales data as input data for the emission inventory. In the centralized review 2008 the use of fertilizer sales data was considered as an appropriate alternative (ARR 2008, para 50).

The time series for fertilizer consumption is presented in Table 195.

Table 195: Mineral fertilizer N consumption in Austria 1990–2012 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	107 394	3 682
1994	177 266	4 917	GB	150 450	4 198
1995	128 000	5 198	RWA	152 633	5 058
1996	125 300	4 600	RWA	126 650	4 899
1997	131 800	6 440	RWA	128 550	5 520
1998	127 500	6 440	RWA	129 650	6 440
1999	119 500	6 808	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
2011	116 751	16 867	GB, RWA	103 690	11 683
2012	97 721	10 733	GB, RWA	107 236	13 800

GB: (BMLFUW 2000–2013): www.gruenerbericht.at

RWA: Raiffeisen Ware Austria, sales company

Values of Table 195 differ from the numbers given in CRF table 4.D 'Nitrogen input from application of synthetic fertilizers'. In the CRF table 4.D NH_3-N and NO_x-N volatilisation losses occurring during fertilizer application are subtracted.

Legume cropping areas

The yearly numbers of the legume cropping areas were taken from official statistics (BMLFUW 2000–2013).

Table 196: Cropped area legume production, 1990–2012.

	Areas [ha]			
Year	peas	soja beans	horse/field beans	clover hey, lucerne, …
1990	40 619	9 271	13 131	57 875
1991	37 880	14 733	14 377	65 467
1992	43 706	52 795	14 014	64 379
1993	44 028	54 064	1 064	68 124
1994	38 839	46 632	10 081	72 388
1995	19 133	13 669	6 886	71 024
1996	30 782	13 315	4 574	72 052
1997	50 913	15 217	2 783	75 976
1998	58 637	20 031	2 043	76 245
1999	46 007	18 541	2 333	75 028
2000	41 114	15 537	2 952	74 266
2001	38 567	16 336	2 789	72 196
2002	41 605	13 995	3 415	75 429
2003	42 097	15 463	3 465	78 813
2004	39 320	17 864	2 835	83 349
2005	36 037	21 429	3 549	88 974
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
2011	11 715	38 123	6 028	104 800
2012	10 704	37 126	6 852	104 808

Harvest Data

Harvest data were taken from (BMLFUW 2000–2013) and the datapool of (BUNDESANSTALT FÜR AGRARWIRTSCHAFT 2013) and are presented in Table 197.

Table 197: Harvest Data I, 1990–2012.

	Harvest [1 000 t]								
Year	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
2011	5 669	1 782	202	859	110	2 453	816	3 456	12
2012	4 839	1 275	205	662	93	2 351	665	3 114	10

Table 198: Harvest Data II, 1990–2012.

	Harvest [1 000 t]								
Year	silo-green maize	clover-hey	rape	Sun-flower	soja bean	horse-/fodder bean	peas	vege-tables	oil pumkin
1990	4 289	717	102	57	18	41	145	273	3
1991	4 252	797	128	72	37	37	133	277	4
1992	3 523	587	126	79	81	31	137	227	4
1993	4 220	628	125	104	103	29	107	230	3
1994	4 152	743	217	92	105	27	134	246	3
1995	3 996	823	268	61	31	17	60	302	5

Year	Harvest [1 000 t] silo-green maize	clover-hey	rape	Sun-flower	soja bean	horse-/fodder bean	peas	vege-tables	oil pumkin
1996	3 918	858	121	44	27	10	93	297	8
1997	3 940	962	129	44	34	6	162	349	8
1998	3 865	1 014	128	57	51	5	178	313	11
1999	3 729	1 025	193	64	50	6	140	399	6
2000	3 531	1 440	125	55	33	7	97	361	6
2001	3 035	1 349	147	51	34	7	112	391	7
2002	3 285	1 395	129	58	35	9	96	406	9
2003	3 026	1 425	78	71	39	9	93	376	10
2004	3 374	1 474	121	78	45	8	122	414	5
2005	3 600	1 515	104	81	61	10	90	384	8
2006	3 546	1 635	137	85	65	12	90	392	11
2007	3 741	1 695	145	60	53	11	57	402	12
2008	3 949	1 605	175	80	54	8	45	426	8
2009	3 789	1 597	171	71	71	7	35	449	8
2010	3 557	1 624	171	66	95	11	31	457	15
2011	4 006	1 598	180	74	109	18	36	557	16
2012	4 003	1 626	149	53	104	16	15	471	13

Sewage sludge application on fields

Amounts of agriculturally applied sewage sludge were obtained from: Water Quality Report 2000 (PHILIPPITSCH et al. 2001), Report on sewage sludge (UMWELTBUNDESAMT 1997), Austrian report on water pollution control (BMLFUW 2002), and submissions from Austria's federal provinces to the Umweltbundesamt (UMWELTBUNDESAMT 2011b, 2013a).

Table 199: Amount of sewage sludge (dry matter) produced in Austria, 1990–2012.

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

Year	Total [t dm]	agriculturally applied [t dm]	agriculturally applied [%]
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
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
2011	261 340	42 261	16.2
2012	262 956	40 498	15.4

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*. 59.1% (5.83 Gg in 2012) of N_2O emissions from agricultural soils arise from this sub-category (see Table 191).

N_2O emissions from following sub-sources were estimated:

- *Synthetic fertilizers* (mineral fertilizers and urea),
- *Animal waste* (manure applied to soils),
- Biological *nitrogen fixation* through legumes,
- Incorporation of crop residues after harvest,
- Application of *sewage sludge* on agricultural soils.

The nitrogen input is corrected for gaseous losses through volatilization of NH_3 and NO_X.

Nitrogen input from all sources is calculated using IPCC Tier 1a (GPG, equation 4.20/4.21) and the emission factor of 1.25% (IPCC GPG, p.4.54, 4.60). The calculation is described in the following subchapters. The conversion from N_2O-N to N_2O emissions is performed by multiplication with (44/28).

This method estimates total direct N_2O emissions, irrespective of type of soils, of land use (e.g. grassland and cropland soils) and of vegetation, irrespective of the nitrogen compounds (e.g. organic, inorganic nitrogen), and irrespective of climatic factors.

Nitrogen input through application of synthetic (mineral) N fertilizers

The method applied for calculation of the emissions is IPCC Tier 1a (GPG, Equation 4.22) but with Austria specific consideration of nitrogen losses (NH_3-N, NO_x-N).

$$F_{SN} = N_{FERT} * (1- Frac_{GASF})$$

F_{SN} = *Annual amount of synthetic fertilizer nitrogen applied on soils, corrected for volatile N-losses [t N]*

N_{FERT} = *Annual amount of nitrogen in synthetic fertilizers (mineral and urea) applied on soils [t N] – (see* Table 195)

$Frac_{GASF}$ =*Fraction of nitrogen lost through gaseous emissions of NH_3 and NO_x [t/t] – 0.023 for mineral fertilizers and 0.153 for urea fertilizers (see below)*

NH_3-N and NO_x-N volatilization losses from mineral fertilizer application ($Frac_{GASF}$)

With regard to a comprehensive treatment of the nitrogen budget, Austria established a link between the ammonia and nitrous oxide emissions inventory. This procedure enables the use of country specific data, which is more accurate than the use of the default value for $Frac_{GASF}$.

NH_3 and NO_x emissions from Sector 4 Agriculture are estimated according to the EMEP/CORINAIR atmospheric emission inventory guidebook (EEA 2007). For the calculation of NH_3-N losses from synthetic fertilizers the CORINAIR detailed methodology was applied. This method uses specific NH_3 emission factors for different types of synthetic fertilizers and for different climatic conditions. For urea the CORINAIR default value of 0.15 t NH_3-N per ton of fertilizer-N was applied. As calcium-ammonium-nitrate and ammonium-nitrate fertilizers represent the dominant form of non-urea synthetic fertilizers being used in Europe (FREIBAUER & KALTSCHMITT 2001), an average emission factor of 0.02 t NH_3-N per ton of fertilizer-N is applied for fertilizers other than urea (STREBL et al. 2003).

For the calculation of NO_x-N losses the CORINAIR simple methodology is applied. Emissions are calculated as a fixed percentage of total fertilizer nitrogen applied to soil. For all mineral fertilizer types the CORINAIR recommended emission factor of 0.3% (i.e. 0.003 t NO_x-N per ton applied fertilizer-N) is used (EEA 2007).

Nitrogen input through application of animal manure

A country specific methodology based on the N-flow approach was used. According to the IPCC method nitrogen from manure that is used as a biofuel should be subtracted, but this is irrelevant for Austria because in Austria manure is not used as a biofuel at all.

Nitrogen left for spreading

After storage, manure is applied to agricultural soils. Manure application is connected with NH_3-N, NO_x-N and N_2O-N losses that depend on the amount of manure N. With regard to a comprehensive treatment of the nitrogen budged, Austria established a link between the ammonia and nitrous oxide emissions inventory. This procedure enables the use of country specific data, which is more accurate than the use of the default value for $Frac_{GASM}$.

From total N excretion by Austrian livestock, the following losses were subtracted:

- N excreted during grazing,
- NH_3-N losses from housing,
- NH_3-N losses during manure storage,
- NO_x-N losses from manure management,
- N_2O-N losses from manure management,
- The remaining N is applied to agricultural soils.

NH_3-N and NO_x-N losses from housing and storage were calculated following the CORINAIR EMEP – methodology. The CORINAIR detailed methodology was applied for the calculation of NH_3-N emissions from cattle and swine, for the estimation of NO_x-N emissions the CORINAIR simple methodology was applied.

Table 200: Animal manure left for spreading on agricultural soils per livestock category 1990–2012 (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	145 697	55 363	2 591	50 677	8 866	19 293
1991	144 553	53 857	3 162	50 153	8 740	19 050
1992	140 882	52 567	3 339	47 201	8 930	19 497
1993	142 598	52 161	3 830	47 484	9 165	20 000
1994	142 706	51 948	4 977	47 126	9 134	19 543
1995	145 644	48 272	11 647	46 718	9 280	19 471
1996	143 483	48 085	11 779	45 243	9 208	19 118
1997	143 060	50 451	9 451	43 868	9 181	19 288
1998	143 325	51 950	8 555	43 063	8 911	20 356
1999	140 308	50 634	9 804	42 833	7 926	18 463
2000	137 792	45 893	14 036	42 572	7 701	17 934
2001	137 494	45 163	14 318	41 691	8 063	18 453
2002	134 964	45 044	13 616	40 907	7 847	17 858
2003	134 530	43 441	13 520	42 020	7 687	17 695
2004	133 543	42 694	14 551	42 032	7 285	16 801
2005	132 665	42 477	14 990	40 336	7 250	17 445
2006	132 301	42 543	14 978	40 306	7 385	17 019
2007	133 907	42 823	14 920	40 360	7 301	18 150
2008	132 539	43 685	14 594	40 256	6 826	16 929
2009	134 403	43 946	14 490	41 447	6 736	17 430
2010	134 473	44 057	14 289	41 304	6 525	17 443
2011	132 510	44 127	14 067	40 291	6 322	16 825
2012	131 536	44 555	13 607	39 697	6 032	16 742

Table 201: Animal manure left for spreading on agricultural soils per livestock category 1990–2012 (II).

Year	Nitrogen left for spreading [Mg N per year]					
	IPCC Livestock Categories					
	total	poultry	sheep	goats	horses/solipeds	other animals
1990	145 697	4803	1 928	218	1 728	231
1991	144 553	5063	2 028	238	2 030	231
1992	140 882	4791	1 941	230	2 157	231
1993	142 598	5095	2 076	276	2 281	231
1994	142 706	4981	2 128	290	2 345	235
1995	145 644	4871	2 272	316	2 547	251
1996	143 483	4533	2 369	317	2 573	258
1997	143 060	5138	2 386	340	2 606	350
1998	143 325	4969	2 244	316	2 648	313
1999	140 308	5009	2 191	338	2 867	243
2000	137 792	4113	2 110	327	2 867	239
2001	137 494	4358	1 993	346	2 867	239
2002	134 964	4356	1 893	337	2 867	239

Year	Nitrogen left for spreading [Mg N per year]					
	IPCC Livestock Categories					
	total	poultry	sheep	goats	horses/solipeds	other animals
2003	134 530	4506	2 025	318	3 061	256
2004	133 543	4504	2 035	324	3 061	256
2005	132 665	4502	2 026	321	3 061	256
2006	132 301	4500	1 943	310	3 061	256
2007	133 907	4498	2 185	353	3 062	256
2008	132 539	4496	2 072	364	3 061	256
2009	134 403	4496	2 144	397	3 060	256
2010	134 473	5045	2 229	418	2 868	296
2011	132 510	5045	2 246	422	2 868	296
2012	131 536	5045	2 268	427	2 868	296

Values of Table 200 differ from the numbers given in CRF table 4.D 'Nitrogen input from manure applied to soils'. In the CRF table 4.D additionally NH_3-N and NO_x-N volatilization losses occurring during manure application are subtracted.

A more detailed description of the methods applied for the calculation of NH_3 and NO_x emissions is given in the report „Austria's Informative Report 2014 – Submission under the UNECE Convention on Long-range Transboundary Air Pollution" (UMWELTBUNDESAMT 2014a). Austria's Informative Report 2014 will be published in spring 2014. 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). Emissions from cattle and swine are estimated using a country specific methodology whereas emission from sheep, goats, horses and poultry are estimated with the CORINAIR simple methodology.

Losses of Ammonia (NH_3-N) occur during animal housing (1), the storage of manure (2) and the application of organic fertilizers on agricultural soils (3). Losses of nitric oxide (NO_x-N) were considered for manure management and field spreading of manure (4).

1) NH_3 emissions from housing (cattle and swine)

Table 202 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 202: Emission factors for NH_3 emissions from animal housing.

Manure management system	CORINAIR Emission factor [kg NH_3-N (kg N excreted)$^{-1}$]
Cattle, tied systems, liquid slurry system	0.040
Cattle, tied systems, solid storage system	0.039
Cattle, loose houses, liquid slurry system	0.118

Manure management system	CORINAIR Emission factor [kg NH_3-N (kg N excreted)$^{-1}$]
Cattle, loose houses, solid storage system	0.118
Fattening pigs, liquid slurry system	0.150
Fattening pigs, solid storage system	15% of total N + 30% of the remaining TAN
Sows plus litter, liquid slurry system	0.167
Sows plus litter, solid storage system	0.167

2) NH_3 emissions from manure storage

NH_3 emissions from storage are estimated from the amount of N left in the manure when the manure enters the storage. This amount of N is calculated as following:

From total N excretion the N excreted during grazing and the NH_3-N losses from housing (see above) are subtracted. The remaining N enters the store.

Cattle and swine

NH_3-N losses are estimated with CORINAIR default emission factors given in Table 203.

Table 203: NH_3 emission factors for manure storage.

Manure storage system	CORINAIR Emission factor [kg NH_3-N (kg TAN)$^{-1}$]
Cattle, liquid slurry system	0.15
Cattle, solid storage system	0.30
Pigs, liquid slurry system	0.12
Pigs, solid storage system	0.30

* *15% + 0.3% of remaining TAN for deep litter (as used for fattening pigs in agriculture), otherwise 15% for daily removal of solid manure*

TAN content in excreta

The detailed method makes use of the total NH_3 nitrogen (TAN) when calculating emissions. TAN content for Austrian cattle and swine manure is given in SCHECHTNER 1991.

Table 204: 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 205 shows correction factors (CF) to emission factors (EF) for a range of manure treatment options. Untreated variants systems, for example uncomposted solid manure, give the reference value '1'. EF for other treatment options, managements and systems get an associated CF, e.g. +20% for the composting of solid manure (CF = 1.2). The CF is multiplied with the EF. Factors were taken from the Swiss ammonia inventory which is calculated with the computer based programme 'DYNAMO' (MENZI et al. 2003, REIDY et al. 2007, REIDY & MENZI 2005). Due to similar management strategies and geographic structures, Swiss animal husbandry is closest to Austrian animal husbandry.

DYNAMO is based on the N flow model and estimates ammonia emissions for each stage of the manure management continuum. Animal categories, manure management systems and a range of additional parameters are considered within DYNAMO. DYNAMO parameters were adapted to Austrian specific conditions. The DYNAMO model is peer reviewed by the EAGER[78] group and published in (REIDY et al. 2008, 2009).

Table 205: Correction factors (CF) for NH_3 emissions from manure storage.

Manure storage	[CF]
Uncomposted solid manure	1
Composted solid manure	1.2
Uncovered tank	1
Solid cover – liquid system	0.2
Aerated open tank – liquid system	1.1
Straw cover – liquid system	0.6
Plastic foil cover – liquid system	0.4
Natural crust – liquid system	0.6

Sheep, goats, horses, poultry and other animals

The CORINAIR simple methodology uses an average emission factor per animal for each livestock category. Table 206 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 206: CORINAIR default ammonia emission factors (simple methodology) (1)

NFR	Livestock category	NH_3 loss housing [kg NH_3 head^{-1} yr^{-1}]	NH_3 loss storage [kg NH_3 head^{-1} yr^{-1}]
4.B.3	Sheep(2)	0.24	
4.B.4	Goats(2)	0.24	
4.B.6	Horses (mules and asses included)	2.90	
4.B.9	Laying hens	0.19	0.03
4.B.9	Other Poultry (ducks, geese, turkeys)	0.48	0.06
4.B.13	Other animals	0.24	

(1) Emissions are expressed as kg NH_3 per animal, as counted in the annual agricultural census

(2) The emission factors are calculated for female adult animals; the emissions of the young animals are included in the given values.

The CORINAIR guidelines do not give default values for NH_3 emissions from the livestock category 'other animals'. In Austria deer dominates this livestock category. As sheep is the most similar livestock category to deer, for 'other animals' the NH_3 emission factor of sheep is used.

[78] European Agricultural Gaseous Emissions Inventory Researchers Network (EAGER)

3) NH_3-N volatilization losses occurring during manure application

CORINAIR default NH_3 emission factors for spreading of slurry and farmyard manure (expressed as share of TAN) have been applied:

Table 207: Emission factors for NH_3 emissions from animal waste application.

Application technique	CORINAIR Emission factor [kg NH_3-N (kg TAN)$^{-1}$]
spreading solid manure cattle	0.79
spreading solid manure pigs	0.81
broadcast spreading liquid manure cattle	0.50
broadcast spreading liquid manure pigs	0.25

Table 208 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 208: 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 1990–2012 can be found in Table 196.

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 197)*
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 2000–2013) and the datapool of (BUNDESANSTALT FÜR AGRARWIRTSCHAFT 2013) and are presented in Table 197. The other parameters used are presented in the following table:

Table 209: Input parameters used to estimate emissions from crop residues.

	Dm [t/t]	ExF [t/t]	$Frac_{NCR}$ [t N/t d.m.]	$Frac_{CRR}$ [t/t]	$Frac_{CRB}$ [t/t]
Wheat	0.86	1.0	0.005	0.7	0.0042
Rye	0.86	1.4	0.005	0.7	0.0042
Barley	0.86	1.1	0.005	0.7	0.0042
Oats	0.86	1.5	0.005	0.7	0.0042
Maize (corn)	0.50	1.4	0.005	0.0	0.0000
Potato	0.30	0.3	0.012	0.0	0.0000
Sugarbeet	0.45	0.8	0.007	0.0	0.0000
Fodderbeet	0.20	3.0	0.014	1.0	0.0000
Maize (silo)	0.30	0.0	0.014	1.0	0.0000
Clover-hay	0.86	0.0	0.018	1.0	0.0000
Rape	0.86	21	0.009	0.0	0.0000
Sunflower	0.86	2.5	0.009	0.0	0.0000
Sojabean	0.40	1.5	0.023	0.0	0.0000
Fodderbean	0.40	1.5	0.025	0.0	0.0000
Peas	0.40	1.0	0.038	0.0	0.0000
Vegetables	0.20	0.8	0.015	0.0	0.0000
Oil pumpkin	0.80	72.0	0.015	0.0	0.0000

Values were taken from (UMWELTBUNDESAMT 1998a) and had been worked out by Austrian Experts (Ministery of Agriculture, Fachbeirat für Bodenschutz und Bodenfruchtbarkeit – advisory board for soil fertility and soil protection of the Federal Ministry for Agriculture and Forestry, Environment and Water Management).

In 2007 the figures of the N fractions of agricultural crops have been recalculated. The reason for the recalculation is that the applied N contents of several crops obtained from (UMWELTBUNDESAMT 1998a) were partially not adjusted to dry matter basis. Hence, the recalculation led to higher N values for different crop products (N fixing crops and other). The low average N fractions of Austrian crops have been noted by the S & A Report 2006.

In CRF table 4.D for the fraction of nitrogen in N-fixing crops ($Frac_{NCRBF}$) the arithmetic mean of 0.026 is reported. For the fraction of nitrogen in non-N-fixing crops ($Frac_{NCRO}$) the arithmetic mean of 0.009 is reported. These values are now closer to the IPCC default values of 0.03 ($Frac_{NCRBF}$) and 0.015 ($Frac_{NCRO}$).

Nitrogen input through use of sewage sludge

N_2O emissions

The method applied for the calculation of the emissions is IPCC Tier 1b with a default emission factor of 1.25% N_2O-N per kg N input to agricultural soils, corrected for volatilisation. NH_3-N and NO_x-N volatilisation losses were calculated following the CORINAIR EMEP methodology.

In Austria fertilisation by sewage sludge is very small. In 2012 N_2O emissions from sewage sludge contributed only 0.3% of N_2O emissions from category 4.D Agricultural Soils.

N content data of sewage sludge was obtained from (UMWELTBUNDESAMT 1997). The study contains sewage sludge analyses carried out by the Umweltbundesamt. Digested sludge samples from 17 municipal sewage sludge treatment plants taken in winter 1994/1995 were investigated with regard to more than one hundred inorganic, organic and biological parameters in order to get an idea of the quality of municipal sewage sludge. Following this study a mean value of 3.9% N in dry matter was taken.

In 2007 the N-content value of sewage sludge was re-examined. The comparison with national studies (ZESSNER, M. 1999) and (ÖWAV-Regelblatt Nr. 17 – Landwirtschaftliche Verwertung von Klärschlamm 2004 – www.oewav.at) approved the value of 3.9% N/dm.

The amount of nitrogen input from agriculturally applied sewage sludge was calculated according following formula:

$$F_{Sslu} = Sslu_N * Sslu_{agric}$$

F_{Sslu} = *Annual nitrogen input to soils by agriculturally applied sewage sludge [t N]*

$Sslu_N$ = *Nitrogen content in dry matter [%] – 3.9%*

$Sslu_{agric}$ = *Annual amount of sewage sludge agriculturally applied [t/t] (see Table 199)*

Annual agricultural consumption of sewage sludge, nitrogen and volatilization losses are presented in the following table.

Table 210: 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
2011	1 648.18	247.23	16.48	1 384.47	0.16
2012	1 579.41	236.91	15.79	1 326.70	0.16

NH_3-N and NO_x-N volatilization losses from sewage sludge application

For the calculation of NH_3-N emissions the CORINAIR default emission factor for slurry spreading (0.15 kg NH_3-N per kg sewage sludge N) was applied (EEA 2007).

NO_x-N losses were estimated using the conservative emission factor of 1% of sewage sludge nitrogen (FREIBAUER & KALTSCHMITT 2001).

CH_4 emissions

According to the Institute for Applied Ecology (DETZEL et al. 2003) and (SCHÄFER 2002) the average carbon content of sewage sludge amounts about 300 kg carbon per ton sewage sludge. While 48% of the carbon remains in the soil, 52% are emitted to air. 5% of this emitted carbon is emitted as CH_4. Consequential about 10.4 kg methane is emitted per ton sewage sludge.

6.4.2.2 Pasture, range and paddock manure (4.D.2)

Key Source: No

Following the IPCC Guidelines, N_2O emissions resulting from nitrogen input through excretions of grazing animals (directly dropped onto the soil) were calculated under *Manure Management* but reported under *Agricultural Soils*.

$$F_{GRAZ} = N_{exGRAZ} * EF_{GRAZ}$$

F_{GRAZ} = *N_2O emissions induced by nitrogen excreted from grazing animals, expressed as N_2O-N [t N].*

N_{exGRAZ} = *Nitrogen excreted during grazing (amount of animal manure nitrogen produced by grazing animals and directly dropped on agricultural soils during grazing) [t N] – see Table 211*

EF_{GRAZ} = *A constant emission factor for N_2O from manure of grazing animals has been used [t N_2O-N/t N], – 0.02 (IPCC GUIDELINES 1997), workbook table 4-8*

Table 211: Nitrogen excreted during grazing (N_{exGRAZ}) 1990–2012.

Year	N excretion grazing [Mg]	Year	N excretion grazing [Mg]
1990	17 312	2002	11 864
1991	16 832	2003	11 608
1992	15 757	2004	11 360
1993	15 699	2005	10 854
1994	15 364	2006	10 308
1995	15 751	2007	10 157
1996	15 298	2008	9 604
1997	14 848	2009	9 728
1998	14 047	2010	9 775
1999	13 608	2011	9 725
2000	13 303	2012	9 645
2001	12 625		

6.4.2.3 Indirect soil emissions (4.D.3)

Key Source: Yes (N_2O)

According to IPCC definition, indirect N_2O emissions are caused by atmospheric deposition of nitrogen and by nitrogen leaching from soils.

N_2O emissions through atmospheric nitrogen deposition

Emissions were calculated following IPCC Tier 1a (GPG, Equation 4.31):

$$F_{AD} = [(N_{FERT} * Frac_{GASF}) + (N_{ex} * Frac_{GASM}) + (N_{SEWSL} * Frac_{GASSEWSL})] * EF_{AD}$$

F_{AD} = N_2O emissions from atmospheric deposition, expressed as N_2O-N [t N]

N_{FERT} = Nitrogen in mineral fertilizers applied on soils [t N] (see Table 195)

$Frac_{GASF}$ = Fraction of nitrogen lost from mineral fertilizer application through gaseous emissions of NH_3 and NO_x. [t/t] – 0.023 for mineral fertilizers and 0.153 for urea fertilizers (EEA 1999) p.10–15, table 5.1.

N_{ex} = Total nitrogen annually produced in animal waste management systems [t N] (N excretion values see Table 187 and Table 188)

$Frac_{GASM}$ = Fraction of animal manure that is volatized as NH_3 or NO_x [t/t] (adopted from calculations of NH_3 and NO_x emissions following the CORINAIR methodology)

EF_{AD} = N_2O emission factor (constant over the time series) for emissions from atmospheric deposition: tons of N_2O-nitrogen released per ton of volatized nitrogen – 0.01 [t/t] (IPCC GUIDELINES 1997)

N_{SEWSL} = nitrogen in agriculturally applied sewage sludge [t N] (see Table 210)

$Frac_{GASSEWSL}$= Fraction of sewage sludge N that is volatized as NH_3 or NO_x [t/t] (adopted from calculations of NH_3 and NO_x emissions following the CORINAIR methodology) (see Table 210)

Total N excretion by livestock that volatizes ($Frac_{GASM}$) includes:

- NH_3-N losses from housing, storage, grazing,
- NO_x-N losses from manure management,
- NH_3-N and NO_x-N losses from animal waste application.

Table 212: NH_3-N and NO_x-N volatilisation losses of mineral fertilizers and livestock N excretion 1990 to 2012.

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	48 054	0.26
1991	4 204	0.03	47 959	0.26
1992	3 633	0.03	46 875	0.26
1993	2 949	0.03	47 812	0.26
1994	4 006	0.03	47 779	0.26
1995	4 168	0.03	48 509	0.26
1996	3 550	0.03	47 677	0.26
1997	3 674	0.03	48 057	0.26
1998	3 819	0.03	48 212	0.26
1999	3 702	0.03	47 089	0.26
2000	3 465	0.03	45 735	0.26
2001	3 212	0.03	45 983	0.26
2002	3 321	0.03	45 261	0.27
2003	3 266	0.03	45 269	0.27
2004	3 142	0.03	44 917	0.27
2005	3 279	0.03	44 794	0.27
2006	3 573	0.04	44 771	0.27
2007	3 863	0.04	45 434	0.27
2008	4 103	0.03	44 970	0.27
2009	4 356	0.04	45 594	0.27
2010	3 653	0.04	45 965	0.27
2011	3 904	0.04	45 271	0.27
2012	4 260	0.04	44 923	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 2014 – Submission under the UNECE Convention on Long-range Transboundary Air Pollution' (UMWELTBUNDESAMT 2014a). Austria's Informative Report 2014 will be published in spring 2014.

N_2O emissions through nitrogen leaching losses

A country-specific methodology based on the N-flow approach was used.

Following IPCC recommended values, leaching losses from nitrogen fertilizers are estimated to be about 30% of the nitrogen inputs from synthetic fertilizer use, livestock excretion, and sewage sludge application. N_2O emissions are then estimated as 2.5% of the leaching losses, as suggested by the IPCC.

The calculation follows the following formular:

$$E\text{-}N_2O_{LL} = (F_{FERT} + N_{exLFS} + N_{exGRAZ} + F_{Sslu}) * Frac_{LEACH} * EF\text{-}N_2O_{LL}$$

$E\text{-}N_2O_{LL}$ = N_2O emissions from leaching losses, expressed as N_2O-N [t N]

F_{FERT} = Annual amount of nitrogen in synthetic fertilizers (mineral and urea) applied on soils [t N] (seeTable 195)

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 200)

N_{exGRAZ} = Annual amount of animal manure nitrogen produced by grazing animals and directly dropped on agricultural soils during grazing [t N] (see Table 211)

F_{Sslu} = Annual nitrogen input from sewage sludge applied on agricultural soils [t N] (see Chapter 4 D 1 – Nitrogen input through the use of sewage sludge)

$Frac_{LEACH}$ = Fraction of nitrogen applied on soils that leaches (0.3 [t/t] following IPCC REFERENCE MANUAL, TABLE 4-24)

$EF\text{-}N_2O_{LL}$ = Emission factor for N_2O from leaching, expressed as N_2O-N (0.025 [t/t] following IPCC-GPG TABLE 4-18)

6.4.3 Source specific QA/QC

In the categories 4.D. the following source specific QA/QC procedures have been carried out:

- ✓ NH_3-N and NO_x-N losses calculated in compliance to the obligations under UNECE/CLRTAP;
- ✓ Methods and emission factors reviewed by the EAGER[79] network;
- ✓ Plausibility of CRF N-fractions checked;
- ✓ Differences to IPCC default values explained and documented;
- ✓ External review by Austrian agricultural experts (stakeholder meetings);
- ✓ expanded QA and verification activities in 2012: in-depth review of the agriculture model.

Sector specific routine control procedures are provided in chapter 6.1.4.

6.4.4 Uncertainties

Uncertainties are presented in Table 157.

6.4.5 Recalculations

Minor changes of N_2O emissions from agricultural soils are the result of revised amounts of anaerobic digested manure.

[79] 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 2012 total emissions from this category amounted to 0.62 Gg CO_2 equivalent, this is a share of 0.01% in total GHG emissions from sector agriculture. CH_4 and N_2O emissions for the years from 1990 to 2012 are presented in Table 213.

Table 213: Emissions from field burning (4.F) 1990–2012.

Year	CH_4	N_2O
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
2011	0.03	0.000
2012	0.02	0.000
Trend 1990–2012	***-56.6%***	***-64.5%***
Share in Agriculture	***0.01%***	***0.00%***

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 209).

According to the *Presidential Conference of the Austrian Chambers of Agriculture* (personal communication to Mag. Längauer), in Austria about 681 ha were burnt in 2012. This value corresponds to about 0.1% of the relevant cereal area in 2012.

6.5.2.2 Other (4.F.5)

Key Source: No

This category comprises burning residual wood of vinicultures on open fields in Austria.

A simple method (Emission = Activity x Emission Factor) using country specific emission factors was applied.

Activity data (viniculture area) are taken from the datapool of (BUNDESANSTALT FÜR AGRARWIRTSCHAFT 2013). 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 214: Activity data for field burning of agricultural residues 1990–2012.

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	46 635	3 498
2011	46 635	3 498
2012	46 635	3 498

The emission factors (4 828 g CH_4/Mg and 49.7 g N_2O/Mg burnt wood) were calculated by multiplying the emission factors of 7 kg N_2O/TJ and 680 g CH_4/TJ (STANZEL et al. 1995) by a calorific value of 7.1 MJ/kg burnt wood which corresponds to burning wood logs in poor operation furnace systems.

6.5.3 Source specific QA/QC

Sector specific routine control procedures are provided in chapter 6.1.4.

6.5.4 Recalculations

No recalculations have been carried out since last years´ submission.

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 215: Emissions and removals from Sector 5 LULUCF by sub-categories[1] in Gg CO_2 equivalents.

Year	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	-9 877	-10 929	54	322	42	184	451
1991	-15 600	-16 659	54	317	42	187	460
1992	-10 806	-11 896	76	312	42	191	469
1993	-11 253	-12 368	94	307	42	195	477
1994	-10 185	-11 304	100	307	42	193	477
1995	-11 484	-12 296	114	140	36	144	378
1996	-8 454	-9 274	130	141	36	139	374
1997	-17 194	-18 024	147	143	36	134	369
1998	-15 375	-16 207	157	145	36	130	365
1999	-18 291	-19 124	160	145	36	128	365
2000	-15 231	-16 034	169	145	36	87	366
2001	-17 161	-17 985	177	145	36	99	368
2002	-11 095	-12 232	196	353	47	204	336
2003	-1 083	-2 244	207	349	47	220	338
2004	-6 143	-7 328	227	350	47	231	330
2005	-7 625	-8 783	223	353	37	222	323
2006	-1 807	-2 970	231	352	39	226	315
2007	-750	-1 945	251	354	51	230	308
2008	140	-1 053	253	355	49	235	300
2009	-3 904	-4 604	263	49	69	101	217
2010	-3 893	-4 565	247	46	73	97	210
2011	-3 871	-4 526	248	43	70	92	202
2012	-3 839	-4 487	250	41	75	88	194
Trend BY-2012	***-61.1***	***-58.9***	***365.0***	***-87.2***	***77.8***	***-52.1***	***-56.9***

[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

Table 215 shows that land use, land use change and forestry is a net sink in Austria, with an exception in 2008. For the years after 2002 a significant increase in biomass drain in forest land causes a clear decrease in the net sink of the biomass of the subcategory „forest land remaining forest land (*5.A.1*) with related impacts on the totals of the LULUCF sector.

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 CO_2, whereas the other sub categories are sources of GHG emissions. Total emissions arising from the other sub categories amount to 4–

61% of removals from forest land in most years. However, in the years 2007 and 2008 also the subcategory forest land remaining forest land represents a net emission source according to the updates and improvement steps in the estimates of submission 2012.

7.1.1 Emission Trends

In 2012, net removals from sector 5 amount to 3 839 Gg CO_2 equivalents which corresponds 4.8% of total GHG in Austria (without LULUCF), compared to 13% in the base year. The removals of sector 5 decreased by 61.1% from the base year to 2012.

The most important sub-category is forest land (*5.A*) with net removals of 4 487 CO_2 in 2012. The total emissions from the other sub-categories amount to 649 Gg CO_2 equivalents in 2012.

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 CO_2 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. 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 reported net sink of the sector for the years after 2002 is much lower than reported in the previous submissions before 2012 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 216.

Table 216: Key sources of LULUCF.

IPCC Category	Source Categories	Key Sources	
		GHG	**KS-Assessment***
5.A.1	Forest land remaining forest land	CO_2	LA; TA
5.A.2	Land converted to forest land	CO_2	LA; TA
5.B.1	Cropland remaining cropland	CO_2	TA; LA 2012 (only T2)
5.B.2	Land converted to cropland	CO_2	LA 1990; LA 2012 (only T2)
5.C.2	Land converted to grassland	CO_2	LA 1990; TA; LA 2012 (only T2)
5.D.2	Land converted to wetlands	CO_2	LA 2012 (only T2)
5.E.2	Land converted to settlements	CO_2	LA 1990; LA 2012 (only T2)
5.F.2	Land converted to other land	CO_2	LA; TA

LA = Level Assessment (if not further specified – for the years 1990 and 2012)

TA = Trend Assessment BY–2012

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 7.1 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 2012 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. As announced in NIR 2013 a detailed assessment of the ARD activities under Article 3.3 of the Kyoto Protocol was carried out in the years 2011–2013. On the basis of these assessments, also the areas of land use changes to and from forests, the emission factors for those sites and the related estimates of the emissions/removals were revised for the whole time series. For area consistency reasons this led also to an update of activity data (area) in some other LUC subcategories.

Data for the total cropland area are available annually from STATISTIK AUSTRIA (STATISTIK AUSTRIA 1990–2013). Based on the Austrian farm structure surveys (e.g. 1993, 1995, 1999, 2010) 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 7.6.2).

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 217). 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 fact the forest definition and count as forest land according to Austrian law and the at-site-assessments by the NFI.

Table 217 presents land use data and data for land use changes for the year 1990 and 2012 for the total area of Austria as used for the calculations. For the submission 2014, the results of the ARD NFI 2011/13 were for the first time available. On basis of these results the LUC areas to and from forests were revised for submission 2014. Furthermore, for area consistency reasons also the LUC areas from other categories to wetlands, settlements and other land had to be revised for submission 2014 due to the new ARD NFI results.

Table 217: Land use and LUC data for Austria for the years 1990 and 2012.

Area in ha	1990	2012	Diff. 1990–2012
5.A Forest land – total area	**3 891 333**	**4 013 000**	**121 667**
1 Forest land remaining forest land – total area	3 631 514	3 851 270	219 756
1.1a Forest land remaining forest land: coniferous	2 473 995	2 411 985	-62 009
1.1b Forest land remaining forest land: deciduous	750 151	928 715	178 563
1.1c Forest land remaining forest land: forest not in yield	407 368	510 570	103 201
2. Land converted to forest land	259 819	161 730	-98 089
2.1 Cropland converted to forest land	30 962	14 427	-16 535
2.2 Grassland converted to forest land	144 197	84 896	-59 301
2.3 Wetland converted to forest land	12 534	10 007	-2 527
2.4 Settlement converted to forest land	17 122	8 782	-8 340
2.5 Other Land converted to forest land	55 004	43 618	-11 387
5.B Cropland – total area	**1 507 533**	**1 425 328**	**-82 205**
1. Cropland remaining cropland	1 466 439	1 373 862	-92 577
1a Annual remaining annual and perennial remaining perennial	1 436 285	1 345 003	-91 282
1b Annual converted to perennial	16 722	15 937	-785
1c Perennial converted to annual	13 433	12 922	- 511
2. Land converted to cropland	41 094	51 466	10 372
2.1Forest Land converted to cropland	4 125	3 478	-647
2.2 Grassland Land converted to cropland	36 968	47 987	11 019
2.2a Grassland converted to perennial cropland	1 498	1 944	447
2.2b Grassland converted to annual cropland	35 470	46 043	10 573
2.3 Wetland Land converted to cropland	NO	NO	NO
2.4 Settlement converted to cropland	NO	NO	NO
2.5 Other Land converted to Cropland	NO	NO	NO
5.C. Grassland – total area	**1 992 765**	**1 790 197**	**-202 568**
1. Grassland remaining grassland	1 944 009	1 733 049	-210 960
2. Land converted to grassland	48 756	57 148	8 392
2.1 Forest land converted to grassland	32 467	30 553	-1 915
2.2 Arable land converted to grassland	16 288	26 595	10 307
2.2a annual cropland converted to grassland	16 112	26 308	10 195
2.2b perennial cropland converted to grassland	176	288	111
2.3 Wetland land converted to grassland	NO	NO	NO
2.4 Settlement converted to grassland	NO	NO	NO
2.5 Other land converted to grassland	NO	NO	NO
5 D Wetlands – total area	**133 068**	**148 096**	**15 029**
1. Wetlands remaining wetlands	127 557	123 964	-3 593

Area in ha	1990	2012	Diff. 1990–2012
2. Land converted to wetlands	5 511	24 133	18 622
2.1 Forest land converted to wetlands	1 706	2 148	441
2.2 Arable land converted to wetlands	NO	NO	NO
2.3 Grassland converted to wetlands	3 804	21 985	18 181
2.4 Settlement converted to wetlands	NO	NO	NO
2.5 Other land converted to wetlands	NO	NO	NO
5 E Settlements – total area	**384 065**	**538 107**	**154 042**
1. Settlements remaining settlements	176 291	393 930	217 639
2. Land converted to settlements	207 774	144 178	- 63 596
2.1 Forest land converted to settlements	9 792	9 525	-267
2.2 Arable land converted to settlements	142 266	99 193	-43 072
2.3 Grassland converted to settlements	55 717	35 459	-20 257
2.4 Wetlands converted to settlements	NO	NO	NO
2.5 Other land converted to settlements	NO	NO	NO
5 F Other land – total area	**478 236**	**472 271**	**-5 964**
1. Other land remaining other land	419 098	418 837	-261
2. Land converted to other land	59 137	53 435	-5 703
2.1 Forest land converted to other land	18 134	11 675	-6 460
2.2 Arable land converted to other land	NO	NO	NO
2.3 Grassland converted to other land	41 003	41 760	757
2.4 Wetlands converted to other land	NO	NO	NO
2.5 Other land converted to other land	NO	NO	NO
Total area	**8 387 000**	**8 387 000**	

Table 218 shows the land-use change matrix for the years 1990 and 2012. Slight deviations (< 1%) of the total areas in this table to the reported areas are due to the smoothing of the time series and due to rounding differences.

Table 218: Land use and land-use change matrix for Austria 1990–2012.

in 1 000 ha	Forest land	Cropland	Grass-land	Wetlands	Settlements	Other land	Total 2012
Forest land	3 817	18	104	12	11	51	**4 013**
Cropland	5	1 368	52				**1 425**
Grassland	37	29	1.724				**1 790**
Wetlands	3		24	121			**148**
Settlements	14	116	42		366		**538**
Other land	16		47			410	**473**
Total 1.1.1990	**3 892**	**1 531**	**1 993**	**133**	**377**	**461**	**8 387**

7.1.3.2 Definition of C-pools

As recommended by the ERT during the ICR 2013 a detailed description of the C-pools as used in the GHG-reporting of Austria is given in the table below.

Table 219: Definitions of C-pools

Pools		Description
Living biomass	Above ground biomass	Forest land: All living biomass (DBH > 5cm) above the soil including stem, stump, branches, seeds, bark and foliage (foliage only of evergreen trees). At ARD sites and LUC from and to forests all forest biomass (shrubs, forest understory) with a DBH > 0 cm to 5 cm is also taken under consideration. Other subcategories: All living biomass is taken under consideration
	Below ground biomass	All living biomass of live roots with a diameter > 2 mm.
Dead organic matter	Dead wood	All non-living woody biomass not contained in the litter or soil, standing on the ground, without roots, as they are already considered as part of the litter or soil.
	Litter	All non-living biomass lying dead in various states of decomposition above the mineral or organic soils.
Soils	Soil organic matter	All organic matter in mineral and organic soils (including peat) to a soil depth of 50 cm (forests, LUC from and to forests) or to a soil depth of 30 cm (all other land uses and LUC).

7.1.3.3 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

Step3: If step 1 and 2 do not allow any explanation further check of the used statistics and their estimates (see 1.2) and/or communication with the data providers

1.1.2) Check for plausibility of the emission factors as well as the related input data and their trends

Step 1: Documentation of the most important reasons for changes and non-changes of emission factors

Step 2: Check and documentation if these changes or non-changes of emission factors fit to trends of underlying conditions

Step 3: If step 1 and 2 do not allow any explanation further check of the used statistics and their estimates (see 1.2) and/or communication with the data providers

1.1.3) Check of input data for completeness

1.2) Estimations

1.2.1) Check of the correctness of all equations in the estimate files

1.2.2) Check of the correctness of all interim results

1.3) Check of the plausibility of the results and their trends related to point 1.1 and documentation of the plausibility of changes and non-changes on basis of point 1.1

1.4) Check of the correctness of all data and results transfer

2) Top-down check

2.1) Check of the consistence of the total area for Austria.

2.2) Comparison of the used activity data with those from other statistics. Documentation of the results of these comparisons and documentation of the reasons for the choice of statistics when data deviate more than 5% compared to other statistics

2.3) Comparison of the used emission factors and underlying input data with those of other data sources (e.g. from literature results in NIRs of other comparable regions IPCC default values). Documentation of the results of these comparisons. Further check according to points 1.1 and 1.2 as well as check on the suitability of the used input data in case of inplausible differences. Documentation of this further check.

7.1.5 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. ±19 000 Gg CO_2. This represents on average ±152% 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 clearly higher (several hundred % up to several thousand %).

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. ±5 600 Gg CO_2 (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 ±60% and ±2 139%.

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 CO_2 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

As announced in NIR 2013, the submission 2014 contains estimates of the detailed assessments of the ARD activities under Article 3.3 of the Kyoto Protocol including biomass and dead wood stock changes due to these activities for the first time. This ARD assessment was carried out in the years 2011 to 2013. On basis of these assessments, also the areas of land-use-changes to and from forests, the emission factors at these lands and estimates of the emissions/removals at these lands were revised for the whole time series since 1990. For area consistency reasons this led also to an update of land use changes and emissions/removals in some other subcategories.

These changes had also an impact on the results of subcategory 5.A.1 which are based on the results of the NFIs for total Austria minus those biomass and dead wood stock changes due to LUCs involving forests (in order to avoid double accounting). A change in *5.A.2* or in LUC categories from forest to other land uses represents also a change in subtrahends for the derivation of the results for the subcategory *5.A.1* on basis of the NFI results for all Austria.

In response to review findings the estimates of the emissions/removals in the mineral soils of LUC categories with wetlands were revised. Due to a lack in information and methods in the IPCC GPG (2003) and 2006 guidelines as well as a lack of information in other literature, it is assumed that the soil carbon stocks do not change after conversion from and to wetlands.

The conversion rates between annual, perennial cropland and grassland of the last years were updated on basis of the most recent data from the national inventory IACS (*german:* "INVEKOS"). Furthermore, mistakes in the upscaling factors of the cropland vs. grassland conversion rates (subsample ➔ country-wide data) have been identified and were corrected for the 2014 submission (compared to previous submissions).

7.1.7 Completeness

Table 220 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 CO_2 emissions/removals are estimated.

Table 220: IPCC categories according to the IPCC-Good Practice Guidance for Land-Use, Land-Use Change and Forestry.

IPCC categories[80]/ Sub division for calculation	**Description**	**Status for CO_2**	**Other GHG**
5 A	Forest land	✓	
5.A.1	Forest land remaining forest land	✓	
Coniferous	Increase, decrease, net change of carbon stock	✓	
Deciduous	Increase, decrease, net change of carbon stock	✓	
	Net carbon stock change in dead organic matter	✓	
	Net carbon stock change in soils	✓	
5.A.2	Land converted to forest land	✓	
5.A.2.1	Cropland converted to forest land	✓	
	Carbon stock change in biomass	✓	
	Carbon stock change in soils	✓	
5.A.2.2	Grassland converted to forest land	✓	
	Carbon stock change in biomass	✓	
	Carbon stock change in soils	✓	
5.A.2.3	Wetlands converted to forest land	✓	
	Carbon stock change in biomass	✓	
	Carbon stock change in soils	✓	
5.A.2.4	Settlements converted to forest land	✓	
	Carbon stock change in biomass	✓	
	Carbon stock change in soils	✓	
5.A.2.5	Other land converted to forest land	✓	
	Carbon stock change in biomass	✓	
	Carbon stock change in soils	✓	
5.B	Cropland	✓	
5.B.1	Cropland remaining cropland	✓	
Annual remaining annual	*Carbon stock change in living biomass*	✓	
Annual remaining annual	*Carbon stock change in soils*	✓	
Perennial remaining perennial	*Carbon stock change in living biomass*	✓	
Perennial remaining perennial	*Carbon stock change in soils*	✓	
Annual converted to perennial	*Carbon stock change in living biomass*	✓	
Annual converted to perennial	*Carbon stock change in soils*	✓	
Perennial converted to annual	*Carbon stock change in living biomass*	✓	
Perennial converted to annual	*Carbon stock change in soils*	✓	
5.B.2	Land converted to cropland	✓	
5.B.2.1	Forest land converted to cropland	✓	
	Carbon stock change in biomass	✓	
	Carbon stock change in soils	✓	✓ N_2O
5.B.2.2	Grassland converted to cropland	✓	

[80] IPCC categories – applied according to the "Good Practice Guidance for LULUCF (2003)"

IPCC categories[80]/ Sub division for calculation	Description	Status for CO_2	Other GHG
	Carbon stock change in living biomass	✓	
	Carbon stock change in soils	✓	✓ N_2O
5.B.2.3	Wetland converted to cropland	NO	
5.B.2.4	Settlements converted to cropland	NO	
5.B.2.5	Other land converted to cropland	NO	
5.C	Grassland	✓	
5.C.1	Grassland remaining grassland	✓	
	Carbon stock change in soils	✓	
5.C.2	Land converted to grassland	✓	
5.C.2.1	Forest land converted to grassland	✓	
	Carbon stock change in biomass	✓	
	Carbon stock change in soils	✓	
5.C.2.2	Cropland converted to grassland	✓	
	Carbon stock change in living biomass	✓	
	Carbon stock change in soil	✓	
5.C.2.3	Wetland converted to grassland	NO	
5.C.2.4	Settlements converted to grassland	NO	
5.C.2.5	Other land converted to grassland	NO	
5.D	Wetlands	✓	
5.D.2.1	Forest land converted to wetlands	✓	
	Carbon stock change in living biomass	✓	
	Carbon stock change in soil	✓	
5.D.2.2	Cropland converted to wetlands	NO	
5.D.2.3	Grassland converted to wetlands	✓	
	Carbon stock change in living biomass	✓	
	Carbon stock change in soil	✓	
5.D.2.4	Settlements converted to wetlands	NO	
5.D.2.5	Other land converted to wetlands	NO	
5.E	Settlements		
5.E.2.1	Forest land converted to settlements	✓	
	Carbon stock change in living biomass	✓	
	Carbon stock change in soil	✓	
5.E.2.2	Cropland converted to settlements	✓	
	Carbon stock change in living biomass	✓	
	Carbon stock change in soil	✓	
5.E.2.3	Grassland converted to settlements	✓	
	Carbon stock change in living biomass	✓	
	Carbon stock change in soil	✓	
5.E.2.4	Wetlands converted to settlements	NO	
5.E.2.5	Other land converted to settlements	NO	
5.F	Other Land		

IPCC categories[80]/ Sub division for calculation	Description	Status for CO_2	Other GHG
5.F.2.1	Forest land converted to other land	✓	
	Carbon stock change in living biomass	✓	
	Carbon stock change in soil	✓	
5.F.2.2	Cropland converted to other land	NO	
5.F.2.3	Grassland converted to other land	✓	
	Carbon stock change in living biomass	✓	
	Carbon stock change in soil	✓	
5.F.2.4	Wetlands converted to other land	NO	
5.F.2.5	Settlements converted to other land	NO	
5(IV) 5 B Limestone $CaCO_3$: Total amount applied	CO_2 emissions due to liming of cropland and grassland	✓	
5(IV) 5 B Limestone $CaCO_3$: Carbon	CO_2 emissions due to liming of cropland and grassland	✓	
5(V) 5 A 1 BiomassBurn_contr.	Biomass Burning: Controlled: Forest land remaining forest land	NO	NO
5(V) 5 A 1 BiomassBurn_wildfires	Biomass Burning: Wildfires: Forest land remaining forest land	IE (1)	✓ N_2O ✓ CH_4
5(V) 5 B 1 BiomassBurn_controlled	Biomass Burning: controlled: residues of perennial cropland	IE (2)	IE (3) N_2O, CH_4

1) *CO_2 emissions caused by wildfires (CRF Table 5(V)) are included in the category 5.A.1. Data on the area affected by* wildfires are available for the years 1990 to 2012.

2) *Included in the harvest of perennial cropland biomass*

3) *Included in Sector 4.F estimates. - field burning of agricultural residues*

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:

- Improvement of estimates for C-stock changes in forests not in yield as recommended by ERT during the ICR 2013.
- Improvement of the values for biomass C-stocks in viticulture and orchards. The default carbon accumulation factor of 2.1 tons C/ha/yr for the derivation of biomass increase, which leads to biomass carbon stock at harvest of 63 t C /ha after a rotation period of 30 years (IPCC GPG 2003), is probably too high for Austrian conditions and will be improved with country- and species-specific values when they become available.
- Improvement of areas for alpine pastures: In the year 2010 new entry conditions for receiving support for alpine pastures in the framework of the Rural development programme in Austria led to different, reduced areas of alpine pastures. Only fodder areas have been recorded since then, without stony, unproductive and tree covered patches in these areas. A recalculation of these grassland areas will be likely done for the next submission after thorough examinations of the LULUCF-Team.
- Christmas trees: For Christmas trees data on roots biomass will have to be added examining root-shoot biomass relations (e.g. MOKANY ET AL. 2006, national data).

- Energy crops: For energy crops data on roots biomass will have to be added examining root-shoot biomass relations (e.g. MOKANY ET AL. 2006, national data). Furthermore it will be examined, if a splitting of areal data and a distinction of different energy crops is possible for the next submissions (poplar, sallow, energy grass (Miscanthus giganteus*)*,

7.2 Forest land (5.A)

7.2.1 Category description

4.01 Mio ha (47.8%) of Austria are forest land (BFW 2013). There was a steady increase of the standing C stocks in the Austrian forests in the last decades (since the first NFI 1961-70). The sustaining of the Austrian forests in the past helped to restore an important carbon stock in the Austrian landscape and to avoid net CO_2 emissions to the atmosphere from the sector LULUCF: In 1990 the Austrian forests represented a carbon stock of 339 ± 42 Mt carbon from biomass and 463 ± 185 Mt carbon from soil, i.e. humus layer plus mineral soil to 50 cm depth. This total carbon stock represents approximately 40 times the Austrian CO_2 equivalent emissions of the greenhouse gases CO_2, CH_4 and N_2O in the year 1990 (UMWELTBUNDESAMT 2000).

Emission/Removal trends of forest land

With regard to forest land the annual net CO_2 removals under sector 5 of the reported period 1990–2012[81] range from 1 053 Gg CO_2 to 19 124 Gg CO_2 (mean: 9 863 Gg CO_2). The most important sub-category is forest land remaining forest land (*5.A.1*), whereas land use changes to forests (*5.A.2*) and from forests (*5.B.2* to *5.F.2*) have only minor influence on the net CO_2 balance.

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 (except for the land use changes to and from forests for which the ARD NFI 2011 to 2013 provided accurate figures for the last years up to 2014).

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 CO_2 (from 4 324 Gg CO_2 to 16 385 Gg CO_2). Between 1990 and 2012 the net carbon sink of this category ranges between 1% and 24% of the total CO_2 equivalent emissions without LULUCF of the GHGs CO_2, CH_4 and N_2O in this period.

For the reported period 1990 to 2012 the total annual net CO_2 removals (biomass and soil) from land use changes to forest range from about 1 879 Gg CO_2 to 3 412 Gg CO_2. The total annual emissions (biomass and soil) from land use changes from forests vary between 548 Gg CO_2 and 1 205 Gg CO_2.

[81] For the years since 2009 the means for the last period (2007 to 2009) of the National Forest Inventory (NFI) have been reported.

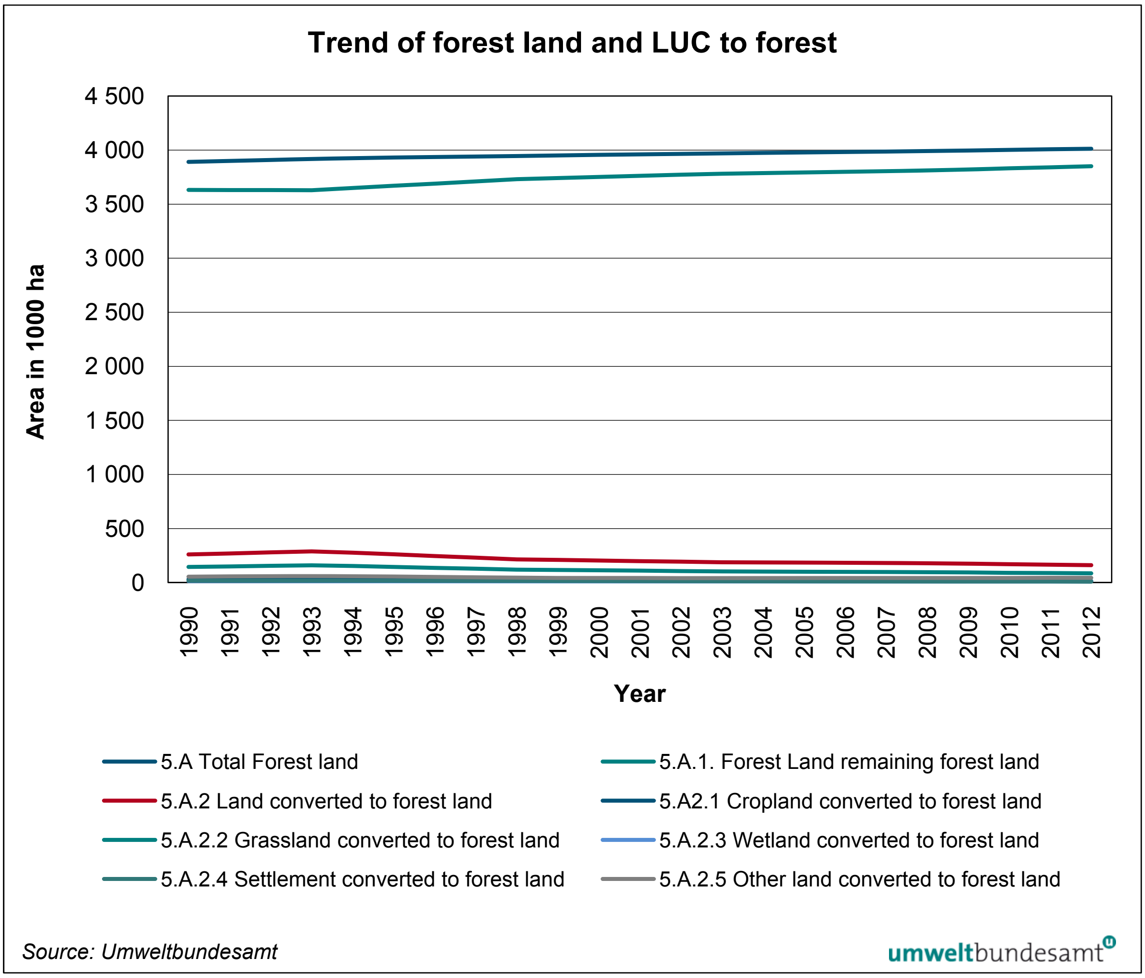


Figure 33: Trend of forest land and LUC to forest (covering a conversion period of 20 years) from 1990 to 2012 in 1 000 ha (Total forest land includes also forest out of yield).

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 CO_2 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.

Table 221: CO_2 removals/emissions from IPCC Category 5.A Forest Land and Forest land conversions from 1990–2012 (Gg CO_2 resp. Gg CO_2 equiv.)

	5 A Total Forest land	5.A.1. Forest land remaining Forest land	5.A.2. Land converted to Forest land	5.A.2.1 Cropland converted to Forest land	5.A.2.2 Grassland converted to Forest land	5.A.2.3 Wetlands converted to Forest land	5.A.2.4 Settlements converted to Forest land	5.A.2.5 Other Land converted to Forest land	5.A.1_BiomassBurn_wild_CO2	5.A.1_BiomassBurn_wild_CH4	5.A.1_BiomassBurn_wild_N2O	5 Forestland Conv
1990	-10 930	-7 849	-3 081	-422	-1 033	-93	-368	-1 165	IE	0.582	0.135	1 172
1991	-16 660	-13 472	-3 187	-437	-1 068	-96	-381	-1 206	IE	0.154	0.036	1 183
1992	-11 896	-8 602	-3 294	-451	-1 102	-99	-394	-1 247	IE	0.384	0.089	1 194
1993	-12 369	-8 957	-3 412	-468	-1 143	-103	-408	-1 291	IE	0.326	0.076	1 205
1994	-11 304	-8 035	-3 269	-448	-1 094	-98	-391	-1 238	IE	0.169	0.039	1 205
1995	-12 296	-9 230	-3 066	-421	-1 022	-92	-368	-1 164	IE	0.093	0.022	857
1996	-9 274	-6 379	-2 895	-397	-967	-87	-347	-1 098	IE	0.084	0.020	849
1997	-18 024	-15 299	-2 725	-373	-913	-82	-326	-1 031	IE	0.058	0.014	844
1998	-16 207	-13 654	-2 554	-350	-858	-77	-305	-964	IE	0.271	0.063	838
1999	-19 124	-16 637	-2 487	-341	-835	-75	-297	-940	IE	0.023	0.005	839
2000	-16 034	-13 613	-2 421	-332	-812	-73	-289	-915	IE	0.122	0.028	840
2001	-17 985	-15 630	-2 355	-323	-790	-71	-281	-890	IE	0.070	0.016	841
2002	-12 233	-9 944	-2 288	-305	-759	-73	-271	-880	IE	0.559	0.130	1 130
2003	-2 244	-25	-2 219	-292	-731	-72	-261	-863	IE	0.533	0.124	1 131
2004	-7 329	-5 135	-2 193	-284	-718	-72	-257	-863	IE	0.049	0.011	1 122
2005	-8 783	-6 616	-2 167	-277	-704	-72	-253	-862	IE	0.090	0.021	1 113
2006	-2 971	-829	-2 142	-267	-689	-74	-248	-864	IE	0.215	0.050	1 103
2007	-1 945	171	-2 116	-257	-674	-76	-243	-867	IE	0.108	0.025	1 093
2008	-1 053	1 038	-2 091	-247	-659	-77	-238	-870	IE	0.146	0.034	1 083
2009	-4 605	-2 575	-2 030	-234	-628	-74	-224	-870	IE	0.163	0.038	579
2010	-4 565	-2 586	-1 979	-222	-602	-74	-212	-869	IE	0.143	0.033	569
2011	-4 526	-2 597	-1 929	-210	-576	-74	-201	-868	IE	0.128	0.030	558
2012	-4 487	-2 608	-1 879	-198	-551	-74	-189	-867	IE	0.160	0.037	548

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, 2013; 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 covering the total forest area. In the period 2011-2013 a reduced ARD NFI was carried out at the previous LUC areas from and to forests and at new LUC areas since the NFI period 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 m^2 size at each grid point. The NFI provides representative and systematically measured data for the total Austrian forest area and for all Austrian areas of LUCs from and to forests. This includes the areas of the complete 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 2010a 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 af-/reforestation 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, 2007/09 and at ARD areas in 2011/13. 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: 3 224 kha. This is the sum of the figures of 1.1a and 1.1b in Table 217).
3) The result of step 2 is split according to the area-distribution of coniferous and deciduous trees, e.g. for 1990: coniferous 2 474 kha + deciduous 750 kha = 3 224 kha (see Table 217 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. 3 224 kha) minus LUC to forests (e.g. 260 kha). For 1990: 407 kha (see 1.1c in Table 217).
5) Total forest land remaining forest land in CRF table is the sum of step 3 and 4 = 3 631kha.

The result of step 5 and the LUC to forest sum up to the total forest area according to NFI (e.g. in 1990: 3 631 kha + 260 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)**. The assumption for the exclusion of carbon stock changes in non-productive forests is the following: There is a balance between C-losses due to decay and C-gains due to biomass increment. There is no extraction of biomass due to the missing access to these forests, but the opposite, planting measures are carried out (for maintaining the essential protective function of these forests). Therefore, we assume that this assumption is conservative.

The NFI 2007/09 carried out for the first time an assessment of the standing stocks in the non-productive forests. So, with the next NFI and a re-assessment of these stocks an estimate of the biomass stock changes in the non-productive forests will be possible.

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 and for the whole time series to be reported. A division of these areas by the NFI assessment period leads to data for the annual LUCs.

The specific shares of individual land use categories of these LUCs were assessed in the NFIs 2000/02 and 2007/09 and in the ARD NFI 2011/13 (which cover the observation periods between the years of the NFI periods 1992/96 to 2000/02, 2000/02 to 2007/09 and 2007/09 to 2011/13). 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. The various past/previous LU categories as assessed by the NFI were summed up according to the IPCC-GPG LU categories (Table 222).

In the years 2011 to 2013 a reduced NFI was carried out only at all NFI plots which had according to previous NFIs ARD activities. In addition, all NFI grid points and plots were inspected which were suspicious for a potential LUC to/from forests on basis of an assessment of latest aerial images for Austria for the period after the last NFI 2007/09. The NFI grid points and plots were checked in these latest aerial images for a potential LUC to/from forests since NFI 2007/09. In clear or suspicious cases for a current LUC at site inspections of the NFI plots were carried out for clarification if a recent LUC to/from forests in the period since the last NFI 2007/09 occurred or not and related measurement of the new LUC areas were carried out. The ARD NFI 2011/13 had also the purpose to measure and to assess for the first time and in detail the biomass stock changes and the dead wood stock changes at all old and new plots with LUCS to/from forests for the Kyoto-period 2008 to 2012. In previous submissions, rough estimates of the biomass stock changes at such LUC areas on basis of NFI results were carried out and used.

With the ARD NFI 2011/13 also a thorough inspection of all ARD areas was carried out for the appropriateness of the classification as ARD areas. Areas previously accounted as ARD areas due to

- measurement or assessment errors,
- different classifications for unchanged plots by different NFI inspection teams in different NFIs
- short time oscillations in activities below the legal time frames for accounting as afforestation or deforestation (see chapter 10.4.1.2)

could be identified and were deleted as ARD areas. On basis of the results of these thorough inspections of each ARD plot, for submission 2014 the ARD areas of previous submissions were reduced by these misclassified ARD areas. The LUC areas to/from forests were reduced accordingly.

Table 222: LU-classification systems (IPCC-GPG and NFI 2000/02, 2007/09 and ARD NFI 2011/13).

Land use categories in the IPCC GPG	LU classifications for LUC from and to forests according to the NFI (2000/02, 2007/09 and ARD NFI 2011/13)
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 Landfills, dumps Urban, residential zone
Other land	Unmanaged alpine dwarf shrub heaths Scree Rock Others

Table 223: Land use changes to forest (%, ha) observed from 1990 to 2012 (covering the NFI periods 1986/90, 1992/96, 2000/02, 2007/09 and the ARD NFI 2011/13; based on BFW 2013).

Categories of land use changes according to the IPCC GPG 2003	1990 – NFI 1992/96		NFI 1992/96 – NFI 2000/02		NFI 2000/02 – NFI 2007/09		NFI 2007/09 – ARD NFI 2011/13	
	LUC to forest land (%)	LUC to forest land [1000 ha]	LUC to forest land (%)	LUC to forest land [1000 ha]	LUC to forest land (%)	LUC to forest land [1000 ha]	LUC to forest land (%)	LUC to forest land [1000 ha]
Cropland (5 A.2.1)	11.9	6.9	11.9	6.5	6.2	3.4	6.2	1.8
Grassland (5 A.2.2)	55.5	32.0	55.5	30.1	50.2	27.8	48.9	14.1
Wetlands (5 A.2.3)	4.8	2.8	4.8	2.6	8.7	4.8	4.9	1.4
Settlements (5 A.2.4)	6.6	3.8	6.6	3.6	5.0	2.8	3.1	0.9
Others (5 A.2.5)	21.2	12.2	21.2	11.5	29.9	16.6	36.9	10.7
Total	**100.0**	**57.7**	**100.0**	**54.3**	**100.0**	**55.4**	**100.0**	**28.9**

Table 224: Land use changes from forest (%, ha) observed from 1990 to 2012 (covering the NFI periods 1986/90, 1992/96, 2000/02, 2007/09 and the ARD NFI 2011/13; based on BFW 2013).

Categories of land use changes according to the IPCC GPG 2003	1990 – NFI 1992/96		NFI 1992/96 – NFI 2000/02		NFI 2000/02 – NFI 2007/09		NFI 2007/09 – ARD NFI 2011/13	
	LUC from forest land (%)	LUC from forest land [1000 ha]	LUC from forest land (%)	LUC from forest land [1000 ha]	LUC from forest land (%)	LUC from forest land [1000 ha]	LUC from forest land (%)	LUC from forest land [1000 ha]
Cropland (5 A.2.1)	6.2	1.2	6.2	1.1	6.1	1.6	5.4	0.4
Grassland (5 A.2.2)	49.0	9.5	49.0	8.5	56.7	14.5	55.9	3.7
Wetlands (5 A.2.3)	2.6	0.5	2.6	0.4	2.2	0.6	14.0	0.9
Settlements (5 A.2.4)	14.8	2.9	14.8	2.6	20.0	5.1	10.3	0.7
Others (5 A.2.5)	27.4	5.3	27.4	4.7	15.0	3.8	14.4	1.0
Total	**100.0**	**19.4**	**100.0**	**17.3**	**100.0**	**25.6**	**100.0**	**6.6**

As shown in Table 223 and Table 224 the land use changes to and from forests mainly appear from/to grassland sites (49–56 % or 49–57 %, respectively). The land use changes from or to other categories are far below this value.

For the years 1994 back to 1970 it was assumed that the measured land use changes between two NFI observation periods show the same ratio of distribution between land use change subcategories as between the NFI period 1992/96 to 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, but no further distribution into the different LUC subcategories. So, the ratios of change areas from and to FL from/to individual other land use categories according to NFI 2000/02 could be applied directly to split the total LUC areas from/to FL according to the NFIs 1986/90 and 1992/96 to individual past/previous LUC categories. For the years from 1983 back to 1970 (NFIs before NFI 1986/90) only the net changes of the total forest area according to these older NFIs (1961/70, 1971/80, 1981/85) is available. These figures on the net forest area changes 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 net increase or loss of forest area between two consecutive previous NFIs. Thus, also for the years from 1983 back to 1970 annual LUC areas from and to forest could be estimated.

In response to the recommendations of the ERT during the ICR 2013 a detailed assessment of the NFI data was carried out for the years 1989 to 1994 covered by the NFIs 1986/90 and 1992/96 in order to provide better estimates for ARD activities that occurred after the 1st of January 1990 (see chapter KP-LULUCF). The result showed slightly higher LUC activities from and to forests in the year 1989 than for the following years 1990–94. The time series 1989 to 1994 of both, the LUC areas and the ARD areas, was adjusted accordingly.

Figure 34 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 results of NFI 2000/02, NFI 2007/09 and ARD NFI 2011/23. The results are finally summed up according to the areas of LUC as shown in Table 223 and Table 224. The specific carbon stocks for litter and soil for each forest growth region are shown in Table 235:Specific C-stocks (t C ha-1) for litter and soil (0–50 cm) stratified according to five forest growth regions in Austria..

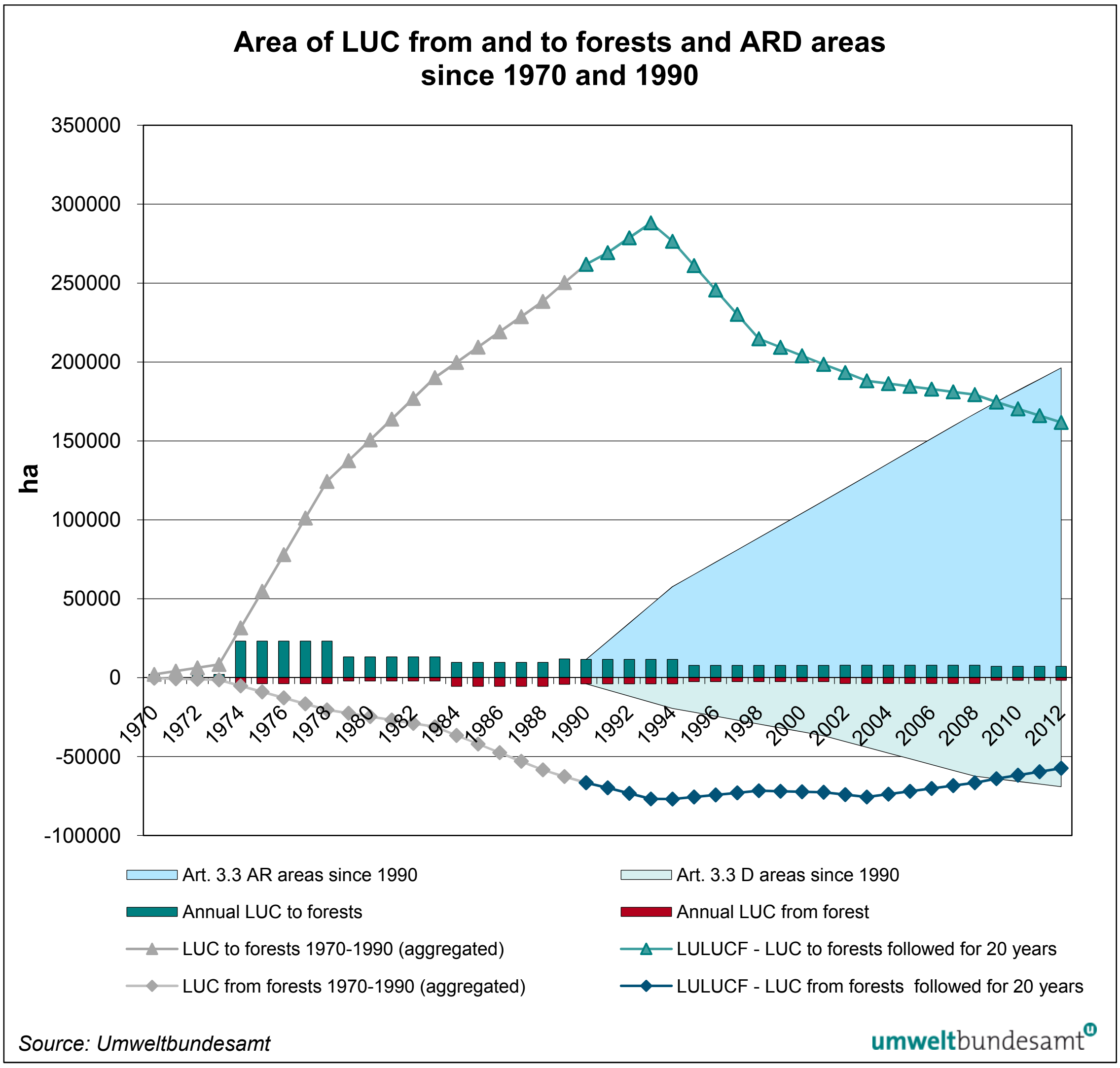


Figure 34: Areas of LUC from and to forests and ARD areas since 1970 and 1990, respectively.

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% (*in situ*, i.e. potential of the standing stock to reach this threshold);
- Minimum height: 2 m (*in situ*, i.e. potential of the standing stock to reach this threshold);
- 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 2013; 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, was carried out in the period 2011/13.

In addition to the NFI drain 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 225 gives an overview of the different harvest statistics in Austria.

Table 225: 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.	m³ 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).	m³ 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	m³ 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 regrowth by forests or biomass losses due to e.g. traditional (non-commercial) fuel wood consumption, forest land conversion, mortality, 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 from biomass with a DBH ≥ 5cm due to annual land use changes from and to forestsare subtracted from the totals based on the total increment and drain of biomass with a DBH ≥ 5cm according to NFI results. The approaches on calculating CO_2 emissions and removals related to land use changes are described in more detail in chapter 7.2.4.2.

The NFI provides mean values for annual increment and drain 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 drain 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 which is not the NFI assessment 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. In a next step, these NFI means are converted with relative indices[82] to obtain annual data of increment and drain (instead of using the means or interpolated values for single years). For drain 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 drain differences like weather conditions, timber demand and prices or wind throws. Such reasons for different growth and different drain in individual years explain the high annual variations in the CO_2 net removals by the Austrian forests. Table 226 shows the results of these estimates of annual values for increment and drain on basis of the average annual increment and drain according to NFIs and the relative indices.

[82] Values for the relative variation in the individual years of the time series

Table 226: Increment and drain in the Austrian forests on basis of NFIs and interpolated on basis of relative indices[83]. Italic years represent the annual average of the previous NFI period. Equally shaded cells represent the same observation period.

Year	Average annual increment according to NFI 1000 m^3 o.b	annual increment interpolated on basis of indices 1000 m^3 o.b.	average annual drain according to NFI 1000 m^3 o.b	annual drain interpolated on basis of indices 1000 m^3 o.b.
1985	31 416	32 243	19 846	19 358
1986		30 314		20 201
1987		31 416		19 583
1988		31 416		21 275
1989		29 180		20 265
1990		28 945		23 034
1991	27 337	28 004	19 521	16 849
1992		25 180		17 958
1993		25 415		17 969
1994		27 298		21 052
1995		27 872		18 461
1996		26 897		20 071
1997	31 255	34 109	18 797	19 690
1998		31 835		18 766
1999		34 434		18 832
2000		30 828		17 752
2001		32 810		18 007
2002		31 720		21 166
2003		26 093		24 317
2004		29 845		23 500
2005	30 371	31 151	25 888	23 483
2006		29 878		27 281
2007		31 955		30 395
2008		31 955		31 076
2009		*30 371*		*25 888*
2010		*30 371*		*25 888*
2011		*30 371*		*25 888*
2012		*30 371*		*25 888*

Wood densities

Shrinkage values, wood densities (absolute dry) and C contents for all tree species in Austria are used to convert the increment and drain of m^3 stemwood over bark (o.b.) which is measured by the NFI into t carbon increment and t carbon drain of the stemwood o.b. The mean wood densities according to Table 227 represent aggregated values on basis of the species composition of increment and drain in Austria (see example in Table 228 for last two NFIs) and on country specific values for the shrinkage and wood densities for all individual tree species (Austrian Standard ÖNORM B3012). These conversion factors are calculated for each inventory period and separately for increment and drain respectively. Between the inventories they show only minor differences (< 1%) because the shares of the tree species change very slowly.

[83] Please note that these increment and harvest rates do not represent those for "FL remaining FL", but those for "FL remaining FL" plus all subcategories of LUC from and to FL due to the Austrian-wide assessment of the NFIs.

Further details on the approach and methodology are given in (UMWELTBUNDESAMT 2000).

Table 227: 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

Table 228: Share of tree species in total stemwood increment and drain of the NFIs 2007/09 and 2000/02. (BFW 2011).

Tree species	**% in total increment NFI 07/09**	**% in total drain t NFI 07/09**	**% in total increment NFI 00/02**	**% in total drain NFI 00/12**
Spruce	66.4	68.7	64.5	66.0
Fir	4.2	4.0	3.8	4.7
Larch	3.9	4.0	4.9	4.9
pine (pinus sylvestris)	4.0	6.3	5.2	8.2
pine (pinus nigra)	0.2	0.6	0.5	0.7
pinus cembra	0.2	0.1	0.2	0.1
Weymouth pine (pinus strobus)	0.0	0.0	0.0	0.1
douglas fir	0.1	0.0	0.1	0.0
Total coniferous	**79**	**84**	**79**	**85**
beech (fagus sylvatica)	9.1	6.8	8.3	6.7
oak	2.2	2.2	2.5	2.0
hornbeam	0.8	0.5	1.0	0.7
ash	2.7	1.2	2.5	1.0
maple	1.4	0.7	1.3	0.7
elm	0.2	0.2	0.2	0.3
chestnut	0.2	0.2	0.2	0.1
robinia	0.3	0.3	0.4	0.3
Sorbus, Prunus	0.3	0.3	0.4	0.2
birch	0.7	0.9	0.7	0.8
alder	1.3	1.3	1.4	1.3
lime tree (Tilia)	0.4	0.2	0.4	0.2
poplar (Populus alba, Populus tremula)	0.5	0.5	0.5	0.4
poplar (Populus nigra, populus canadensis)	0.4	0.8	0.6	0.5
willow (Salix)	0.4	0.4	0.4	0.5
Total decidous	**21**	**16**	**21**	**15**
Total	**100**	**100**	**100**	**100**

Biomass functions (BF)

The increment and drain of the other tree compartments (branches, needles, roots) are estimated with the help of biomass functions (BF, Table 229) 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). Biomass functions as listed in Table 229 are applied to each single tree at the NFI plots of each NFI period to derive increment and drain of branches and roots of these trees. Only the evergreen biomass is estimated (leaves of deciduous trees become part of the soil C pool within one year).The compiled results for each tree species are further extrapolated to the total Austrian (productive) forest. These estimates are carried out at the Austrian Federal Research and Training Centre for Forests, Natural Hazards and Landscape.

Table 229: 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)

On basis of the results of these biomass functions the average biomass expansion ratios according to Table 230 for total tree biomass/stemwood biomass were derived. The aggregated expansion factors in Table 230 are not used for the estimates but are provided as additional information for transparency reasons and to allow comparisons. The estimates of increment and drain of the other tree compartments are based on the biomass functions shown in Table 229.

Since the submission 2012 partly new biomass functions were applied. 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 submissions before the submission 2012. The changes of the average expansion ratios due to the use of the improved functions is given in Table 230 (old vs. new i.e. „submissions before 2012" vs. „since submission 2012").

Table 230: Average expansion ratios total tree biomass/stemwood biomass for the Austrian forests for the period 1990–2008. Aggregated values derived from the single NFI tree data on basis of the applied biomass functions (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
drain	1.62	1.60	1.63	1.59

The resulting mean annual biomass increments and drain 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 biomass increment and drain as estimated on basis of the NFI results for all Austrian forests includes also biomass increment and drain of LUC areas to/from forests. Therefore, to avoid any double accounting the biomass increment and drain of the LUC areas to/from forests needs to be subtracted from the estimates on basis of the NFI results to get the biomass increment and drain of subcategory 5.A.1. For submission 2014 a revision of the activity data and emission factors for the LUC categories to/from forests was carried out on basis of the finalised ARD NFI 2011/13 (see chapters 7.2.2.2 and 7.2.4.2). These changes had also an impact on the results of subcategory 5.A.1: A change in 5.A.2 or in LUC categories from forest to other land uses represents also a change in subtrahends for the derivation of the biomass gains/losses for the subcategory 5.A.1 on basis of the NFI results for all Austria. Consequently, the emissions/removals of biomass from subcategory 5.A.1 in submission 2014 differ slightly to those of the previous submission.

The time series of measured values for individual years ends with the year 2009. For the years since 2008 the mean values of biomass increment and biomass drain 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 drain 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 drain, 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 drain, 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. 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. The NFI 2007/09 carried out for the first time an assessment of the standing stocks in the non-productive forests. So, with the next NFI and a re-assessment of these stocks an estimate of the biomass stock changes in the non-productive forests will be possible.

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 with the estimates of the litter/soil C stock changes, because any falling dead tree (part) is accounted as C flux to litter/soil in the modelling of the litter/soil C stock changes. 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) for the total forest area is 4.5 m^3 ha^{-1} for the inventory period 1992/96, 6.1 m^3 ha^{-1} for the inventory period 2000/02 and 8.4 m^3 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.

Based on the new ARD NFI 2011/13 stock changes in dead wood are available at land use changes areas from and to forests for the first time (see chapter 7.2.4.2 – Dead wood). In order to fulfil the requirements of the reporting format and to report only the category *5.A.1 Forest land remaining forest land* without any double accounting, estimates of emissions and removals from C-stock changes of dead wood due to annual land use changes from and to forests are subtracted from the totals. For the calculation of the C-stock changes the conversion factors for stemwood as shown in Table 227 were used. These conversion factors do not include any estimates for roots and branches of the dead trees. The rationale in behind is that dead roots are already part of the soil C pool and dead trees have usually only a negligible branch mass. It was assumed that the ratio between deciduous and coniferous dead wood is equal to the deciduous/coniferous ratio of the living trees.

The results of the NFI obviously show an increase of dead wood in Austria. However, the annual net C-stock changes range between 221Gg CO_2 and 843 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

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 drain at the plots) and with tools for the conversion of stemwood to total tree biomass (see chapter 7.2.4.1.1). Any litterfall, dead roots input, any harvest residues input (e.g. needles, branches, pieces of stem, stump, roots) and fallen dead trees were estimated for the NFI plots and were included as C flux to the litter/soil in the Yasso simulations of the soil C stock changes. So, the Yasso simulations also account for any flux of dead wood to the litter/soil (e.g. falling dead trees and branches, stumps and non-extracted tree parts after harvest). To avoid any double accounting all these compartments are not accounted in the estimates of the dead wood stock pool, but only the changes in standing dead wood.

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. The model was applied for each NFI plot using annual averages of input data of each plot (biomass, temperature and precipitation) for the model simulation. So, the simulations are based on the annual variation of input data. 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 litter/soil C pool and its changes, 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. The simulation results for the NFI plots were extrapolated for the areas of forests in yield of the subcategory *5.A.1* in the single years of the time series.

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 CO_2 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. CO_2 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-CO_2 gases from this category are reported. According to the IPCC (GPG 2003) a TIER 1 method following the equation 3.2.20 was applied.

$$Lfire\ (t\ GHG) = A * B * C * D * 10^{-6}$$

A *area burnt (ha)*

B *mass of available fuel, kg dm* ha^{-1}

C *combustion efficiency*

D *emission factor*

Data on the annual area affected by wildfires are available for the years 1990 to 2012 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 N_2O and CH_4 were taken from table 3.A.1.16 (IPCC GPG 2003).

However, the amounts of N_2O and CH_4 emissions caused by biomass burning due to wildfires are negligible, as they range between 0.005 and 0.58 Gg CO_2 equivalents. This is due to the small area concerned.

7.2.4.1.5 Consequences of the improvements for submission 2012 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 for submission 2012 as described in NIR 2012 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 CO_2 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 230). 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 CO_2 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 CO_2, 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 CO_2. The changes in the dead wood pool represent an increase in removals of around 200 Gg CO_2, 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. m^3 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 m^3 o.b. This change represents an increase in removals of around 200 Gg CO_2 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 CO_2 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 CO_2 (with harvested wood products on basis of instantaneous oxidation) and from -6 516 to 244 Gg CO_2 (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)

As announced in NIR 2013, the submission 2014 contains estimates of the detailed assessments of the ARD activities under Article 3.3 of the Kyoto Protocol and biomass and dead wood stock changes due to these activities for the first time. The ARD assessment was carried out in the years 2011 to 2013. On the basis of these assessments the areas of land-use-changes to and from forests, the emission factors at these lands and the estimates of the emissions/removals at these lands were revised. More detailed information to the related C-pools is given below. 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

Based on the results of the ARD NFI 2011/2013 the experts of the Federal Research and Training Centre for Forests, Natural Hazards and Landscape provided detailed, measured values for increment and drain at the areas of LUC to and from forests (BFW, 2013) The data are available for coniferous and deciduous trees (dbh ≥ 5cm) and for two age classes of the ARD lands (long-term ARD areas which had the LUC already in previous NFI periods and short term ARD areas which had the LUC in the most recent period of assessment). For the forest biomass with a dbh < 5cm the stock changes were estimated. The detailed data for biomass increment and biomass drain, stock changes respectively, are summarised in Table 231 and Table 232.

Table 231: Annual biomass increment and drain (DBH ≥ 5 cm) at ARD areas

	Biomass increment DBH ≥ 5 cm, total tree biomass (t/ha/a)		Biomass drain DBH ≥ 5 cm, total tree biomass (t/ha/a)	
	coniferous	deciduous	coniferous	deciduous
long term AR areas	1.88	2.01	0.35	0.97
short term AR areas	2.83	1.85	0.00	0.00
long term D areas	0.16	0.32	0.24	0.09
short term D areas	0.48	1.13	38.96	48.94

Table 232: Annual biomass stock change (DBH < 5 cm) at ARD areas

	Biomass stock changes DBH < 5 cm (t/ha/a)			
	Above ground		Below ground	
	coniferous	deciduous	coniferous	deciduous
long term AR areas	0.03	0.11	0.004	0.012
short term AR areas	0.04	0.29	0.006	0.032
long term D areas	0.001	0.060	0.0003	0.007
short term D areas	0.0003	0.116	0.00004	0.013

The biomass stock changes at the LUC lands to and from forests of the whole time series were recalculated with these single values in Table 231 and Table 232. Due to these changes in emission factors and activity data the emissions/removals of all LUC subcategories to/from forests in submission 2014 changed to those of previous submissions.

Conversion factors (BF, BEF, C)

The detailed biomass assessment at the ARD areas between NFI 2007/09 and ARD NFI 2011/13 allowed the application of the same biomass functions as used in sector 5.A.1. (see Biomass functions (BF)) to derive biomass increment and biomass harvest of trees with a DBH ≥ 5cm. The stock changes of biomass < 5 cm is estimated based on counting between the last two NFI periods.

Table 233: C-conversion factors for forest biomass land use changes areas from and to forest land.

Conversion factors	increment		harvest	
	coniferous	deciduous	coniferous	deciduous
Above ground - stem	0.490	0.483	0.492	0.483
other tree compartments - branches, roots	0.473	0.480	0.473	0.481

For areas with LUC to forests the calculations lead on average for 1990 to 2012 to the following result of annual net C stock change in living biomass (DBH>0cm) per ha and year:

$\Delta C_{BM} = 1.204 \text{ t C ha}^{-1} \text{ a}^{-1}$

This value is almost the same compared to that used in previous submissions (1.176 t C ha^{-1} a^{-1}).

For areas with LUC from forests to other land uses the calculations lead to the following result of average annual C stock change in living biomass (DBH>0cm) per ha and year for the time series 1990 to 2012:

$\Delta C_{BM} = -1.682 \text{ t C ha}^{-1} \text{ a}^{-1}$

In the year of LUC from forests to other land uses, the following annual C stock drain in living biomass (DBH>0cm) per ha and year results:

$\Delta C_{BM\ drain} = -42.6 \text{ t C ha}^{-1} \text{ a}^{-1}$

This measured biomass drain per ha in the year of LUC from forests used in submission 2014 is almost twice as high as the roughly estimated biomass drain per ha in the year of LUC from forests as used in previous submissions (21.168 t C ha^{-1} a^{-1})

An overview of the emissions/removals from land use changes from and to forests is given in Table 221.

7.2.4.2.2 Dead wood

Based on ARD NFI 2011/2013 the experts of the Federal Research and Training Centre for Forests, Natural Hazards and Landscape provided detailed, measured values for stock changes of standing dead wood at areas of LUC to and from forests (BFW, 2013). The stock changes are summarised in Table 300.

Table 234: Annual stock changes of dead wood at ARD areas based on the ARD NFI 2011/13 (BFW, 2013).

	Stock changes – dead wood (t/ha/a)
long term AR areas	0.032
short term AR areas	0.123
long term D areas	0.01
short term D areas	-0.26

7.2.4.2.3 Litter and soil

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 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. 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 235 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.

In response to review findings the estimates of the emissions/removals in the mineral soils of LUC categories with wetlands were revised. In previous submissions wetlands (flooded land) were assumed to have a 0 soil C stock. Using the IPCC GPG approach of calculating the C stock change between a period of 20 years led to unrealistic annual C stock gains (WL to FL) or losses (FL to WL) in mineral soils for lands with such LUC. Due to a lack of information in literature for submission 2014 no C-stock changes in mineral soil are assumed at LUC between forest land and wetland. The changes WL to FL are higher than those of FL to WL and FL can be expected to have higher C stocks in soil. Therefore, this approach used for submission 2014 represents a conservative estimate.

Table 235: 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**	**Calcare-ous 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	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 in-tensive 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 LANDEREGIERUNG 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.

The estimate of C stocks in bogs (0–50 cm) is 500 t C ha^{-1} based on 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 (⅓ of these areas are assumed to be sealed and ⅔ unsealed; unsealed areas have the same soil C stock as intensively used 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, 2007/09 and the ARD NFI 2011/13 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 235). Consequently, for each IPCC GPG land use change category from and to forest an area weighted mean value of soil C-stocks for each subcategory and growth region was calculated for each NFI period (NFI 1992/96 to 200/02, NFI 2000/02 to 2007/09 and NFI 2007/09 to ARD NFI 2011/13). 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 236, Table 237 and Table 238.

Table 236: 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.

	C-stocks (t ha^{-1}) in soils (0–50 cm)[1]									
Land use categories (IPCC – GPG)	**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	91	117	109	77	88	91	117	109	77	88
Cropland	90	73	77	65	56	-	90	71	65	56
Grassland	123	125	117	85	77	116	128	115	88	75
Wetlands	0	0	0	0	0	0	0	0	0	0
Settlements	60	25	60	27	10	60	44	60	19	60
Other land	53	51	21	27	30	73	25	40	30	30

1 - no LUC from/to forest could be observed in these regions

Table 237: 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.

	C-stocks (t ha^{-1}) in soils (0–50 cm)[1]									
Land use categories (IPCC – GPG)	**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	91	117	109	77	88	91	117	109	77	88
Cropland	90	81	78	65	57	-	88	-	68	56
Grassland	128	130	117	87	91	128	128	114	124	75
Wetlands	0	0	0	0	0	0	0	0	0	0
Settlements	-	19	60	9	39	60	46	41	27	12
Other land	46	49	49	30	39	53	41	22	13	-

[1] - no LUC from/to forest could be observed in these regions

Table 238: 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 period 2007/09 and the ARD NFI period 2011/13.

	C-stocks (t ha^{-1}) in soils (0–50 cm)[1]									
Land use categories (IPCC – GPG)	**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	91	117	109	77	88	91	117	109	77	88
Cropland	-	77	76	65	56	-	90	-	70	-
Grassland	130	130	115	88	75	117	132	113	106	75
Wetlands	0	0	0	0	0	0	0	0	0	0
Settlements	20	60	60	-	-	60	-	60	20	60
Other land	35	81	32	21	-	-	33	79	14	-

[1] - 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 235) and mineral soil (see Table 236, Table 237 and Table 238) 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

$$\Delta\ SOC = A*(SOC_O - SOC_{O\text{-}T})/20$$

Δ SOC = 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 →109 t C ha^{-1}, see Table 237)

$SOC_{O\text{-}T}$ = carbon stock in soils before conversion, respectively (e.g. area weighted mean value of soil C stocks from grassland converted to forest land in the Calcareous Alps: 117 t C ha^{-1}, see Table 237).

Annual carbon stock changes in litter at LUC areas from and to forest land:

$$\Delta C_{LT} = A^* (C_{LTo} - C_{LTo\text{-}t})/T$$

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_{LTo} = carbon stock in litter after conversion, (e.g. 24 t C ha^{-1} for Calcareous Alps, see Table 237)

$C_{LTo\text{-}t}$ = 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 ±40% for the average annual net change[84] 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 ±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 sec-

[84] 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. Therefore, we consider this problem to be of minor relevance.

tor 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. For this reason the absolute values of the uncertainties of the single LULUCF subcategories cannot be compared with the reported emissions/removals of the individual subcategories, but as an approximation the relative uncertainties of the subcategories can be compared with the related emissions/removals. For the totals of the LULUCF sector the uncertainty is of course consistent with its emissions/removals.

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 (±40%).

The forest litter/soil simulations for the single plots show a standard deviation ±0.7 t C ha^{-1} a^{-1}. The average emission out of the forest soils is 0.2 t C ha^{-1} 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 ±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: ±100% until 1994, ±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 239 shows the uncertainties for the areas of the subcategories with LUC to and from forests:

Table 239: Uncertainties of LUC areas to and from forests

	before NFI 1985/90[1]	**since NFI 1985/90**[1]
Annual LUC area CL to FL or FL to CL	±200%	±80%
Annual LUC area GL to FL or FL to GL	±200%	±10%
Annual LUC area WL to FL or FL to WL	±200%	±120%
Annual LUC area SL to FL or FL to SL	±200%	±80%
Annual LUC area OL to FL or FL to OL	±200%	±80%
Annual LUC area to or from FL	±200%	±10%

[1] *Distributions were truncated at 0, because negative areas are not possible*

The uncertainty of the LUC areas to and from forest are the outcome of the statistical design of the NFI. 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).

For the litter/soil C stocks of all LUC areas the uncertainties according to Table 240 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 235 (other land) or on expert judgement based on information from related studies.

Table 240: Uncertainties of the litter/soil C stocks in the forest growth regions according to Table 235 (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	Foothills	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
	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: ±18 712 Gg CO_2. This represents on average ±138% in the years 1990 to 2002 with significant annual net sinks in category *5.A* and between 215 and 1 756% 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 CO_2 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 ±44% in the years 1990 to 2002 with significant annual net sinks and in the range of 44 to 152% 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 HAUK & SCHADAUER (2009) and SCHIELER & HAUK (2001)).

The calculation of the data for category *5.A* is embedded in the overall QA/QC-system of the Austrian GHG inventory (see chapter 7.1.4).

7.2.7 Recalculations

The following recalculations were conducted in the submission 2014:

- New activity data for LUC from and to forest based on the ARD NFI 2011/13 and revision of these LUCs for the whole time series
- Data on biomass and dead wood changes for LUCs from and to forest land on basis of the results of the NFI 2007/09 and the ARD NFI 2011/13.
- Revisions of the litter and soil C stock changes for LUCs from and to forest land due to the new activity data
- In response to review findings the estimates of the emissions/removals in the mineral soils of LUC categories with wetlands were revised. It is assumed that the soil carbon stocks do not change after conversion.
- The changed emission/removal figures for biomass and dead wood of LUC lands to and from forests had also an impact on the biomass and dead wood results of 5.A.1. The 5.A.1 results are based on the results of the NFIs for all Austria minus those biomass and dead wood stock changes due to LUCs involving forests (in order to avoid double accounting). A change in 5.A.2 or in LUC categories from forest to other land uses represents also a change in subtrahends for the derivation of the results for the subcategory 5.A.1 on basis of the NFI results for all Austria.

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 2012. 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 241.

Table 241: 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
- CO_2 emissions due to biomass burning of agricultural residues
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_2O 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_2O emissions from soils due to LUC from grassland to cropland

In 2012 1.43 Mio ha of Austria were arable land including annual and permanent crops (STATISTIK AUSTRIA 2013).

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 2012 the land use change area to cropland was 51 466 ha. The annual emissions of land converted to cropland from 1990–2012 range from 186 Gg CO_2 equivalents to 219 Gg CO_2 equivalents. The source is mainly caused by soil C stock changes of land use change areas, particularly by grassland converted to cropland.

Table 242: Activity data of cropland (1990–2012) 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	1 507 533	1 466 439	1 436 285	16 722	13 433	41 094	4 125	36 968	35 470	1 498	NO	NO	NO
1991	1 526 723	1 485 730	1 455 579	16 644	13 508	40 993	4 346	36 647	35 162	1 485	NO	NO	NO
1992	1 518 074	1 477 178	1 447 028	16 576	13 575	40 896	4 567	36 329	34 857	1 472	NO	NO	NO
1993	1 500 454	1 459 655	1 429 520	16 503	13 632	40 799	4 787	36 012	34 553	1 459	NO	NO	NO
1994	1 501 453	1 460 994	1 430 848	16 465	13 681	40 459	4 792	35 667	34 221	1 445	NO	NO	NO
1995	1 492 280	1 452 249	1 422 103	16 427	13 718	40 031	4 710	35 321	33 890	1 431	NO	NO	NO
1996	1 491 907	1 452 334	1 422 197	16 393	13 744	39 573	4 628	34 945	33 529	1 416	NO	NO	NO
1997	1 481 910	1 442 696	1 412 604	16 354	13 738	39 214	4 546	34 668	33 263	1 405	NO	NO	NO
1998	1 470 763	1 431 895	1 401 879	16 307	13 709	38 868	4 463	34 405	33 011	1 394	NO	NO	NO
1999	1 470 396	1 431 771	1 401 862	16 243	13 666	38 625	4 483	34 142	32 758	1 383	NO	NO	NO
2000	1 462 108	1 423 677	1 393 874	16 193	13 609	38 431	4 504	33 928	32 553	1 375	NO	NO	NO
2001	1 460 067	1 421 842	1 392 161	16 133	13 548	38 225	4 524	33 702	32 336	1 366	NO	NO	NO
2002	1 459 095	1 421 008	1 391 454	16 076	13 477	38 087	4 612	33 476	32 119	1 356	NO	NO	NO
2003	1 459 991	1 421 958	1 392 528	15 903	13 527	38 033	4 699	33 333	31 983	1 351	NO	NO	NO
2004	1 454 572	1 417 189	1 388 173	15 703	13 313	37 383	4 581	32 802	31 473	1 329	NO	NO	NO
2005	1 455 984	1 418 403	1 389 842	15 430	13 131	37 581	4 463	33 118	31 776	1 342	NO	NO	NO
2006	1 453 893	1 414 028	1 385 608	15 404	13 016	39 865	4 345	35 520	34 081	1 439	NO	NO	NO
2007	1 451 900	1 408 174	1 379 450	15 740	12 984	43 726	4 226	39 500	37 899	1 601	NO	NO	NO
2008	1 443 738	1 395 910	1 367 476	15 744	12 690	47 828	4 108	43 720	41 948	1 772	NO	NO	NO
2009	1 438 292	1 389 731	1 361 385	15 709	12 638	48 561	3 934	44 627	42 818	1 808	NO	NO	NO
2010	1 433 989	1 384 958	1 356 245	15 817	12 896	49 031	3 782	45 249	43 415	1 834	NO	NO	NO
2011	1 429 899	1 380 166	1 351 410	15 843	12 913	49 733	3 630	46 103	44 235	1 868	NO	NO	NO
2012	1 425 328	1 373 862	1 345 003	15 937	12 922	51 466	3 478	47 987	46 043	1 944	NO	NO	NO

Table 243: Emissions from cropland management (1990–2012) in Gg CO_2; 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	N2O (in CO2 equiv)
1990	53.78	-255.50	-284.66	-130.18	159.34	90.30	218.98	81.09	117.68	124.20	-6.52	20.22
1991	53.72	-256.25	-290.17	-129.96	163.88	91.06	218.91	82.02	116.74	123.23	-6.49	20.15
1992	76.14	-233.30	-266.60	-129.08	162.38	90.72	218.72	82.94	115.69	122.12	-6.42	20.08
1993	93.85	-215.41	-247.74	-128.54	160.87	90.69	218.56	83.90	114.65	121.00	-6.36	20.02
1994	99.75	-208.27	-239.19	-128.43	159.36	90.73	217.29	83.92	113.52	119.81	-6.29	19.85
1995	114.48	-170.38	-202.23	-128.08	159.93	91.97	192.89	60.87	112.38	118.59	-6.21	19.64
1996	130.36	-152.70	-185.43	-127.75	160.48	91.95	191.11	60.47	111.22	117.37	-6.16	19.42
1997	147.30	-134.40	-164.09	-127.41	157.10	92.08	189.62	60.07	110.30	116.40	-6.10	19.24
1998	157.31	-122.49	-149.11	-127.06	153.69	91.64	188.15	59.68	109.40	115.42	-6.03	19.08
1999	160.47	-118.41	-143.93	-126.64	152.16	91.63	187.25	59.77	108.53	114.50	-5.97	18.95
2000	168.77	-108.11	-132.54	-126.19	150.62	90.35	186.53	59.85	107.82	113.75	-5.92	18.86
2001	176.69	-99.39	-122.75	-125.71	149.07	90.27	185.80	59.94	107.11	112.99	-5.89	18.75
2002	196.03	-90.74	-112.33	-125.23	146.82	90.23	196.54	71.54	106.36	112.20	-5.84	18.64
2003	206.95	-79.05	-123.83	-126.40	171.18	90.27	195.73	71.50	105.67	111.41	-5.74	18.56
2004	227.35	-56.93	-46.67	-126.19	115.93	90.22	194.06	70.55	105.30	111.37	-6.07	18.21
2005	223.24	-59.06	-53.15	-125.43	119.52	90.28	192.03	69.60	104.15	109.58	-5.42	18.27
2006	230.62	-54.18	-65.36	-119.11	130.29	90.09	194.71	68.63	106.69	110.87	-4.18	19.39
2007	250.87	-43.83	-74.80	-113.46	144.43	90.01	204.69	67.65	115.75	119.44	-3.70	21.29
2008	253.41	-53.88	-24.86	-121.58	92.56	88.24	219.05	66.68	129.06	133.47	-4.40	23.31
2009	263.40	-24.15	-47.11	-121.97	144.93	88.17	199.38	35.09	140.63	148.03	-7.40	23.67
2010	246.91	-41.90	-134.51	-119.40	212.01	87.32	201.49	34.17	143.42	151.19	-7.78	23.90
2011	247.58	-42.85	-87.35	-122.14	166.63	87.17	203.26	33.25	145.77	153.57	-7.81	24.25
2012	250.10	-43.65	-86.00	-121.05	163.40	86.99	206.77	32.33	149.32	156.66	-7.34	25.11

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 1960–2013). 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 are implemented in this submission (STATISTIK AUSTRIA 2012).

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 2013. 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.

Annual conversions between grassland and cropland, which were again converted the other direction after few years ("short time oscillating changes"), are not taken into account. Only permanent conversions are calculated. The subsample of IACS data for the examination of permanent land use conversions between grassland to cropland in Austria has to comply to the following:

a) continuity
b) constancy of area
c) initial homogeneity of the land unit: units had to be entirely grass- or cropland in 2002 (first year of IACS data base). This way, any spatial increase of one land use category could unambiguously be ascribed to a conversion from the other.

Restrictions a–c retained about one third of the grassland units available in IACS for further analysis (=subsample).

For submission 2014 the assessment period was enlarged for the years 2002–2013 (instead of 2002–2010 for previous submissions).

Each unit's composition was calculated for all of the years 2002–2013. A permanent conversion to either grass- or cropland in a unit was assumed if the category's share in this unit increased at least once and never decreased during 2002–2013.

Furthermore in 2013 the correction factors for upscaling the conversion rates from the subsample to the country-wide data have been improved (compared to previous submissions).The years before 2002 are not sufficiently reflected in the IACS database to derive LUC between cropland and grassland. In order to receive reliable activity data before 2002 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 2002 and 2005. The LUC activity data of these years are rather stable and it is assumed that LUC before 2002 followed the same trend. This is the reason for the rather stable values between 1990 and 2002 and for higher fluctuations after 2002 which are caused by the area (activity) data for the subcategory for LUCs from grassland to cropland.

The LUC area from grassland to cropland derived by this method is in the order of 3.8% 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.

The changes in the areas of land use change from grassland to cropland due to the improved upscaling factors and due to the use of recent data for the last years led also to slightly different 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 different outcomes for the emissions/removals of the cropland sub-category compared to previous submissions.

The areas of the LUC subcategory FL to CL were changed on basis of the ARD assessment that was finalised in 2013. Also the biomass stock changes and dead wood stock changes at these LUC lands were measured accurately during this assessment (see chapters 7.2.2.2 and 7.2.4.2). So, the emission estimates for this subcategory and for the whole time series changed on basis of these new activity data and emission factors.

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, orchards, tree nurseries, christmas trees, perennial energy crops);
- House gardens (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 orchards, vineyards, house gardens and plantations for Christmas trees and energy crops 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 gardens 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 256.3 Gg CO_2 and 24.2 Gg CO_2.

In the following sub chapters the methodologies and used emission factors for the estimates are explained.

7.3.4.1.1 Changes of carbon stock in biomass of „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 is assumed to be perennial.

According to Tier 1 GPG (IPCC 2003) for perennial cultures as viticulture, orchards 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 and based entirely on the activity data from Statistik Austria (STATISTIK AUSTRIA, 1960–2013). 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 of planted vineyards (STATISTIK AUSTRIA 2010) for 2009 and the following years. All together the Austrian total vine area comprises 46 653 ha (STATISTIK AUSTRIA 2013b) but 1 102 ha of this total vine area is out of production and thus planted with annual crops to increase soil fertility, before it is replanted with vine again. This area is covered by the category annual cropland remaining annual accordingly.

Table 244: Estimated total area of perennial crops from 1990–2012 in ha (including areas of LUC to perennial cropland).

	Viticulture	Orchards	House gardens	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	73 898
2008	49 842	14 507	4 444	2 141	2 849	73 783
2009	45 533	14 696	3 510	2 785	2 426	68 949
2010	45 533	14 884	2 576	3 652	2 002	68 647
2011	45 533	14 884	2 576	3 544	2 002	68 539
2012	45 533	14 884	2 576	3 467	2 002	68 462

Figure 35 indicates the decrease of the total perennial cropland area from 1960 to 2012. 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.

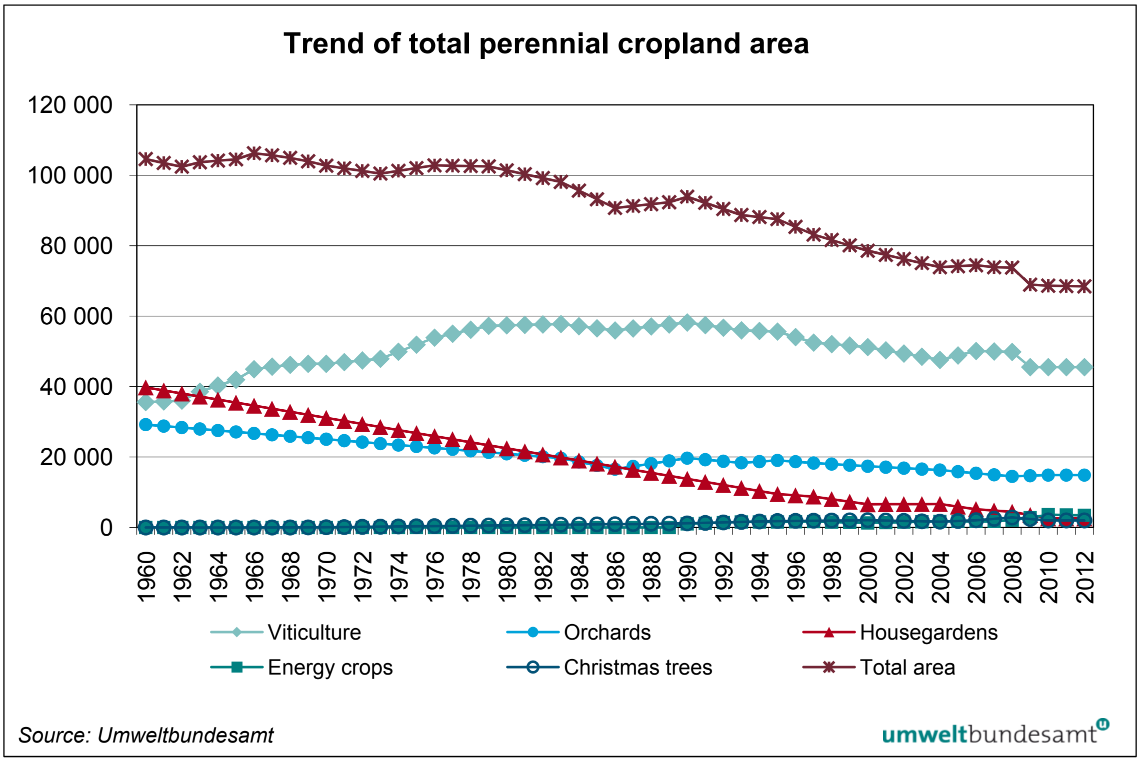


Figure 35: Trend of total perennial cropland area (ha) from 1960–2012 (including LUC areas to perennial cropland).

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 orchards and house gardens 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 re-planted 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, orchards and house gardens the following Tier 1 equation from the IPCC GPG (2003) was applied:

*Annual change in biomass = (area of perennial cropland remaining perennial cropland[a] * Carbon accumulation rate) – (area of perennial cropland before 30 years[a.b] * 0.033 * biomass carbon stock at harvest)*

[a]*excluding areas of Christmas tree cultures and energy crops (which are estimated according to the approaches below)*

[b]*excluding 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^{-1}a^{-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 gardens, viticulture and orchards. It is planned to assess and report national data for viticulture and orchards.

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:

*Annual change in biomass = (area of Christmas tree cultures remaining Christmas tree cultures * Carbon accumulation rate) – (area of Christmas trees before 10 years * 0.1 * biomass carbon stock at harvest)*

According to [BMLFUW 2000] 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^{-1} a^{-1}.

For energy crops also a country specific value of 30 t C ha^{-1} for the carbon stock at harvest was used (SPLECHTNA & GLATZEL 2005). According to this literature the rotation period for energy crops is six years. This leads to a carbon accumulation rate of 5 t C ha^{-1} a^{-1} for energy crops.

For calculating the carbon stock change of living biomass on energy crops the following equation was applied:

*Annual change in biomass of energy crops = (area of energy crops remaining energy crops * Carbon accumulation rate) – (area of energy crops before 6 years * 0.166 * biomass carbon stock at harvest)*

Figures for the area of energy crops are available since 1990 (STATISTIK AUSTRIA 1960–2013).

Table 245: 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, house gardens	2.1	30	Tier 1 IPCC GPG (2003)
Christmas trees	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 total land use change area from annual cropland converted to perennial cropland was 15 937 ha in 2012.

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 the IPCC GPG (2.1 t C $ha^{-1}a^{-1}$) 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 * $L_{conversion}$*

L conversion= C after –C before

C_{after}	*= carbon stock immediately after conversion is 0*
ΔC_{growth}	*= IPCC default value for perennial crops carbon accumulation rate is 2.1 t C $ha^{-1}a^{-1}$ (annual growth rate in each year of the whole LUC transition period of 20 years)*
C_{before}	*= country specific value of carbon stock of annual crops before conversion is 6.67 t C $ha^{-1}a^{-1}$ (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. The average carbon stock of living biomass in annual cropland was calculated by using country specific data from Statistic 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 belowground 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 total land use change area from perennial cropland converted to annual cropland was 12 922 ha in 2012.

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):

*Annual change in biomass = annual area of currently converted land * (L conversion + ΔC growth)*

$L_{conversion}$ = C_{after} – C_{before}

C_{after} = carbon stock immediately after conversion is 0

ΔC_{growth} = country specific value for annual crops carbon accumulation rate is 6.67 t C $ha^{-1}a^{-1}$(see chapter 7.3.4.1.2; accounted only for the year of LUC)

C_{before} = IPCC default value for carbon stock of perennial cropland biomass before conversion is 63 t C ha^{-1}(accounted only for the year of LUC)

7.3.4.1.4 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 follows 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 the study of UMWELTBUNDESAMT (2010b),the IPCC GPG default factors have been assessed against results from national long-term field experiments. Consistency between 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 246 shows the national factors used since the submission 2011 compared to the previously used IPCC default values.

Starting point of the estimates are the applied national management factors according to Table 246.

Table 246: Management factors for arable land according to IPCC (Default values. IPCC GPG 2003) and national studies (UMWELTBUNDESAMT 2010b).

Factor value type		Level	IPCC default	Applied national factors
Land use (F_{LU})	F_{LU}	Long-term cultivated	0.82	0.93
Tillage (F_{MG})	F_{MG1}	Full	1.0	1.0
	F_{MG2}	Reduced	1.03	1.03
	F_{MG3}	No-Till	1.10	1.10
Input (F_I)	F_{I1}	Low	0.92	0.92
	F_{I2}	Medium	1.0	1.0
	F_{I3}	High – without manure	1.07	1.07
	F_{I4}	High – with manure	1.34	1.11

These management factors are in a next step multiplied with the areas of related management in Austria for two years, first for 1990 (as indicated in the NIR being representative for the management in the period up to 1990) and in a next step for 2011 (being representative for the recent management). The result of these individual multiplications is added to sums for each management factor value type (F_{LU}. F_{MG}. F_I) and for each year (1990, 2011). In a next step these sums for each management factor value type and year are divided by the total areas to result in specific average F_{LU}, F_{MG} and F_I for 1990 („$(F_{LU} \times F_{MG} \times F_I)_{1990}$") and for 2011 („$(F_{LU} \times F_{MG} \times F_I)_{2011}$"). These average ($(F_{LU} \times F_{MG} \times F_I)_{1990}$) and ($(F_{LU} \times F_{MG} \times F_I)_{2011}$) are used then to calculate the average soil C stock change for 21 years. The following equations shall demonstrate the approach:

$$(F_{LU} \times F_{MG} \times F_I)_{1990} = ((F_{LU} \times CL_{1990FLU})/CL_{tot}) \times ((F_{MG1} \times CL_{1990FMG1} + \ldots + F_{MG3} \times CL_{1990FMG3})/CL_{tot}) \times ((F_{I1} \times CL_{1990FI1} + \ldots + Fi_4 \times CL_{1990FI4})/CL_{tot}) \quad (1)$$

$$(F_{LU} \times F_{MG} \times F_I)_{2011} = ((F_{LU} \times CL_{2011FLU})/CL_{tot}) \times ((F_{MG1} \times CL_{2011FMG1} + \ldots + F_{MG3} \times CL_{2011FMG3})/CL_{tot}) \times ((F_{I1} \times CL_{2011FI1} + \ldots + Fi_4 \times CL_{2011FI4})/CL_{tot}) \quad (2)$$

$$SOC_{1990+21} = (SOC_{1990}/(F_{LU} \times F_{MG} \times F_I)_{1990}) \times (F_{LU} \times F_{MG} \times F_I)_{2011} \quad (3)$$

$$\Delta SOC_{21} = (SOC_{1990+21} - SOC_{1990})/21 = 0.044\ t\ C\ ha^{-1}\ a^{-1} \quad (4)$$

$(F_{LU} \times F_{MG} \times F_I)_{1990}$ *average Management factor for Austria for 1990*

$(F_{LU} \times F_{MG} \times F_I)_{2011}$ *average Management factor for Austria for 2011*

CL.... areas of cropland where "tot" represents related total CL area; CL with indices of managemnent factors and years represent CL areas with indicated management type in the indicated year according to the Austrian agricultural statistics

note for understanding: $CL_{FlU} = CL_{tot}$

$CL_{FMG1} + \ldots + CL_{FMG3} = CL_{tot}$

$CL_{FI1} + \ldots + CL_{1990FI4} = CL_{tot}$

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)*

$SOC_{1990+21}$ *av. soil carbon stock per ha after 21 years based on different land management factors (calculated value 50.92 t C ha*$^{-1}$*)*

ΔSOC_{21} *average annual carbon stock change in Austrian cropland soils (t C ha*$^{-1}$ *a*$^{-1}$*) over a period of 21 years*

Annual change in carbon stock of mineral soils in annual cropland remaining annual cropland = ΔSOC_{21} ** area of annual cropland remaining annual cropland.*

This estimation method is based exactly on the approach of the examples at p. 3.76 and p. 3.78 in the 2003 IPCC GPG with the only difference that the C stock at the start of the inventory period (SOC_{1990}) is known in Austria (50 t C/ha). Its division by the average management factors representing the period to 1990 $(F_{LU} \times F_{MG} \times F_{I})_{1990}$ in the equation above is therefore only a back-calculation to the reference C stock (SOC_{REF} according to the GPG examples) on basis of which the C stock 1990 + 21 years ($SOC_{1990+21}$) can be calculated with the recent average management factors $(Flu \times Fmg \times Fi)_{2011}$. It should be noted that the IPCC GPG 2003 don't provide specific information in how to proceed if the inventory period is longer than 20 years. Therefore, the approach of the IPCC 2006 guidelines was used to divide $(SOC_{1990+21} - SOC_{1990})$ by the length of the inventory period.

The estimates result in an average annual increase of soil organic carbon of 44 kg ha^{-1} a^{-1} since 1990. 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 sub-category „perennial cropland remaining perennial cropland" the same soil C stock changes as for „annual cropland remaining annual cropland" are assumed.

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 15 937 ha from 1990 to 2012.

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 the IPCC GPG, the calculation steps for determining SOC_0. $SOC_{(0-T)}$ and net soil change per ha of area are as follows:

- Step 1: Select the reference carbon stock value (SOC_{REF}) based on climate and soil type for each area of land being inventoried

  → not necessary as Austrian specific values were available.
- Step 2: Calculate the pre-conversion C stock (SOC_{0-T}) of land being converted into annual cropland. based on the reference carbon stock and management factors

  → average carbon stock in Austrian soils of perennial cropland 57 t C ha^{-1}
- Step 3: Calculate SOC_0 by repeating step 2 using the same reference carbon stock for Austrian cropland

  → average carbon stock in Austrian soils of annual cropland 50 t C ha^{-1}
- Step 4: Calculate the average annual change in soil C stock for the area over the transition period (20 years)
- Step 5: multiply the average annual change in soil C stock by the conversion area.

Annual change in carbon stock of mineral soils in annual cropland converted to perennial cropland =

*Δ SOC_{20} * conversion area for a transition period of 20 years*

Δ SOC = (SOC_0 - SOC $_{0-T}$)/20 = 0.35 t C ha^{-1} a^{-1}

Δ SOC_{20}...average annual carbon stock change in soils of annual cropland converted to perennial cropland (t C ha^{-1} a^{-1}) over a LUC transition period of 20 years

SOC_0…… carbon stock in soils 20 years after conversion from annual to perennial cropland (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 13 433 ha to 12 922 ha from 1990 to 2012.

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:

Δ SOC_{20} = (SOC_0 - SOC $_{0-T}$)/20 =- 0.35 t C ha^{-1} a^{-1}

Annual change in carbon stock of mineral soils in perennial cropland converted to annual cropland =

*Δ SOC * conversion area for a transition period of 20 years*

Δ SOC_{20}...average annual carbon stock change in soils of perennial cropland converted to annual cropland (t C ha^{-1} a^{-1}) over a LUC transition period of 20 years

7.3.4.1.7 Liming

The application of lime to agricultural soils is a source of CO_2 emissions. There is no detailed data of lime application in Austria since 1994. Therefore, the estimated amount is based on expert judgement. Particularly with respect to lime quality (dolomite, $CaCO_3$), information is incomplete. For the estimation of CO_2 emissions from liming the calculation does not differentiate between cropland and grassland.

According to expert judgement the area for the calculation of liming comprises cropland (without perennial cropland), two and more cut meadows and cultivated pastures. There are no recommendations of the advisory committee for good agricultural practices to lime perennial cropland (BMLFUW 2006c; 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 247: Area with potential lime application in ha.

Landuse (ha)	1990	2012
Cropland	1.406.394	1.355.080
Grassland	884.124	851.411
Total	**2.290.518**	**2.206.491**

The following assumptions were made:

- the recommended amount of lime that should be applied to cropland and grassland according to the Austrian advisory committee for good agricultural practices („Fachbeirat für Bodenfruchtbarkeit") is 0.7 t ha^{-1} a^{-1}.
- a pilot study on waste management in agriculture (UMWELTBUNDESAMT 2004b) showed that only 32% of this recommended amount is actually applied (0.224 t ha^{-1} 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 248: Area with actual lime application in ha.

Landuse (ha)	1990	2012
Cropland	562558	542032
Grassland	353650	340564
Total	**916207**	**882596**

The GPG (IPCC 2003) procedure for calculating the CO_2 emissions was applied.

7.3.4.1.8 Biomass burning

Burning of crop residues in vineyards occurs to some minor extent in Austria. The CO_2-emissions from burning of these agricultural residues in viticulture are included in the CO_2-emissions from biomass harvesting of perennial cropland (CRF table 5.B biomass) and notation key "IE" is therefore applied in CRF table 5(V – B.1.). CH_4- and N_2O-emissions from biomass burning of vineyard residues are reported in sector 4.F agriculture.

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. Based on the new assessment of the ARD NFI 2011/13 the activity data and emission factors for land use changes from forest to cropland were revised for the whole time series. The area in conversion status from forest land to cropland (for a time period of 20 years) ranges from 3 478 ha to 4 792 ha between 1990 and 2012 causing annual emission rates due to the loss of biomass and C stock changes in soil and litter from 32.3 Gg CO_2 to 83.9 Gg CO_2.

For the calculation of the annual change of carbon stocks the IPCC Tier 3 approach is used. Emissions/removals were calculated by country specific values. The changes of the soil carbon stocks were 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. The method is described in chapter 7.2.4.2.

N_2O emissions from soils of forest land converted to cropland

The area of land use conversions (forest land to cropland) was taken from Table 242. The annual release of N_2O was calculated with IPCC default values (TIER 1) using equations 3.3.14 and 3.3.15 (IPCC 2003). 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).

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 LUCs between CL and GL of the most recent years were updated on basis of an assessment of the most recent statistics. In addition, in the extrapolation factor from the assessed sub-sample to all Austria was improved (see chapter 7.3.2).

The average annual land use change area from grassland to annual cropland from 1990–2012 is 2 365 ha. The area in conversion status for a time period of 20 years ranges from 32 802 ha to 47 987 ha for the period 1990 to 2012. Considering the area of the 20 year time period this leads to emissions between 104.2 and 149.3 Gg CO_2.

The average annual land use change area from grassland to perennial cropland from 1990–2012 is 96 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 242. 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 CChapterhapter 7.4.4.2.2). That leads to a country specific value for carbon stock of above ground and below ground grassland biomass before conversion of 5.7 t C ha^{-1}. For the calculation of the annual change in carbon stocks in living biomass of grassland converted to cropland the following equation was applied – GPG IPPC (equation 3.3.8):

*Annual change in biomass = annual area of currently converted land * ($L_{conversion} + \Delta C_{growth}$)*

$L_{conversion} = C_{after} - C_{before}$

ΔC_{growth} = country specific value for annual carbon accumulation rate in annual crops is 6.67 t C $ha^{-1}a^{-1}$(see Chapter 7.3.4.1.2. accounted only for the year of LUC)

C_{after} = carbon stock immediately after conversion is 0

C_{before} = country specific value for carbon stock of grassland biomass before conversion is 5.7 t C ha^{-1}(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

For perennial cropland an annual growth according to the IPCC GPG (2.1 t C $ha^{-1}a^{-1}$) was used for the whole LUC transition period of 20 years:

*Annual change in biomass = conversion area for a transition period of 20 years * ΔC_{growth} + annual area of currently converted land * $L_{conversion}$*

$L_{conversion} = C_{after} - C_{before}$

For the calculation the following values were used:

ΔC_{growth} = IPCC default value for annual carbon accumulation rate in perennial crops is 2.1 t C $ha^{-1}a^{-1}$(annual growth rate in each year of the whole LUC transition period of 20 years)

C_{after} = carbon stock immediately after conversion is 0

C_{before}= country specific value for carbon stock of grassland biomass before conversion. 5.7 t C ha^{-1} (description see Chapter 7.4.4.2.2. biomass loss accounted only in the year of LUC).

The data in the CRF table represent grassland converted to annual cropland and grassland converted to perennial cropland separately as recommended by the ERT.

Changes of carbon stock in mineral soils of grassland converted to annual cropland

Only mineral soils were considered in this category assuming that grassland on organic soils were not converted to cropland (soil inventories have shown that cropland with organic soils does not exist in Austria).

Emissions/removals were calculated by country specific values for carbon stocks in mineral soils of grassland and arable land. For the estimates Austrian specific values of 70 t C ha^{-1} for 0–30 cm depth of grassland and 50 t C ha^{-1} for 0–30 cm depth of arable land were used (GERZABEK et al. 2003, STREBL et al. 2003). For the calculation of the annual change of carbon stocks in grassland soils converted to annual cropland soils the following equation according to IPCC GPG (2003) was applied.

$$\Delta SOC = (SOC_0 - SOC_{0-T})/20 = -1.0 \ t\ C\ ha^{-1}\ a^{-1}$$

*annual change in carbon stock of mineral soils converted from grassland to cropland = Δ SOC * conversion area for a transition period of 20 years*

Δ SOC = average annual carbon stock change in soils of grassland converted to annual cropland (t C ha^{-1} a^{-1}) over a LUC transition period of 20 years

SOC_0 = carbon stock in cropland soils 20 years after conversion from grassland to annual cropland →50 t C ha^{-1}

SOC_{0-T} = carbon stock in Austrian grassland soils before conversion →70 t C ha^{-1}

Changes of carbon stock in mineral soils of grassland converted to perennial cropland

The annual land use change area from grassland to perennial cropland ranges from 1 329 ha to 1 944 ha for the period 1990–2012 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.

$$\Delta SOC = (SOC_0 - SOC_{0-T})/20 = -0.65 \ t\ C\ ha^{-1}\ a^{-1}$$

*annual change in carbon stock of mineral soils converted from grassland to perennial cropland = Δ SOC * conversion area for a transition period of 20 years*

Δ SOC = average annual carbon stock change in soils of grassland converted to perennial cropland (t C ha^{-1} a^{-1})

over a LUC transition period of 20 years

SOC_0 = carbon stock in perennial cropland soils 20 years after conversion from grassland →57 t C ha^{-1}

SOC_{0-T} = carbon stock in grassland soils before conversion →70 t C ha^{-1}

The data in the CRF table represent grassland converted to annual cropland and grassland converted to perennial cropland. Separately, as recommended by the ERT.

N_2O emissions from soils of grassland converted to cropland

The N_2O 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 242.

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 249: 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 239	see Chapter 7.2.5. Table 239
Annual LUC area pCL to aCL. aCL to pCL. GL to pCL	±300%[1]	±260%[1]
Annual LUC area GL to aCL	±200%[1]	±150%[1]

[1] *Distribution was truncated at 0, because negative areas are not possible*

These uncertainties origin from:

- Total cropland: based on information from data source (Statistik Austria)
- Perennial cropland: based on information from data source (Statistik Austria)
- Annual LUC area pCL to aCL. aCL to pCL. GL to pCL: Expert judgement from two agricultural experts on basis of the original data
- Annual LUC area GL to aCL: Expert judgement from two agricultural experts on basis of the original data

Table 250: 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 240	
N_2O emission factor for soil at LUC to CL		±150%
C/N ratio grassland soils	±55%	
C/N ratio forest soils	±58%	
Liming		±50%

These uncertainties origin from:

- Annual CL biomass: for yield based on an assessment from the annual yield statistics; for the expansion factors based on expert judgement
- Perennial CL biomass (except perennial crops below): IPCC GPG
- Perennial energy plants: assessment based on the results of the study that was used [SPLECHTNA & GLATZEL 2005]
- Christmas trees: assessment based on the results of the study that was used [BMLFUW 2000]
- Grassland biomass: for yield based on an assessment from the annual yield statistics; for the expansion factors based on expert judgement
- Soil C stock change in CL rem CL: assessment based on the results of the study that was used (UMWELTBUNDESAMT 2010b)
- N_2O emission factor for soil at LUC to CL: WINIWARTER 2007
- C/N ratio grassland soils: assessment on basis of the soil inventory results
- C/N ratio forest soils: assessment on basis of the soil inventory results
- Liming: expert judgement from two agricultural experts

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: ±810 to ±1 106 Gg CO_2 with higher uncertainties in the 90ies[85]. This reflects the fact that the activity data of previous years have a higher uncertainty (see Table 239). The relative uncertainties in the single years are in the range from ±356 to ±1 849%. 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.

[85] It should be noted that due to the design of the NFI changes in forest biomass stock also include the biomass changes due to LUC to and from forests. As a consequence, the estimates of the overall uncertainty of biomass changes at all forest lands and lands with LUC to and from forests were carried out in the FL sector. For this reason the absolute values of the uncertainties of the single LULUCF subcategories cannot be compared with the reported emissions/removals of the individual subcategories, but as an approximation the relative uncertainties of the subcategories can be compared with the related emissions/removals. For the totals of the LULUCF sector the uncertainty is of course consistent with its emissions/removals.

It should be noted that the net emission/removals of the CL 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

The LUCs between perennial and annual CL and the LUCs between CL and GL of the most recent years were updated on basis of an assessment of the most recent statistics. In addition, the extrapolation factor from the assessed subsample to all Austria used in previous submissions was improved.

The areas of the LUC subcategory FL to CL were changed on basis of the ARD NFI assessment that was finalised in 2013. Also the biomass stock changes and dead wood stock changes at these LUC lands were measured accurately during this assessment. So, the emission estimates for this subcategory and for the whole time series changed on basis of these new activity data and emission factors.

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 2012 1.79 Mio ha of Austria were grassland (STATISTIK AUSTRIA 2013b). Total grassland includes one cut meadows, two cut meadows and three and more cut meadows, permanent pastures, litter meadows, rough pastures, alpine meadows and pastures, grassland where grassland management was stopped and GLÖZ G (grassland in good agricultural and ecological condition no longer used for production).

The annual emission of grassland in Austria amounted to 322 Gg CO_2 in 1990 and 41 Gg CO_2 in 2012. 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 2012 (202 568 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 251: 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 252: Activity data of grassland 1990–2012 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	1 944 009	48 756	32 467	16 288	16 112	176	NO	NO	NO
1991	1 989 050	1 938 637	50 413	34 203	16 210	16 035	175	NO	NO	NO
1992	1 985 335	1 933 255	52 080	35 939	16 141	15 967	175	NO	NO	NO
1993	1 981 620	1 927 878	53 742	37 675	16 067	15 893	174	NO	NO	NO
1994	1 979 096	1 925 357	53 739	37 716	16 023	15 849	173	NO	NO	NO
1995	1 976 571	1 923 524	53 047	37 069	15 979	15 806	173	NO	NO	NO
1996	1 978 490	1 926 131	52 359	36 421	15 938	15 765	172	NO	NO	NO
1997	1 980 408	1 928 749	51 659	35 773	15 886	15 714	172	NO	NO	NO
1998	1 972 662	1 921 705	50 956	35 125	15 831	15 660	171	NO	NO	NO
1999	1 964 915	1 913 871	51 045	35 284	15 761	15 590	170	NO	NO	NO
2000	1 957 169	1 906 024	51 145	35 442	15 702	15 533	170	NO	NO	NO
2001	1 929 902	1 878 667	51 235	35 601	15 634	15 465	169	NO	NO	NO
2002	1 902 636	1 850 446	52 189	36 621	15 568	15 400	168	NO	NO	NO
2003	1 875 369	1 822 417	52 951	37 640	15 311	15 145	166	NO	NO	NO
2004	1 848 102	1 795 935	52 167	37 037	15 130	14 966	164	NO	NO	NO
2005	1 843 105	1 791 228	51 877	36 433	15 443	15 276	167	NO	NO	NO
2006	1 838 107	1 786 528	51 579	35 830	15 749	15 578	170	NO	NO	NO
2007	1 817 138	1 764 349	52 788	35 227	17 562	17 372	190	NO	NO	NO
2008	1 796 168	1 738 889	57 279	34 623	22 656	22 411	245	NO	NO	NO
2009	1 793 183	1 735 693	57 489	33 477	24 013	23 753	260	NO	NO	NO
2010	1 790 197	1 732 613	57 584	32 502	25 082	24 811	271	NO	NO	NO
2011	1 790 197	1 732 639	57 558	31 527	26 031	25 750	281	NO	NO	NO
2012	1 790 197	1 733 049	57 148	30 553	26 595	26 308	288	NO	NO	NO

Table 253: Emissions from grassland management in Gg CO_2 (1990–2012)

	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	2.3 Wetlands converted to grassland	2.4 Settlements converted to grassland	2.5 Other Land converted to grassland
1990	321.74	0.40	321.34	376.24	-54.91	-56.28	1.38	NO	NO	NO
1991	316.68	0.44	316.25	370.95	-54.70	-56.05	1.35	NO	NO	NO
1992	311.69	0.47	311.22	365.61	-54.39	-55.76	1.37	NO	NO	NO
1993	306.86	0.50	306.36	360.51	-54.15	-55.51	1.36	NO	NO	NO
1994	306.83	0.51	306.32	360.36	-54.04	-55.38	1.34	NO	NO	NO
1995	139.73	0.53	139.21	193.08	-53.88	-55.22	1.34	NO	NO	NO
1996	141.44	0.51	140.93	194.66	-53.72	-55.07	1.35	NO	NO	NO
1997	143.19	0.49	142.69	196.23	-53.53	-54.88	1.35	NO	NO	NO
1998	144.99	0.54	144.46	197.82	-53.36	-54.70	1.34	NO	NO	NO
1999	144.81	0.58	144.22	197.36	-53.14	-54.47	1.33	NO	NO	NO
2000	144.61	0.63	143.98	196.90	-52.93	-54.25	1.33	NO	NO	NO
2001	144.54	0.79	143.75	196.45	-52.70	-54.02	1.32	NO	NO	NO
2002	352.57	0.96	351.61	404.07	-52.46	-53.78	1.32	NO	NO	NO
2003	348.52	1.13	347.40	400.01	-52.61	-53.52	0.90	NO	NO	NO
2004	350.14	1.28	348.86	400.63	-51.77	-52.75	0.98	NO	NO	NO
2005	352.53	1.31	351.22	401.25	-50.03	-52.13	2.10	NO	NO	NO
2006	351.68	1.34	350.34	401.52	-51.18	-53.26	2.08	NO	NO	NO
2007	354.17	1.47	352.70	401.79	-49.09	-54.53	5.44	NO	NO	NO
2008	355.05	1.62	353.43	402.06	-48.63	-61.39	12.76	NO	NO	NO
2009	49.23	1.64	47.59	122.83	-75.24	-79.50	4.26	NO	NO	NO
2010	45.69	1.66	44.03	124.85	-80.82	-84.39	3.58	NO	NO	NO
2011	43.46	1.66	41.80	126.87	-85.06	-88.31	3.25	NO	NO	NO
2012	41.24	1.66	39.58	128.88	-89.30	-91.68	2.38	NO	NO	NO

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 1960–2013). 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 (full survey). For the years between the surveys the data have been interpolated. The data of the full farm structure survey 2010 (STATISTIK AUSTRIA 2012) are considered in this submission.

Data for land use changes between cropland and grassland were estimated on basis of IACS. The time series of these lands was changed according to an improved extrapolation factor and an update of these LUC areas for the last years on basis of the most recent statistics (for a detailed description see Chapter 7.3.2).

The LUC area from cropland to grassland is in the order of 0.9 % of the total grassland area (across a LUC transition period of 20 years) and on average 0.04 % of the total grassland area each year.

The LUC areas from forest land to grassland are based on the NFI data (see Chapter 7.2.2). The areas of the LUC subcategory FL to CL were changed for submission 2014 on basis of the ARD assessment that was finalised in 2013. Also the biomass stock changes and dead wood stock changes at these LUC lands were measured accurately during this assessment (see Chapters 7.2.2.2 and 7.2.4.2). So, the emission estimates for this subcategory and for the whole time series changed on basis of these new activity data and emission factors.

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 (2013b) classification for grassland was used for land use definitions:

- One cut meadows,
- Two cut meadows,
- Three and more cut meadows,
- Litter meadows,
- Permanent Pastures,
- Rough Pastures,
- Alpine meadows and pastures,
- Grassland where grassland management was stopped,
- GLÖZ G: grassland in good agricultural and ecological condition no longer used for production.

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 2012 was 1.73 Mio ha.

The annual emissions from grassland remaining grassland between 1990 and 2012 range from 0.4 Gg CO_2 to 1.66 Gg CO_2.

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 approach 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). The equations used for calculating the change in carbon stocks of grassland soils and the method are exactly the same as for cropland described in detail in Chapter 7.3.4.1.4 with the difference of using the soil C stock (SOC_{1990}) for grassland with 70 t C/ha, the management factors for grassland according to the IPCC GPG Table 3.4.5 and the areas of related grassland management in Austria.

These default factors were applied to the Austrian situation of grassland management in the years 1990 and 2011 on basis of national statistics for the grassland management (STATISTIK AUSTRIA 1985–2003; BMLFUW 1985–2011). 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 0.00162 t C ha^{-1} across a period of 21 years is calculated.

The carbon stock changes of grassland soil (70 t C ha^{-1}) from 1990–2012 were calculated then on basis of this annual soil C stock increase.

Annual change in carbon stock of mineral soils in grassland remaining grassland = $\Delta\ SOC_{21}$ ** area of grassland remaining grassland*

$\Delta\ SOC_{21} = (SOC_{1990+21} – SOC_{1990})/21 = 0.00162 t\ C\ ha^{-1}\ a^{-1}$

It should be noted that the IPCC GPG 2003 don't provide specific information in how to proceed if the inventory period is longer than 20 years. Therefore, the approach of the IPCC 2006 guidelines was used to divide $(SOC_{1990+21} - SOC_{1990})$ by the length of the inventory period.

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 ($EF_{cold\ temperate}$ =0.25 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)

The methodology and activity data are described in Chapters 7.2.2 and 7.2.4.2. Based on the new assessment of the ARD NFI 2011/13 the activity data and emission factors for land use changes from forest to grassland were revised for the whole time series. The area in conversion status from forest land to grassland for a time period of 20 year ranges from 37 716 ha to 30 553 ha between the years 1990 and 2012. The main part of conversion takes place from forests to pasture causing annual emissions due to the loss of biomass and C stock changes in soil and litter between 122.8 Gg CO_2 and 404.1 Gg CO_2.

For the calculation of the annual change of carbon stocks IPCC Tier 3 approach is used. Emissions/removals were calculated by country specific values. The changes of soil carbon stocks were 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. 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 1990–2012 is 1 259 ha. The average annual land use change area (1990–2012) from perennial cropland to grassland is 14 ha. The total area in conversion status for a time period of 20 years amounts to 16 288 ha in 1990 and 26 595 ha in 2012. Considering the area of the 20 years time period this leads to annual removals from 54.9 Gg CO_2 in 1990 and 89.3 Gg CO_2 in 2012.

Changes of carbon stock in biomass of annual cropland converted to grassland

The carbon stock of living biomass in annual cropland was estimated 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 biomass 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 254: 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

The country specific root-to-shoot ratios 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 t 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 the 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).

*Annual change in biomass =annual area of currently converted land * (*$L_{conversion} + \Delta C_{growth}$*)*

$L_{conversion} = C_{after} - C_{before}$

C_{after} = carbon stock immediately after conversion is 0

ΔC_{growth} = country specific value for grassland biomass 5.70 t C ha^{-1}a^{-1}(accounted only for the year of LUC)

C_{before} = country specific value of carbon stock of annual crops before conversion is 6.67 t C ha^{-1}a^{-1}(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 2012 is 15 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_{before} = IPCC default value of biomass carbon stock of perennial crops before conversion is 63 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 16 112 ha and 26 308 ha in the years 1990 and 2012, respectively.

The IPCC method with a four step approach was applied. The calculation steps for determining SOC_0. $SOC_{(0-T)}$ and net soil change per ha of area are as follows:

- Step 1: Selecting Austrian specific values for annual cropland before conversion →SOC_{0-T}
- Step 2: Selecting Austrian specific values for grassland 20 years after conversion → SOC_0
- Step 3: Calculation of average annual carbon stock change for the LUC period of 20 a.
- Step 4: Multiply the annual carbon stock change by the conversion area for a transition period of 20 years.

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).

Average annual carbon stock change (t C ha^{-1} a^{-1})= $(SOC_0 - SOC_{0-T})/20 = 1.0$

SOC_0…… carbon stock in soils 20 years after conversion from annual cropland to grassland →70 t C ha^{-1}

SOC_{0-T}….. carbon stock change in cropland soils before conversion→ 50 t C ha^{-1}

Changes of carbon stock in mineral soil of perennial cropland converted to grassland

The area in conversion status from perennial cropland converted to grassland for a time period of 20 years amounts to 176 ha and 288 ha in the years 1990 and 2012:

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).

$\Delta SOC = (SOC_0 – SOC_{0-T})/20 = 0.65$ t C ha^{-1} a^{-1}

*annual change in carbon stock of mineral soils converted from grassland to perennial cropland = Δ SOC * conversion area for a transition period of 20 years*

SOC_0…… carbon stock in soils 20 years after conversion from perennial cropland to grassland →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 255: 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 239	see Chapter 7.2.5. Table 239
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*

These uncertainties origin from:

- Total grassland: based on information from data source (Statistik Austria)
- Area of organic grassland soils: assessment on basis of the soil inventory results
- Annual LUC area pCL to GL: expert judgement from two agricultural experts on basis of the original data
- Annual LUC area aCL to GL: expert judgement from two agricultural experts on basis of the original data

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 the 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 CO_2 with higher uncertainties in the 90ies[86]. Like in the cropland subcategory, this difference is caused by the activity data of previous years which have a higher uncertainty (see Table 255). The relative uncertainties in the single years are in the range from ±154 to ±1 392%. Very 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.

[86] It should be noted that due to the design of the NFI changes in forest biomass stock also include the biomass changes due to LUC to and from forests. As a consequence, the estimates of the overall uncertainty of biomass changes at all forest lands and lands with LUC to and from forests were carried out in the FL sector. For this reason the absolute values of the uncertainties of the single LULUCF subcategories cannot be compared with the reported emissions/removals of the individual subcategories, but as an approximation the relative uncertainties of the subcategories can be compared with the related emissions/removals. For the totals of the LULUCF sector the uncertainty is of course consistent with its emissions/removals.

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

The areas of CL and GL of the most recent years were updated on basis of an assessment of the most recent statistics. In addition, the extrapolation factor from the assessed subsample to all Austria used in previous submissions was improved.

The areas of the LUC subcategory FL to GL were changed on basis of the ARD NFI assessment that was finalised in 2013. Also the biomass stock changes and dead wood stock changes at these LUC lands were measured accurately during this assessment. So, the emission estimates for this subcategory and for the whole time series changed on basis of these new activity data and emission factors.

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 148 096 ha in the years 1990–2012.

The shares of the different previous land use types before conversion to wetland vary between the years and results in the annual variations in the emissions of this subcategory.

Table 256 and Table 257 show the land use change and removals/emissions from LUC to wetland from 1990–2012.

Table 256: Activity data of wetland 1990–2012 in ha.

	5 D Total wetland	1. Wetland remaining wetland	2. Land converted to wetland	2.1 Forest land converted to wetlands	2.2 Cropland converted to wetlands	2.3 Grassland converted to wetlands	2.4 Settlements converted to wetlands	2.5 Other Land converted to wetlands
1990	133 068	127 557	5 511	1 706	NO	3 804	NO	NO
1991	133 519	127 009	6 510	1 798	NO	4 713	NO	NO
1992	133 970	126 460	7 510	1 889	NO	5 621	NO	NO
1993	134 422	125 912	8 509	1 980	NO	6 529	NO	NO

	5 D Total wetland	1. Wetland remaining wetland	2. Land converted to wetland	2.1 Forest land converted to wetlands	2.2 Cropland converted to wetlands	2.3 Grassland converted to wetlands	2.4 Settlements converted to wetlands	2.5 Other Land converted to wetlands
1994	134 873	125 453	9 420	1 982	NO	7 438	NO	NO
1995	135 587	125 177	10 410	1 948	NO	8 462	NO	NO
1996	136 302	124 901	11 401	1 914	NO	9 487	NO	NO
1997	137 016	124 625	12 392	1 880	NO	10 512	NO	NO
1998	137 731	124 349	13 382	1 846	NO	11 536	NO	NO
1999	138 445	124 030	14 415	1 854	NO	12 561	NO	NO
2000	139 160	123 712	15 448	1 863	NO	13 585	NO	NO
2001	139 874	123 393	16 481	1 871	NO	14 610	NO	NO
2002	140 589	122 757	17 832	1 898	NO	15 935	NO	NO
2003	141 303	122 120	19 183	1 924	NO	17 259	NO	NO
2004	142 018	121 569	20 449	1 865	NO	18 583	NO	NO
2005	142 245	121 018	21 227	1 806	NO	19 421	NO	NO
2006	142 575	120 893	21 682	1 747	NO	19 935	NO	NO
2007	143 477	121 118	22 359	1 688	NO	20 670	NO	NO
2008	144 265	121 344	22 921	1 630	NO	21 291	NO	NO
2009	145 084	122 012	23 071	1 752	NO	21 319	NO	NO
2010	146 123	122 663	23 461	1 884	NO	21 576	NO	NO
2011	146 989	123 313	23 676	2 016	NO	21 660	NO	NO
2012	148 096	123 964	24 133	2 148	NO	21 985	NO	NO

Table 257: Emissions of wetland 1990–2012 in Gg CO_2.

	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	42.08	NE	42.08	23.12	NO	18.97	NO	NO
1991	42.03	NE	42.03	23.06	NO	18.97	NO	NO
1992	41.98	NE	41.98	23.01	NO	18.97	NO	NO
1993	41.93	NE	41.93	22.97	NO	18.97	NO	NO
1994	41.93	NE	41.93	22.97	NO	18.97	NO	NO
1995	35.81	NE	35.81	14.41	NO	21.40	NO	NO
1996	35.81	NE	35.81	14.41	NO	21.40	NO	NO
1997	35.81	NE	35.81	14.41	NO	21.40	NO	NO
1998	35.81	NE	35.81	14.41	NO	21.40	NO	NO
1999	35.80	NE	35.80	14.40	NO	21.40	NO	NO
2000	35.80	NE	35.80	14.40	NO	21.40	NO	NO
2001	35.80	NE	35.80	14.40	NO	21.40	NO	NO
2002	47.28	NE	47.28	19.62	NO	27.66	NO	NO
2003	47.27	NE	47.27	19.62	NO	27.66	NO	NO
2004	47.30	NE	47.30	19.65	NO	27.66	NO	NO

	5 D Total wet-land	1. Wetland re-maining wet-land	2. Land conver-ted 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
2005	37.17	NE	37.17	19.68	NO	17.49	NO	NO
2006	39.32	NE	39.32	19.70	NO	19.62	NO	NO
2007	51.30	NE	51.30	19.72	NO	31.58	NO	NO
2008	48.93	NE	48.93	19.75	NO	29.18	NO	NO
2009	68.78	NE	68.78	49.05	NO	19.73	NO	NO
2010	73.40	NE	73.40	49.06	NO	24.34	NO	NO
2011	69.77	NE	69.77	49.07	NO	20.70	NO	NO
2012	74.84	NE	74.84	49.07	NO	25.77	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 2013). 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 (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, the time series of these LUC areas was updated on basis of the new ARD NFI (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. For area consistency reasons and due to the updated LUC areas FL to WL, also the LUC areas GL to WL were changed for submission 2014 and are slightly different to those of previous submissions.

The area in conversion status of land converted to wetland for a time period of 20 years ranges from 5 511 ha to 24 133 ha for the period 1990 to 2012.

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 and reservoirs,
- water`s edge areas
- Peatland areas.

7.5.4 Methodological Issues

7.5.4.1 Land use changes to Wetland (5.D.2)

7.5.4.1.1 Forest Land converted to Wetland (5.D.2.1)

The methodology and activity data are described in Chapters 7.2.2 and 7.2.4.2. Based on the new assessment of the ARD NFI 2011/13 the activity data and emission factors for land use changes from forest to cropland were revised for the whole time series. Furthermore, in response to a review finding the soil C stock changes in the LUC-categories to WL were assumed to be 0 (see Chapter 7.2.4.2).

The area in conversion status from forest land to wetland for a time period of 20 years ranges from 1630 ha to 2 148 ha between the years 1990 and 2012 causing annual emission rates due to the loss of biomass and C stock changes in soil and litter from 14.4 Gg CO_2 to 49.1 Gg CO_2.

For the calculation of the annual change of carbon stocks the IPCC Tier 3 approach is used. Emissions/removals were calculated by country specific values.

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)

Changes in carbon stocks in biomass of grassland converted to wetland

For the calculation of the annual change in carbon stocks of living biomass in grassland converted to wetland the following equation was applied (equation 3.5.6 GPG)

Annual change in carbon stocks of living biomass in land converted to wetland (tones $C.a^{-1}$):

$$\Delta C_{LW\ flood} = (Sum\ A_i*(B_{after}-B_{before})$$

Ai = annual area of land 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

In response to a review finding the soil C stock changes in the LUC-categories to WL were assumed to be 0. In previous submissions wetlands (flooded land) were assumed to have a 0 soil C stock. Using the IPCC GPG approach of calculating the C stock change between a period of 20 years led to unrealistic annual C stock losses in mineral soils for lands with such LUC. Due to a lack of information in literature for submission 2014 no C-stock changes in mineral soil are assumed at LUC to wetland.

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 239; annual LUC area GL to WL: ±20%. The uncertainty of these LUCs were estimated 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.

The uncertainties of the emission factors are given in Chapter 7.2.5. Table 240 and Chapter 7.3.5. Table 250. 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 CO_2 with a steady increase across the time series or between 419 and 1 605% 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.

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

The areas of the LUC subcategory FL to WL were changed on basis of the ARD assessment that was finalised in 2013. Also the biomass stock changes and dead wood stock changes at these LUC lands were measured accurately during this assessment. So, the emission estimates for this subcategory and for the whole time series changed on basis of these new activity data and emission factors. Furthermore, in response to a review finding the soil C stock changes in the LUC-categories to WL were assumed to be 0.

An update of these LUC areas led also to different LUC lands GL to WL due to area consistency reasons. As a consequence, the related emissions/removals of this LUC category had to be revised.

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 0.54 Mio ha of Austria's surface can be allocated to the IPCC land use category „Settlement" (BEV 2013). The area in conversion status from „Land converted to Settlement" for a time period of 20 years ranges from 144 178 ha to 211 358 ha between the years 1990 and 2012 causing annual emission rates due to C stock changes of biomass and soils from 87 Gg CO_2 to 235 Gg CO_2.

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 CO_2 emissions and IEF for the sum of net C stock changes in living biomass and soils in the category „LUC to settlements". Consequently, the trend of total emissions in this category is partly different to the trend of the total settlement area because:

- the increase of living biomass of perennial species (trees and shrubs) as well as the discounting of soil carbon stocks refer to LUC transition areas for a time period of 20 years. whereas;
- the increase of ground vegetation (annual plants) is accounted only at the LUC areas with current LUC (in the year of LUC) in the categories.

Table 258 and Table 259 show the land use changes and removals/emissions from LUC to settlements for the period 1990 to 2012.

Table 258: Derived land use changes for the subcategory 5 E for the period 1990 to 2012 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	176 291	207 774	9 792	142 266	55 717	NO	NO
1991	391 101	182 638	208 463	10 315	142 856	55 292	NO	NO
1992	398 137	188 985	209 152	10 839	143 447	54 867	NO	NO
1993	405 173	195 332	209 842	11 362	144 037	54 442	NO	NO
1994	412 209	202 189	210 020	11 375	144 628	54 017	NO	NO
1995	419 245	209 006	210 239	11 180	145 467	53 593	NO	NO
1996	426 281	215 823	210 458	10 984	146 306	53 168	NO	NO
1997	433 317	222 640	210 677	10 789	147 145	52 743	NO	NO
1998	440 353	229 457	210 896	10 593	147 984	52 318	NO	NO
1999	447 389	236 031	211 358	10 641	148 823	51 893	NO	NO
2000	454 425	247 966	206 460	10 689	143 682	52 088	NO	NO
2001	461 461	259 900	201 561	10 737	138 542	52 283	NO	NO
2002	468 497	271 468	197 029	11 151	133 401	52 478	NO	NO

	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 Settle-ment	5.E.2.2 Cropland con-verted to Settlement	5.E.2.3 Grassland con-verted to Settlement	5.E.2.4 Wetland con-verted to Settlement	5.F.2.4 Other land con-verted to Settlement
2003	475 395	282 897	192 497	11 565	128 260	52 673	NO	NO
2004	482 293	294 817	187 476	11 490	123 119	52 867	NO	NO
2005	489 190	307 875	181 315	11 414	119 137	50 764	NO	NO
2006	494 950	319 796	175 154	11 339	115 154	48 661	NO	NO
2007	502 903	333 909	168 994	11 263	111 172	46 558	NO	NO
2008	513 017	350 184	162 833	11 188	107 189	44 456	NO	NO
2009	521 598	365 305	156 293	10 733	103 207	42 353	NO	NO
2010	529 188	376 933	152 255	10 330	101 869	40 055	NO	NO
2011	537 502	389 286	148 216	9 928	100 531	37 757	NO	NO
2012	538 107	393 930	144 178	9 525	99 193	35 459	NO	NO

Table 259: Emissions/removals from land use changes to settlement for the period 1990 to 2012 in Gg CO_2.

	5.E.2. Land converted to Settlement	5.E.2.1 Forest land converted to settlement	5.E.2.2 Cropland con-verted to settlement	5.E.2.3 Grassland con-verted to settlement	5.E.2.4 Wetland con-verted to settlement	5.E.2.5 Other Land converted to settlement
1990	184	246	-189	127	NO	NO
1991	187	252	-190	126	NO	NO
1992	191	257	-192	125	NO	NO
1993	195	263	-193	125	NO	NO
1994	193	263	-194	124	NO	NO
1995	144	211	-191	123	NO	NO
1996	139	209	-193	123	NO	NO
1997	134	207	-195	122	NO	NO
1998	130	205	-197	121	NO	NO
1999	128	205	-198	121	NO	NO
2000	87	206	-239	121	NO	NO
2001	99	206	-228	121	NO	NO
2002	204	300	-217	122	NO	NO
2003	220	305	-206	122	NO	NO
2004	231	304	-195	122	NO	NO
2005	222	303	-165	84	NO	NO

	5.E.2. Land converted to Settlement	5.E.2.1 Forest land converted to settlement	5.E.2.2 Cropland converted to settlement	5.E.2.3 Grassland converted to settlement	5.E.2.4 Wetland converted to settlement	5.E.2.5 Other Land converted to settlement
2006	226	302	-157	81	NO	NO
2007	230	301	-148	77	NO	NO
2008	235	300	-139	74	NO	NO
2009	101	161	-131	71	NO	NO
2010	97	158	-128	67	NO	NO
2011	92	154	-125	64	NO	NO
2012	88	150	-122	60	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 2012). 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 258 were derived for the period 1990 to 2012.

The update of the LUC areas from and to forests and FL to SL for submission 2014 according to the finalised ARD NFI 2011/12 (see Chapter 7.2.2.2) and the update of the LUC areas between CL and GL caused also a change of activity data for the LUC categories CL to SL and GL to SL for the whole time series (due to area consistency). As a consequence, the related emissions/removals of this LUC category had to be revised.

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 (t C $ha^{-1}a^{-1}$) of biomass were calculated:

Table 260: Stocks and average annual increments of biomass

t C ha^{-1}				t C ha^{-1} a^{-1}			
trees	**shrubs**	**ground veg.**	**total**	**trees**	**shrubs**	**ground veg.**	**total**
31.4	1.2	1.5	34.1	0.52	0.06	1.5	2.08

The increase of living biomass of perennial species (trees and shrubs) at LUC areas to settlement is calculated with 0.58 t C $ha^{-1}a^{-1}$. This value is used for the whole transition period of 20 years. Annual increase of ground vegetation (annual plants) is accounted only at the areas of 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 intensively managed grassland soils (70 t ha^{-1}). Carbon stocks of sealed areas are set zero. Based on calculations of the regional information derived from the real estate database 2/3 of the national settlement area is unsealed. That results in a carbon stock in soil for settlement area of 50 t ha^{-1} (= 2/3 * 70 t ha^{-1}) on average (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. Based on the new assessment of the ARD NFI 2011/13 the activity data and emission factors for land use changes from forest to settlement were revised for the whole time series. The area in conversion status from Forest Land to settlement for a time period of 20 years ranges from 9 525 ha to 11 565 ha between the years 1990 and 2012 causing annual emission rates due to the loss of biomass and C stock changes in soil and litter from 150 Gg CO_2 to 305 Gg CO_2.

Changes in carbon stocks in biomass of forest land converted to settlement

The annual net emission rates due to loss of forest biomass and increase of biomass on settlement area range from 23 to 109 Gg CO_2 in the years 1990 to 2012.

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 stratified according to five forest growth regions. The stratified LUC areas and C stocks according to these growth regions were used for the estimates. The method is described in Chapter 7.2.4.2

The annual emission rates due to C stock changes in litter range from 16 to 65 Gg CO_2 in the years 1990 to 2012.

The annual emission rates due to C stock changes in soil range from 111 to 132 Gg CO_2 in the years 1990–2012.

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 99 193 to 148 823 ha in the years 1990–2012. The update of the recent LUC areas from and to forest and FL to SL for submission 2014 according to the finalised ARD NFI 2011/12 (see Chapter 7.2.2.2) and the update of the LUC areas between CL and GL caused also changes in the LUC areas GL to SL due to areas consistency reasons. This has also consequences on the related emissions/removals for the whole time series.

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 2012 the annual removal rates range from 122 to 239 Gg CO_2 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 99 193 to 148 823 ha in the years 1990–2012 resulting in annual emission rates due to C stock changes of biomass and soils from 60 Gg CO_2 to 127 Gg CO_2. The update of the recent LUC areas from and to forest and FL to SL for submission 2014 according to the finalised ARD NFI 2011/12 (see Chapter 7.2.2.2) and the update of the LUC areas between CL and GL had significant consequences on the LUC areas GL to SL due to areas consistency reasons and significant consequences on the related emissions/removals for the whole time series.

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 settlements (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 1990–2012 the annual removal rates (net change) range from 69.4 to 102.4 Gg CO_2.

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 PCC 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 130 to 204 Gg CO_2 in the years 1990–2012.

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 1990–2012.

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 1990–2012.

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 239. For the area of LUC from CL to SL and GL to SL triangle distributions were defined.

The uncertainties of the emission factors were given in the Chapter 7.2.5. Table 240 and Chapter 7.3.5. Table 250. For the settlement biomass growth rates ±75% on basis of an expert judgement were used.

The uncertainty of the totals of the emissions/removals of the settlement category across the time series ranges from 1 817 Gg CO_2 to 2 108 Gg CO_2[87]. 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 emissions of the settlement category, the uncertainty lies between 776 and 2 348% 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

The areas of the LUC subcategory FL to SL were changed on basis of the ARD assessment that was finalised in 2013. Also the biomass stock changes and dead wood stock changes at these LUC lands were measured accurately during this assessment. So, the emission estimates for this subcategory and for the whole time series changed on basis of these new activity data and emission factors.

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[87] It should be noted that due to the design of the NFI changes in forest biomass stock also include the biomass changes due to LUC to and from forests. As a consequence, the estimates of the overall uncertainty of biomass changes at all forest lands and lands with LUC to and from forests were carried out in the FL sector. For this reason the absolute values of the uncertainties of the single LULUCF subcategories cannot be compared with the reported emissions/removals of the individual subcategories, but as an approximation the relative uncertainties of the subcategories can be compared with the related emissions/removals. For the totals of the LULUCF sector the uncertainty is of course consistent with its emissions/removals.

An update of the LUC areas to/from forests and between GL and CL led also to different LUC lands CL to SL and GL to SL due to area consistency reasons. As a consequence, the related emissions/removals of these LUC subcategories had to be revised.

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 update of the LUC areas from and to forest land based on the ARD NFI 2011/13. Thus the emissions/removals of the LUC categories to OL had to be revised for the whole time series.

Table 261: Derived land use changes for the subcategory 5.F for the period 1990 to 2012 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	419 098	59 137	18 134	NO	41 003	NO	NO
1991	446 607	385 612	60 995	19 104	NO	41 891	NO	NO
1992	442 817	379 964	62 852	20 073	NO	42 779	NO	NO
1993	447 998	383 288	64 710	21 043	NO	43 667	NO	NO
1994	433 369	367 748	65 621	21 066	NO	44 555	NO	NO
1995	432 316	366 169	66 147	20 704	NO	45 443	NO	NO
1996	418 020	351 347	66 674	20 343	NO	46 331	NO	NO
1997	413 348	346 149	67 200	19 981	NO	47 219	NO	NO
1998	419 491	351 765	67 726	19 619	NO	48 107	NO	NO
1999	414 854	346 152	68 703	19 708	NO	48 995	NO	NO
2000	418 138	350 070	68 068	19 796	NO	48 271	NO	NO
2001	434 695	367 263	67 433	19 885	NO	47 548	NO	NO
2002	450 898	384 229	66 669	19 844	NO	46 824	NO	NO
2003	465 371	399 466	65 905	19 804	NO	46 101	NO	NO
2004	486 159	421 924	64 234	18 857	NO	45 377	NO	NO
2005	478 333	415 769	62 564	17 910	NO	44 654	NO	NO
2006	475 046	414 153	60 893	16 963	NO	43 930	NO	NO

	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
2007	484 868	425 645	59 223	16 016	NO	43 207	NO	NO
2008	498 812	441 260	57 552	15 069	NO	42 483	NO	NO
2009	492 345	436 436	55 908	14 148	NO	41 760	NO	NO
2010	485 503	430 419	55 084	13 324	NO	41 760	NO	NO
2011	474 914	420 655	54 259	12 499	NO	41 760	NO	NO
2012	472 271	418 837	53 435	11 675	NO	41 760	NO	NO

Table 262: Emissions/removals from land use changes to Other Land for the period 1990 to 2012 in Gg CO_2.

	5.F.2. Land converted to Other land	5.F.2.1 Forest land converted to Other land	5.F.2.2 Cropland converted to Other land	5.F.2.3 Grassland converted to Other land	5.F.2.4 Wetland converted to Other land	5.F.2.5 Settlement converted to Other land
1990	451	444	NO	7.0	NO	NO
1991	460	454	NO	6.2	NO	NO
1992	469	463	NO	5.4	NO	NO
1993	477	473	NO	4.6	NO	NO
1994	477	473	NO	3.8	NO	NO
1995	378	375	NO	3.0	NO	NO
1996	374	371	NO	2.2	NO	NO
1997	369	368	NO	1.4	NO	NO
1998	365	364	NO	0.6	NO	NO
1999	365	365	NO	-0.2	NO	NO
2000	366	366	NO	0.5	NO	NO
2001	368	367	NO	1.1	NO	NO
2002	336	334	NO	1.8	NO	NO
2003	338	335	NO	2.4	NO	NO
2004	330	327	NO	3.1	NO	NO
2005	323	319	NO	3.7	NO	NO
2006	315	311	NO	4.4	NO	NO

	5.F.2. Land converted to Other land	5.F.2.1 Forest land converted to Other land	5.F.2.2 Cropland converted to Other land	5.F.2.3 Grassland converted to Other land	5.F.2.4 Wetland converted to Other land	5.F.2.5 Settlement converted to Other land
2007	308	303	NO	5.0	NO	NO
2008	300	295	NO	5.7	NO	NO
2009	217	211	NO	6.3	NO	NO
2010	210	203	NO	6.3	NO	NO
2011	202	196	NO	6.3	NO	NO
2012	194	188	NO	6.3	NO	NO

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 and ARD NFI. 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 263). 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 263: Carbon content of living biomass and soil of other land.

	ha	biomass t C ha^{-1}	soil t C ha^{-1}
glacier bolder	**109 200**	0	0
unproductive area	**168 900**		
alpine Urweiden	56 300	8.2	99.6
Schutt-Felsvegetation	56 300	0.4	13.3
Schneetälchengesellschaften	18 000	0.9	14.3
Spalierstrauch	18 800	7.6	83.6
Kahlflächen	18 700	0	0
other unmanaged alpine grassland[1)]	**243 200**	20.7	119

[1)] *not forest land and not grassland*

According to the share of the different land use areas (glaciers and bolder. types of unproductive areas) in the category other land and the related C stocks per ha in biomass (see Table 263) 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 263 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 263) 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. Based on the new assessment of the ARD NFI 2011/13 the activity data and emission factors for land use changes from forest to other land were revised for the whole time series. The area in conversion status from forest land to other land for a time period of 20 years ranges from 11 675 ha to 21 066 ha in the years 1990 to 2012 causing annual emission rates due to the loss of biomass and C stock changes in soil and litter from 188 Gg CO_2 to 473 Gg CO_2.

Changes in carbon stocks in biomass of forest land converted to other land

For the calculation of the annual change in carbon stocks of living biomass of forest land converted to other land the IPCC Tier 3 approach is used (see Chapter 7.2.4.2).

The annual emission rates due to the loss of biomass on areas of land use change from forest land to other land range from 32 to 158 Gg CO_2 in the years 1990–2012.

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 stratified according to five forest growth regions. The stratified LUC areas and C stocks according to these growth regions were used for the estimates. The method is described in Chapter 7.2.4.2.

The annual emission rates due to C stock changes in litter range from 21 to 96 Gg CO_2 in the years 1990–2012.

The annual emission rates due to C stock changes in mineral soils range from 135 to 220 Gg CO_2 in the years 1990–2012.

7.7.4.1.4 Grassland converted to Other Land (5.F.2.3)

An update of the LUC areas to/from FL and between CL and GL led also to different LUC lands GL to OL due to area consistency reasons in the GL category. As a consequence, the related emissions/removals of this LUC subcategory had to be revised. The area in conversion status from grassland to other land for a time period of 20 years ranges from 41 003 ha to 48 995 ha in the years 1990 to 2012 causing annual emission/removal rates from 7.0 Gg CO_2 to −0.2 Gg CO_2.

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 grassland 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 rates due to the loss of biomass on areas of land use change from grassland land to other land range from 16.3 to 11.0 Gg CO_2 in the years 1990–2012.

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 9.3 Gg CO_2 to 11.1 Gg CO_2 in the years 1990–2012.

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 239. For the area of LUC from GL to OL triangle distributions were defined.

The uncertainties of the emission factors were given in the Chapter 7.2.5, Table 240 and Chapter 7.3.5, Table 250. 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 CO_2 to 1 659 Gg CO_2[88]. Higher values were found for the 90ies where the input data had a lower accuracy. Expressed in % of the total emissions of the other land category, the uncertainty lies between 346 and 537%. 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

The areas of the LUC subcategory FL to OL were changed on basis of the ARD assessment that was finalised in 2013. Also the biomass stock changes and dead wood stock changes at these LUC lands were measured accurately during this assessment. So, the emission estimates for this subcategory and for the whole time series changed on basis of these new activity data and emission factors.

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[88] It should be noted that due to the design of the NFI changes in forest biomass stock also include the biomass changes due to LUC to and from forests. As a consequence, the estimates of the overall uncertainty of biomass changes at all forest lands and lands with LUC to and from forests were carried out in the FL sector. For this reason the absolute values of the uncertainties of the single LULUCF subcategories cannot be compared with the reported emissions/removals of the individual subcategories, but as an approximation the relative uncertainties of the subcategories can be compared with the related emissions/removals. For the totals of the LULUCF sector the uncertainty is of course consistent with its emissions/removals.

An update of these LUC areas to/from forests and between CL and GL led also to different LUC lands GL to OL due to area consistency reasons in the GL category. As a consequence, the related emissions/removals of the LUC subcategory GL to OL had to be revised.

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 (CH_4), carbon dioxide (CO_2) and nitrous oxide (N_2O) emissions.

8.1.1 Emission trend

Overall greenhouse gas emissions from waste management and treatment activities during the year 2012 amounted to 1 657 Gg CO_2 equivalent (1990: 3 587 Gg CO_2 equivalent). These are about 2.1% of total greenhouse gas emissions in Austria in 2012 and 4.6% in the base year. In 2012, greenhouse gas emissions from the waste sector were 53.8% below the level of the base year.

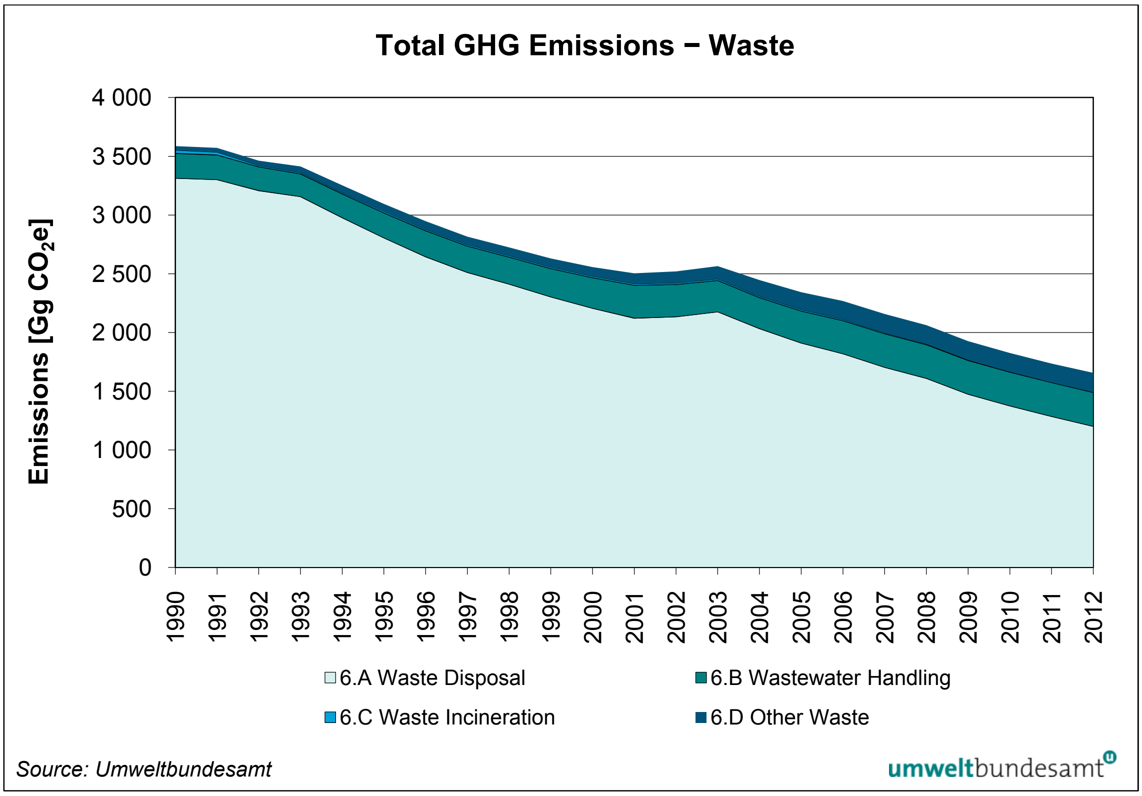

Figure 36: GHG emissions from waste 1990–2012.

Table 264 presents the emission trend by GHG. The major greenhouse gas emitted from this sector is CH_4, which represents 77.2% of all emissions from this sector in 2012, followed by N_2O (22.7%) and CO_2 (0.1%).

CH_4 emissions

CH_4 emissions from the Waste sector amounted to 1 279 Gg CO_2 equivalent in 2012; this was 62.7% below the level of the base year. CH_4 emissions originate from all subcategories within the sector, but the largest source is *6.A Solid Waste Disposal on Land*. 93.9% of total CH_4 emissions from this sector are attributable to this subcategory.

The decrease of CH_4 emissions is a result of waste management policies. The amount of landfilled waste decreased significantly, the organic fraction within these waste decreased as well and methane recovery systems have increasingly been implemented during the period, reducing the amount of methane emitted. Furthermore, the decrease of inhabitants connected to septic tanks or cesspools contributed to the reduction of CH_4 emissions.

N_2O emissions

N_2O emissions from the waste sector increased remarkably over the considered period. In 2012, N_2O emissions from the Waste sector amounted to 376 Gg CO_2 equivalent. This was 182.2% above the level of the base year.

About 70.8% of N_2O emissions from the waste sector originated from waste water handling and about 29.2% 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 N_2O emissions.

CO_2 emissions

CO_2 emissions from waste decreased by 92.4% compared to the base year and amounted to 2.03 Gg CO_2 equivalent in 2012.

CO_2 emissions originate from waste incineration (municipal solid waste, waste oil and hospital waste). The only plant incinerating municipal waste without energy recovery was shut down in 1991, which resulted in a drop of CO_2 emissions from 1991–1992. The decrease in emissions since 2005 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 264: Greenhouse gas emissions from sector waste by gas.

	CO_2	CH_4	N_2O	Total
	[Gg]		[Gg CO_2 e]	
1990	26.89	3 427.11	133.28	3 587.28
1991	23.40	3 415.04	133.49	3 571.93
1992	10.86	3 320.77	132.30	3 463.94
1993	10.60	3 270.24	134.11	3 414.94
1994	10.65	3 090.54	153.05	3 254.24
1995	10.97	2 916.05	169.44	3 096.47
1996	11.30	2 749.73	187.64	2 948.66
1997	11.62	2 608.26	196.80	2 816.67
1998	11.94	2 502.30	211.80	2 726.05
1999	12.26	2 389.52	229.69	2 631.47
2000	12.26	2 288.40	257.51	2 558.17
2001	12.26	2 203.43	288.42	2 504.11

	CO_2	CH_4	N_2O	Total
	[Gg]		[Gg CO_2 e]	
2002	12.26	2 213.41	296.03	2 521.70
2003	12.26	2 253.34	300.42	2 566.02
2004	12.26	2 116.72	318.21	2 447.19
2005	12.26	1 994.51	337.92	2 344.70
2006	10.15	1 901.61	357.05	2 268.81
2007	8.12	1 786.60	364.34	2 159.06
2008	6.09	1 689.59	367.17	2 062.84
2009	4.06	1 553.50	370.04	1 927.59
2010	2.03	1 452.26	372.13	1 826.42
2011	2.03	1 362.41	372.51	1 736.95
2012	2.03	1 278.85	376.12	1 657.00
Trend 1990-2012	***−92.4%***	***−62.7%***	***182.2%***	***−53.8%***

Emission trends by sub categories

Table 265 presents the greenhouse gas emissions by subcategories of waste. As can be seen, the dominant sub-category is *6.A Solid waste disposal on land*. In 2012, this category contributed 72.5% to total greenhouse gas emissions from the waste sector.

Table 265: Greenhouse gas emissions from sector waste by subcategories.

Year	6.A	6.B	6.C	6.D	Total
			[Gg CO_2 e]		
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	284.94	8.15	161.54	2 159.06
2008	1 609.75	286.84	6.11	160.15	2 062.84
2009	1 475.13	287.02	4.07	161.37	1 927.59
2010	1 375.96	287.21	2.04	161.21	1 826.42
2011	1 286.19	288.15	2.04	160.57	1 736.95
2012	1 201.09	289.45	2.04	164.43	1 657.00
Trend 1990–2012	***−63.8%***	***37.0%***	***−92.5%***	***375.6%***	***−53.8%***

8.1.2 Key Categories

Methodology and results of the key category analysis is presented in Chapter 1.5. Table 266 summarizes the key categories in the waste sector.

Table 266: 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_2O	LA 2012; TA

LA = Level Assessment (if not further specified – for the years 1990 and 2012)

TA = Trend Assessment BY–2012

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 obliged[89] 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 2007) for the sub-categories solid waste disposal on land and wastewater handling are provided (see respective subchapters).

8.1.6 Recalculations

Recalculations have been made for all subcategories due to availability of new input data. For further information please refer to the respective subchapters.

8.1.7 Completeness

Table 267 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.

[89] According to § 41 (1) Landfill Ordinance

Table 267: Overview of subcategories of Category Waste: transformation into SNAP Codes and status of estimation.

IPCC Category	SNAP	CO_2	CH_4	N_2O
6.A SOLID WASTE DISPOSAL ON LAND				
6.A.1 Managed Waste Disposal	090401 Solid Waste Disposal on Land	NA	✓	NA
6.A.2 Unmanaged Waste*) Disposal	090402 Unmanaged Waste Disposal	NO	NO	NO
6.B WASTEWATER HANDLING				
6.B.1 Industrial Wastewater	091001 Wastewater treatment in industry	NA	NA	✓
6.B.2 Domestic and Commercial Wastewater	091002 Wastewater treatment in residential/commercial sect.	NA	✓	✓
6.C WASTE INCINERATION				
	090201 Incineration of domestic or municipal waste	✓	✓	✓
	090207 Incineration of hospital wastes	✓	✓	✓
	090208 Incineration of waste oil	✓	NA	✓
6.D OTHER WASTE				
	091003 Sludge spreading**)	IE	IE	IE
	091005 Compost production	NA	✓	✓

**) In Austria all waste disposal sites are managed*

8.2 Managed waste disposal on land (CRF Category 6.A.1)

8.2.1 Source Category Description

Emissions: CH_4

Key Source: Yes

In the year 2012 emissions from solid waste disposal contributed 72.5 % to greenhouse gas emissions from sector Waste and 1.5 % to total greenhouse gas emissions in Austria. From 1990 to 2012 greenhouse gas emissions from this source decreased by 63.8% (see Table 271)

In the Austrian inventory two main categories of waste are distinguished: residual waste and non-residual waste. Residual waste refers only to the part of municipal solid waste[90] collected by the municipal system (mixed composition) that is directly deposited without any pre-treatment. Non-residual waste comprises among others municipal solid waste having been pre-treated, sludge from wastewater treatment and waste from industrial sources.

[90] i.e. waste from households as well as other waste which, because of its nature or composition, is similar to waste from household (Article 2 (b): Council Directive 1999/31/EC of 26 April 1999 on the landfill of waste).

It has to be noted that from 2009 on no waste is allowed to be deposited any more without being pre-treated (due to the Landfill Ordinance[91]), so since 2009 no disposal of 'residual waste' is reported by landfill operators and therefore no new and additional amount of residual waste is taken into account in the inventory. Emissions from this subcategory are therefore only affected by waste deposited before 2009. Waste from households and similar sources covered by the municipal waste collecting system but undergoing a pre-treatment before deposition is not included in this category, but in category 'non-residual waste' (sub-category 'sorting residues', among others from mechanical-biological treatment) and in sector 'energy' respectively, as incineration is a pre-treatment option too.

'Residual waste' corresponds to waste:

- originating from private households and similar sources (administrative facilities of commerce, industry and public administration, kindergartens, schools, hospitals, small enterprises, agriculture, market places and other generation points)
- remaining after separation of paper, glass, plastic etc. at the source
- covered by the municipal waste collecting system
- directly landfilled without having passed any pre-treatment

'Non residual waste'

- comprises pre-treated waste from households (e.g. sorting residues from mechanical-biological treatment) and waste with biodegradable lots from other (industrial) sources
- is divided into the categories wood, construction waste, paper, green waste, sludge, sorting residues/stabilized material (incl. bulky waste), textiles and fats

Stabilized material and sorting residues remaining after mechanical, biological and mechanical-biological treatment and bulky waste are the main fraction deposited. Other fractions deposited are sludge and construction waste. Bio waste, paper and wood are mainly composted, recycled or reused (due to the implementing of the Waste Management Law), fat and textiles are not deposited any more (see Table 272). It has to be noted that from 2009 on no waste with high organic content is allowed to be deposited any more without being pre-treated (due to the Landfill Ordinance).

Table 268 presents a summary of all considered waste types and the corresponding identification numbers (list of waste).

[91] Ordinance on Landfills (Landfill Ordinance 2004), Federal Law Gazette No 164/1996 as amended by Federal Law Gazette No 49/2004; Ordinance on Landfills (Landfill Ordinance 2008), Federal Law Gazette II No 39/2008 as amended by Federal Law Gazette II No 185/2009

Table 268: Considered types of waste (list of waste[92] 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		

The following picture shows the main streams of treatment and disposal of waste from households and similar sources. It also aims to transparently show the distinction between residual and non-residual waste (with regard to municipal solid waste[93]) and to demonstrate that all relevant activity data are taken into account in the inventory.

[92] 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

[93] In fact non-residual waste also comprises waste from other (industrial) sources.

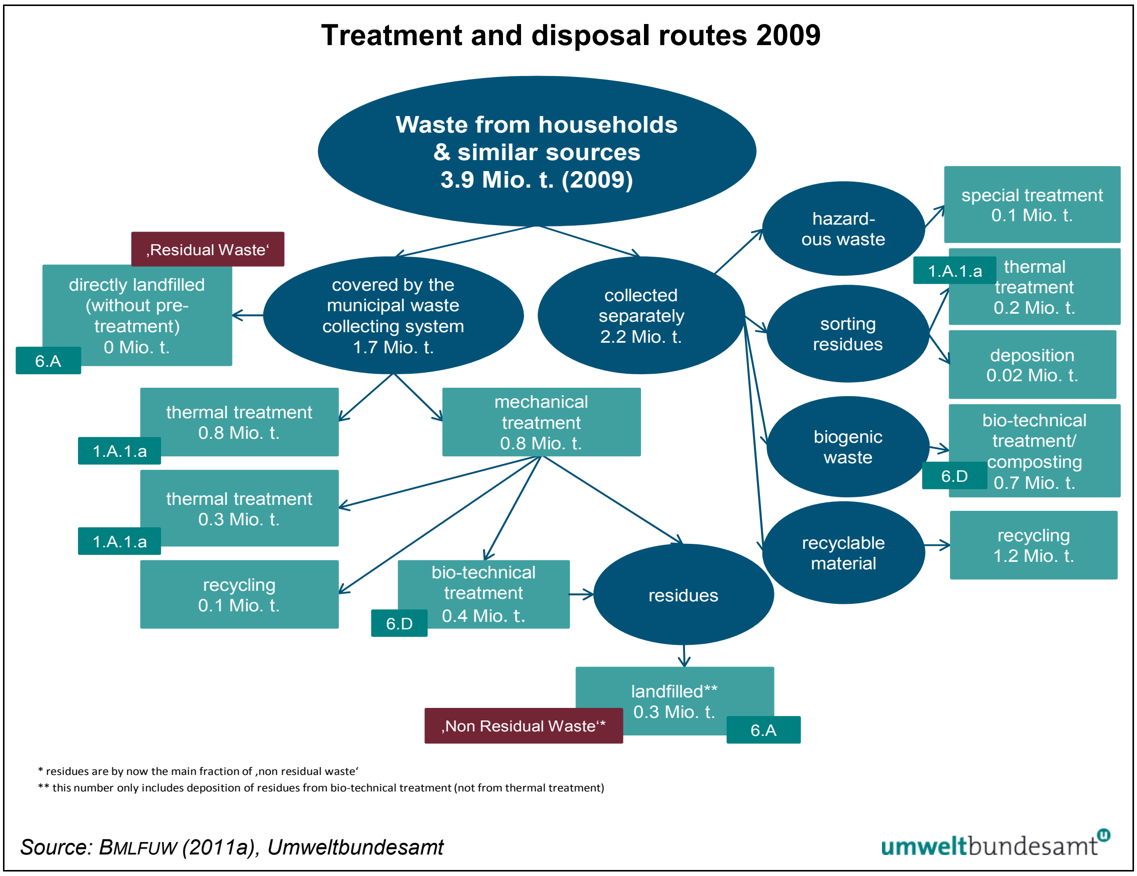

Figure 37: Waste from households and similar sources – treatment and disposal routes 2009.

Almost 100% of waste from households and similar sources is incinerated, recycled or treated mechanical-biologically. In 2009 only sorting residues from potentially recyclable material collected separately (0.4% of total waste from households and similar sources) were directly deposited.

Table 269: Recycling and treatment of waste from households and similar sources.

Treatment	1989[1)]	1999[3)]	2004[3)]	2006[4)]	2008[5)]	2009[6)]	2010[7)]
bio-technical treatment	16.7%[2)]	6.3%	11.2%	17.9%	8.8%	10.4%	8.5%
thermal treatment (incineration)	5.9%	14.7%	28.3%	23.7%	34.7%	36.4%	40.2%
treatment in plants for hazardous waste	0.4%	0.8%	1.2%	1.8%	2.3%	2.4%	2.5%
recycling	12.9%	34.3%	35.6%	34.8%	32.3%	31.7%	30.7%
bio-technical treatment/composting	1.0%	15.4%	16.0%	17.9%	18.2%	18.7%	17.7%
direct deposition at landfills	63.1%	28.5%	7.7%	3.8%	3.7%	0.4%[*)]	0.4%

1) *Federal Waste Management Plan (BMLFUW 2001)*

2) *This value also includes plants used in the past to reduce odour emissions.*

3) *Federal Waste Management Plan (BMLFUW 2006a)*

4) *Annual update (2008) of the Federal Waste Management Plan (BMLFUW 2006a)*

5) *Annual update (2009) of the Federal Waste Management Plan (BMLFUW 2006a)*

6) *Federal Waste Management Plan (BMLFUW 2011a)*

7) *Annual update (2012) of the Federal Waste Management Plan (BMLFUW 2011a)*

*) *solely sorting residues from potentially recyclable material collected separately.*

In Austria all waste disposal sites are managed sites. Only landfills for mass waste contain relevant organic material and are hence sources of CH_4 emissions. All other landfill types are not relevant for GHG emissions.

Table 270: Number and type of landfill sites

Landfill type	2002	2003	2004	2005	2006	2007	2008	2010
Mass waste landfills	61	62	58	50	54	53	46	34
Residual waste landfills*)	18	23	30	27	29	31	40	42
Construction and demolition waste landfills	64	63	124	74	84	87	90	82
Excavated soil material landfills	108	211	454	340	376	377	475 **)	n.a. ***)

*) *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). „Residual waste" has to be disposed of on mass waste landfills.*

**) *In this number inert waste landfills are included*

***) *data on the number of excavated soil material landfills is not available as has not to be collected/reported any more from 2009 on pursuant to EU Waste Statistics Regulation (No. 2150/2002)*

In the inventory waste amounts deposited from 1950 onwards are taken into account. 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[94] 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.

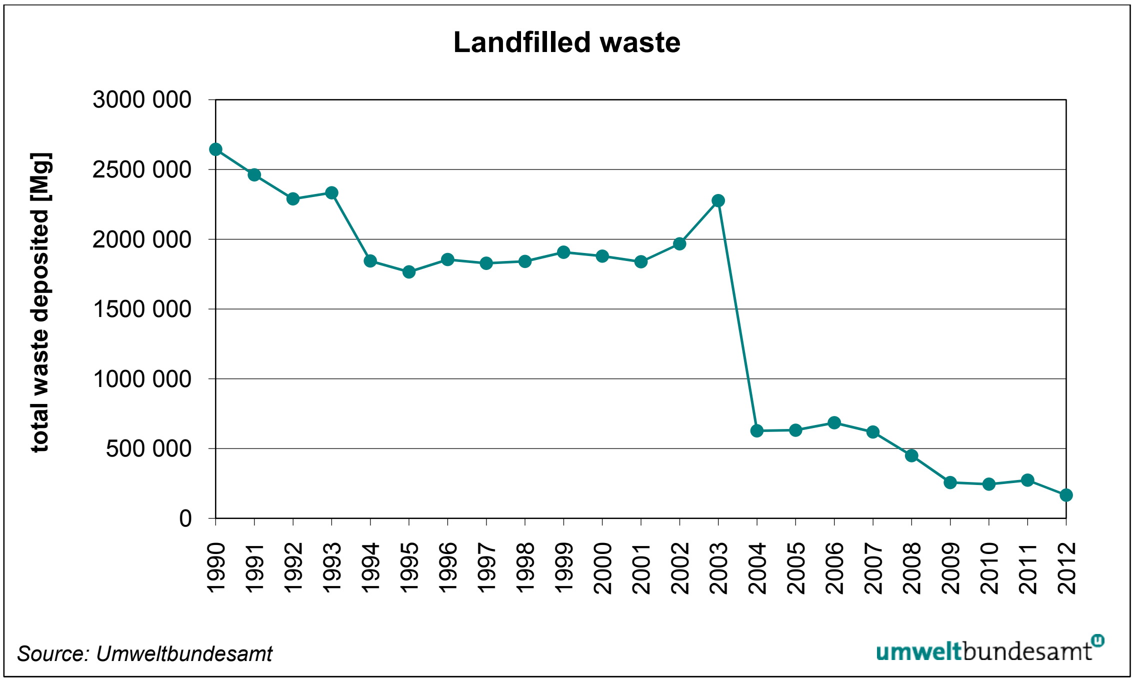

Figure 38: Waste ('residual waste' and 'non-residual waste') with a relevant share of degradable organic carbon (deposited on mass waste landfills), period 1990–2012.

[94] Law on the Remediation of Contaminated Sites (1989), Federal Law Gazette No 299/1989 as amended

Waste management was regulated by the Austrian Waste Management Law[95] (1990). As a result, waste separation and reuse and recycling activities increased and the amounts of deposited waste decreased significantly until 1994.

The amount of deposited waste peaked once more in 2003 due to the remediation of contaminated sites 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 Ordinance[96], which – apart from some exemptions[97] – prohibits the disposal of untreated waste in Austria from 2004 on and therefore leads to reduced waste volumes as well as decreased carbon content in deposited waste.

Since beginning of 2009 no waste is allowed to be deposited any more without being pre-treated (Landfill Ordinance).

8.2.2 Methodological Issues

For the emissions calculation the IPCC Tier 2 (FOD) 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

The quantities of 'residual waste' have been taken from the following sources:

- Data for 2008–2012 have been taken from the EDM[98], an electronic database administered by the BMLFUW and delivering data as input to the national Federal Waste Management Plan. 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[100].
- Data for 1998–2007 were taken from a database for solid waste disposals called „Deponiedatenbank" ('Austrian landfill database'), a database administered and maintained by the Umweltbundesamt until the end of 2008.
- Data for 1950–1997 on the amounts of deposited residual waste were taken from national studies (HACKL & MAUSCHITZ 1999, UMWELTBUNDESAMT 2001c) and the respective Federal Waste Management Plans (BMLFUW 1995, BMLFUW 2001).

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[95] Waste Management Act of 2002, Federal Law Gazette I No 102/2002 as amended by Federal Law Gazette I No 9/2011

[96] Ordinance on Landfills (Landfill Ordinance 2004), Federal Law Gazette No 164/1996 as amended by Federal Law Gazette No 49/2004; Ordinance on Landfills (Landfill Ordinance 2008), Federal Law Gazette II No 39/2008 as amended by Federal Law Gazette II No 185/2009

[97] Under certain circumstances there were some exceptions to this pre-treatment-obligation granted to some Austrian provinces (regulated in § 76 Abs. 7 AWG 2002). In four of the nine Austrian provinces it was still allowed to deposit waste directly without any pre-treatment until the end of 2008.

[98] Electronic Data Management

[99] According to § 41 (1) Landfill Ordinance, Federal Law Gazette No 39/2008

[100] According to §41 (1) Landfill Ordinance, Federal Law Gazette No 39/2008

In the national study (HACKL & MAUSCHITZ 1999) as well as in the Federal Waste Management Plans the amounts of residual waste from administrative facilities of businesses and industries were not considered and therefore originally not included in the data of the years 1950 to 1999. Waste from these sources is however deposited and hence reported by the operators of landfill sites (therefore included in the Austrian landfill database) and thus considered in the time series from 1998 onwards. To achieve a consistent time series, data of the two overlapping years[101] (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.

The quantities of 'non residual waste' of the years 1998–2007 were taken from the database for solid waste disposal ('Deponiedatenbank', 'Austrian landfill database'), data for 2008–2012 have been taken from the EDM (Electronic Data Management). Only the types 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 271 presents activity data and CH_4 emissions from managed waste disposal on land for the period 1990–2012.

Table 271: Activity data for 'residual waste' and 'non residual waste', greenhouse gas emissions and implied emission factors 1990–2012.

Year	Non Residual Waste	Residual Waste	Total Waste		CH_4 Emissions		IEF CH_4
	[Mg/a]	[Mg/a]	[Mg/a]	inter-annual change [%]	[Mg/a]	inter-annual change [%]	[Mg/Mg]*
1990	648 702	1 995 747	2 644 448		157 822		0.06
1991	661 676	1 799 718	2 461 394	-6.9%	157 234	-0.4%	0.07
1992	674 909	1 614 157	2 289 067	-7.0%	152 772	-2.8%	0.07
1993	688 407	1 644 718	2 333 126	1.9%	150 349	-1.6%	0.07
1994	702 175	1 142 067	1 844 242	-21.0%	141 803	-5.7%	0.08
1995	716 219	1 049 709	1 765 928	-4.2%	133 614	-5.8%	0.08
1996	730 543	1 124 169	1 854 713	5.0%	125 978	-5.7%	0.08
1997	745 154	1 082 634	1 827 788	-1.5%	119 596	-5.1%	0.08
1998	760 057	1 081 114	1 841 171	0.7%	114 851	-4.0%	0.07
1999	822 179	1 084 625	1 906 804	3.6%	109 676	-4.5%	0.07
2000	826 874	1 052 061	1 878 935	-1.5%	105 050	-4.2%	0.07
2001	772 786	1 065 592	1 838 378	-2.2%	101 083	-3.8%	0.07
2002	792 753	1 174 543	1 967 296	7.0%	101 641	0.6%	0.06
2003	890 640	1 385 944	2 276 584	15.7%	103 616	1.9%	0.05
2004	344 747	282 656	627 403	-72.4%	96 840	-6.5%	0.18
2005	389 660	241 733	631 393	0.6%	91 002	-6.0%	0.17

[101] Data available from the Federal Waste Management Plan (Bundesabfallwirtschaftsplan - BAWP) as well as from the Austrian landfill database.

Year	Non Residual Waste	Residual Waste	Total Waste		CH_4 Emissions		IEF CH_4
	[Mg/a]	[Mg/a]	[Mg/a]	inter-annual change [%]	[Mg/a]	inter-annual change [%]	[Mg/Mg]*
2006	425 091	260 068	685 159	8.5%	86 626	-4.8%	0.15
2007	464 109	154 517	618 626	-9.7%	81 163	-6.3%	0.15
2008	319 927	129 324	449 251	-27.4%	76 655	-5.6%	0.19
2009	256 340	0	256 340	-42.9%	70 244	-8.4%	0.32
2010	244 786	0	244 786	-4.5%	65 522	-6.7%	0.31
2011	273 313	0	273 313	11.7%	61 247	-6.5%	0.25
2012	166 263	0	166 263	-39.2%	57 195	-6.6%	0.39

* *IEF calculated on basis of gross CH_4 emissions: (CH_4 emissions + CH_4 recovery) / MSW*

CH_4 emissions are affected by volumes as well as composition of deposited waste. Significant changes in volumes happened between 1993 and 1994 or 2003 and 2004. In addition to changes of the waste composition, this resulted in declining emissions. However, CH_4 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 therefore emissions are strongly affected by historical depositions (since 1950). Since 1990 less than 10% of the annual emissions stem from the waste deposited in the respective year, and more than 90% from waste deposited in previous years.

From 1990 to 2012 the waste volume deposited per year has been reduced by 94%. The lower the annual amounts of waste deposited the higher becomes the share of emissions stemming from waste deposited in previous years. The smaller the annual amount of waste deposited, the larger the IEF and vice versa. E.g. in 1990 2 644 448 Mg waste were deposited resulting in an IEF of 0.06 Mg CH_4/Mg waste, whereas in 2012 only 166 263 Mg were landfilled resulting in an IEF of 0.4 Mg CH_4/Mg waste.

The reason for the inter-annual IEF fluctuations is that emissions are quite constantly decreasing over time (except 2002 and 2003; see respective column "inter-annual change [%]" in Table 271) whereas activity data (volume of waste deposited) develop comparatively heterogenously, showing partly sharp decreases (e.g. 2003−2004, 2008−2009[102] and 2011-2012) partly also increases (e.g. 2005-2006 or 2010−2011). This is in general the reason for e.g.:

- the very strong increases of the IEF 2003–2004 (more than threefold), 2008−2009 (+62%) and 2011-2012 (+52%), attributable to the sharp decreases of activity data (2003-2004: −72%; 2008-2009: −43%; 2011-2012: −39%)
- the significant decreases of the IEF 2005-2006 (−13%) and 2010-2011 (−17%), due to the increases of activity data (2005-2006: +8.5%; 2010-2011: +12%)

Inter annual changes of the waste composition are also reflected in the calculated CH_4-emissions. As shown in Table 272 the DOC values change only very slightly between different years. Consequently the change of the waste composition has no significant impact on the considerable changes of the IEF.

The following table shows how the composition of waste deposited changes over time and that non-residual waste fractions with high DOC (such as wood, paper, bio-waste) and 'residual waste' composed of partly high organic contents – see Table 274) play no major role any more.

[102] implementation of the Landfill Ordinance

Table 272: Composition of deposited waste – shares of 'residual waste' and 'non residual waste' fractions 1990–2012 and weighted average of the carbon content (DOC) of the various components of the waste stream.

	residual waste	**non residual waste**								**all waste categories**	
	mixed	**wood**	**paper**	**sludges**	**sorting residues**	**bio-waste**	**textiles**	**constr uction waste**	**fats**	**DOC/L_0 by weight**	
	Share in total waste amount deposited [%]									**DOC**	**L_0**
1990	75.5%	0.5%	1.6%	4.9%	15.5%	0.8%	0.1%	1.2%	0.0%	0.191	0.0822
1995	59.4%	0.8%	2.6%	8.1%	25.7%	1.3%	0.1%	1.9%	0.0%	0.155	0.0659
2000	56.0%	0.4%	1.7%	5.5%	32.5%	0.8%	0.2%	3.0%	0.0%	0.142	0.0602
2001	58.0%	0.3%	2.4%	6.3%	28.7%	1.3%	0.2%	3.0%	0.0%	0.147	0.0623
2002	59.7%	0.3%	1.6%	6.7%	29.1%	0.7%	0.2%	1.7%	0.0%	0.152	0.0644
2003	60.9%	0.3%	1.6%	15.9%	19.0%	1.0%	0.1%	1.1%	0.0%	0.153	0.0649
2004	45.1%	0.8%	0.0%	11.3%	40.0%	0.5%	0.0%	2.3%	0.0%	0.157	0.0660
2005	38.3%	0.3%	0.1%	1.4%	57.2%	0.1%	0.0%	2.6%	0.0%	0.161	0.0671
2006	38.0%	0.7%	0.7%	1.2%	55.9%	0.3%	0.0%	3.2%	0.0%	0.163	0.0679
2007	25.0%	0.7%	0.2%	1.0%	70.6%	0.1%	0.0%	2.3%	0.0%	0.162	0.0669
2008	28.8%	0.0%	0.4%	1.6%	68.4%	0.0%	0.0%	0.8%	0.0%	0.162	0.0670
2009	0.0%	0.0%	0.0%	1.9%	97.9%	0.0%	0.0%	0.1%	0.0%	0.159	0.0641
2010	0.0%	0.0%	0.0%	0.8%	99.0%	0.0%	0.0%	0.2%	0.0%	0.160	0.0644
2011	0.0%	0.0%	0.0%	0.8%	98.9%	0.0%	0.0%	0.2%	0.0%	0.159	0.0643
2012	0.0%	0.0%	0.0%	1.9%	98.0%	0.0%	0.0%	0.1%	0.0%	0.159	0.0641

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 273: Parameters for calculating CH_4 emissions of SWDS.

Waste category/ Parameters	**residual waste**	**wood**	**paper**	**sludges**	**Sorting residues/output MBT[103]/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.								
DOC	See Table 275	0.45	0.3	0.11	0.16	0.16	0.5	0.09	0.2
	(HACKL & MAUSCHITZ 1999) (UMWELTBUNDESAMT 2003) (BMLFUW 2006a)	(BAUMELER et al. 1998)							
L_0[1)]	See Table 275	0.165	0.121	0.444	0.065	0.064	0.202	0.034	0.113
Half life period	7	25	15	7	20	10	15	20	4
	National waste experts	(GILBERG et al. 2005)	(GILBERG et al. 2005)	Assumption: same as residual waste	IPCC default slow decay	Assumption: similar to paper	Assumption: same as paper	IPCC default slow decay	(GILBERG et al. 2005)
Number of considered years[2)]	41	63	63	41	63	50	63	63	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 40 (UMWELTBUNDESAMT 2004d, 2008c, 2013b)								

[1)] *L_0 is calculated for each waste category using the following equation and taking into account waste type specific parameters: $L_0 = [MCF(x) * DOC(x) * DOC_F * F * 16/12$ (Gg CH_4/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).*

[103] MBT: **M**echanical-**b**iological **t**reatment

Biodegradable organic carbon (DOC)

The DOCs of the different waste categories under '**non residual waste'** are constant for the entire time series and are shown in Table 273. These categories are clearly defined (wood, paper, sludge, etc.) and can therefore be considered as quite 'homogenous'. Therefore there was no need to change the DOC over the years.

The DOC of '**residual waste'** has changed over the years in accordance with the changing composition due to the separate collection of biogenic waste, paper and cardboard, and glass, and the increase of food waste in recent years, etc.

For the year 1990 a DOC content of 200 g/kg residual waste was taken (UMWELTBUNDESAMT 2003)[104]. 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 content 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. Since 2009 no residual waste is allowed to be deposited anymore.

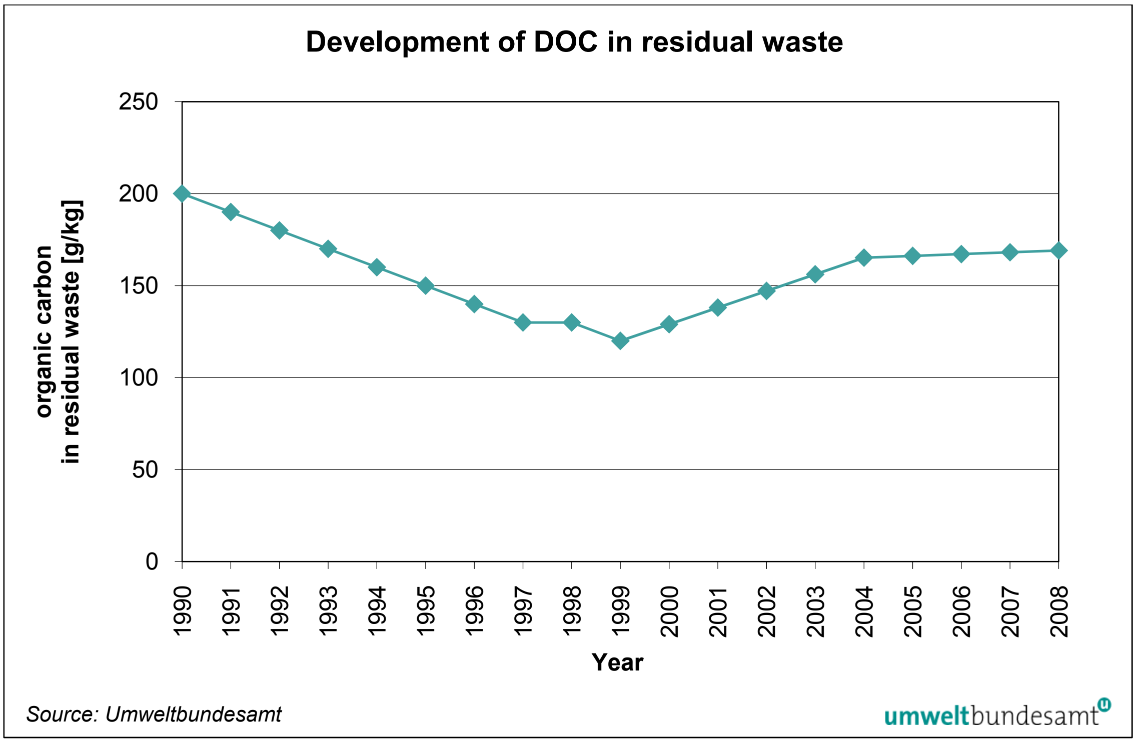

Figure 39: Development of DOC in residual waste.

[104] The values for the years before were taken from another national study (HACKL & MAUSCHITZ 1999).

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 especially of food waste in residual waste (as can be seen in Table 274).

Table 274: 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	22	18	14	14	11	12
Glass	8	6	4	3	5	4
Metal	5	4	4.5	5	3	3
Plastic	10	9	11	15	10	10
Composite materials	11	11	14	–	8	10
Textiles	3	3	4	4	6	6
Hygiene materials	–	–	–	12	11	8
Biogenic components	30	34	30	18	37	40
Hazardous household waste	1	2	1	0.3	2	1
Mineral components	7	8	4	–	4	3
Wood, leather, rubber, other components	2	4	1	3	1	–
Residual fraction	–	–	14	27	2	2

[1)] *(UMWELTBUNDESAMT 2003)*

[2)] *(BMLFUW 2006a)*

[3)] *Annual update (2009) of (BMLFUW 2006a)*

There is no need to update the DOC of residual waste any more as from 2009 on only pre-treated waste, referred to as non-residual waste, is allowed to be deposited. Hence, with regard to residual waste, only historical amounts and DOC values (as shown below) are relevant.

Table 275: Time series of bio-degradable organic carbon content and L_0 of residual waste (i.e. directly deposited)

Year	bio-degradable organic carbon [g/kg Waste (moist mass)]	L_0	Year	bio-degradable organic carbon [g/kg Waste (moist mass)]	L_0
1950–1959	240 1)	0.106	1998	130 2)	0.057
1960–1969	230 1)	0.101	1999	120 2)	0.053
1970–1979	220 1)	0.097	2000	129 *)	0.057
1980–1989	210 1)	0.092	2001	138 *)	0.061
1990	200 2)	0.088	2002	147 *)	0.065
1991	190 2)	0.084	2003	156 *)	0.069
1992	180 2)	0.079	2004	165 3)	0.073
1993	170 2)	0.075	2005	166 *)	0.073
1994	160 2)	0.070	2006	167 *)	0.074
1995	150 2)	0.066	2007	168 *)	0.074
1996	140 2)	0.062	2008	169 4)	0.074
1997	130 2)	0.057	2009–2012	n.r.**)	n.r.

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)*

***) not relevant (see introductory sentence to Table 275)*

Landfill gas recovery

In 2004, the Umweltbundesamt investigated the amount of annually collected landfill gas by questionnaires sent to landfill operators (UMWELTBUNDESAMT 2004d), 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 whereas in 2001 at all operating mass landfills landfill gas was collected.

In 2008 and 2013 further surveys were conducted (UMWELTBUNDESAMT 2008c, UMWELTBUNDESAMT 2013b) to get new data on collected landfill gas as well as information on its use from landfill operators. Results show that from 2002 on the amount of landfill gas recovered decreased (despite a consistent recovery practice) as a consequence of.

- the reduced carbon content of deposited waste and consequently reduced landfill gas production
- the slightly decreasing methane concentration in recovered landfill gas[105] – an effect that is due to the extensive capturing of landfill gas which can lead to the dilution of the landfill gas captured.

Compared to 2002 (maximum amount of landfill gas captured), landfill gas recovered decreased by 59% by 2012.

[105] a methane concentration of 55 % (default) is used for the estimation of the landfill gas **produced** ('F') over the whole time-series.

The consideration of the results of the new study (UMWELTBUNDESAMT 2013b) has led to – compared to the values used for submission 2013 that were based on a mean value of the recovery rate of the years 2002 to 2007 – lower amounts of landfill gas recovered for the years 2008-2011.

During the ICR 2013 the ERT questioned the assumption made on methane concentration in the recovered landfill gas to calculate the recovered CH_4. Unlike the methane concentration used for the years 2002-2007 (decreasing concentrations) this parameter was originally held constant for the subsequent years 2008 to 2011 (ARR 2013 para 67). Austria has taken in this submission the values for CH_4 recovery for 2008-2012 directly from the study (UMWELTBUNDESAMT 2013b). As these values already consider the (changing) methane concentration, no extra calculation had to be made and hence no assumptions are necessary any more.

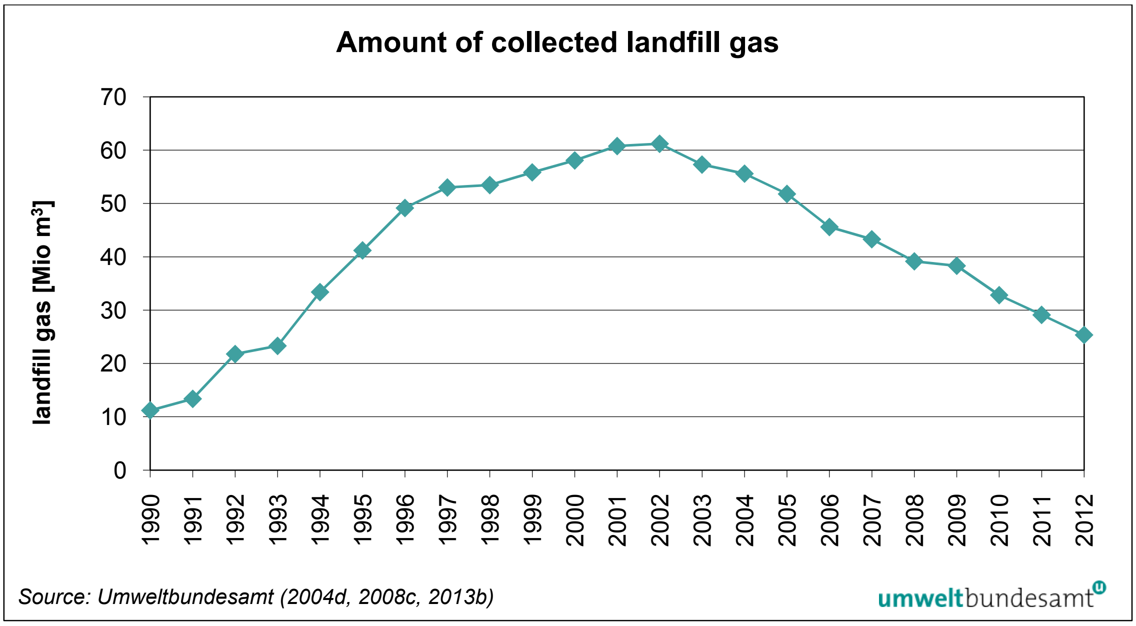

Figure 40: Amount of collected landfill gas 1990 to 2012.

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 2007).

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 (BMLFUW 2006a);
- emission factors, taking into account IPCC default values and national expert know-how on waste and landfills are used.

Table 276: Uncertainty assessment for managed waste disposal on land

	(WINIWARTER & RYPDAL 2000)	Expert judgement 2005 (WINIWARTER 2007)
Activity data	25%	12%
Emission factor	35%	25%

8.2.4 Recalculations

New data on the landfill gas recovery became available, leading to revised CH_4 emissions for 2008–2011. Based on a new study on landfill gas practice in Austria (UMWELTBUNDESAMT 2013b), less CH_4 is recovered and consequently more CH_4 emitted.

Table 277: Recalculations with respect to previous submission in category 'waste disposal on land'

Difference	2008	2009	2010	2011
CO_2e [Gg]	33.6	17.1	25.9	33.4
[%]	+2.1%	+1.2%	+1.9%	+2.7%

8.3 Wastewater Handling (CRF Source Category 6.B)

8.3.1 Source Category Description

Emissions: CH_4, N_2O

Key Source: Yes (N_2O)

In the year 2012, greenhouse gas emissions from wastewater handling contributed 17.5% to greenhouse gas emissions from sector Waste and 0.4% to total greenhouse gas emissions in Austria.

From 1990 to 2012 greenhouse gas emissions from this source increased by 37.0% 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 278: Greenhouse gas emissions from industrial as well as domestic and commercial wastewater treatment 1990–2012.

	6.B.2 Domestic and commercial wastewater		6.B.1 Industrial wastewater	Total
	CH_4 emissions [Gg]	N_2O emissions [Gg]	N_2O 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

	6.B.2 Domestic and commercial wastewater		6.B.1 Industrial wastewater	Total
	CH_4 emissions [Gg]	N_2O emissions [Gg]	N_2O emissions [Gg]	[Gg CO_2 equivalent]
1995	4.21	0.36	0.05	212.91
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	284.94
2008	1.29	0.66	0.18	286.84
2009	1.20	0.66	0.18	287.02
2010	1.10	0.67	0.19	287.21
2011	1.11	0.67	0.19	288.15
2012	1.11	0.67	0.19	289.45
Trend 1990–2012	***–77%***	***97%***	***1 352%***	***37%***

In 1990 about 59% of the population was connected to municipal sewage treatment plants. Since then the connection rate increased up to 94% in 2012. Consequently the use of septic tanks has declined and therefore CH_4 emissions decreased and N_2O emissions increased.

8.3.2 Methodological Issues

Wastewater treatment plants use aerobic procedures (resulting in N_2O emissions), whereas septic tanks are characterised by anaerobic conditions (resulting in CH_4 emissions). Further N_2O emissions occur when wastewater in a first step collected in septic tanks is then treated in waste water treatment plants or is partly released to the environment (percolation into the groundwater or application on agricultural soils).

Activity data

In the year 2010[106] 93.9% of the Austrian population was connected to municipal wastewater treatment plants. The remaining wastewater is treated either in septic tanks (3.8% of the Austrian population), domestic wastewater treatment plants (2.1%), or other disposal facilities, which are not further specified in the respective data sources ('unspecified disposal routes': 0.2%).

[106] the latest year for which data on connection rate is currently available

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 2006b, BMLFUW 2008, BMLFUW 2010, BMLFUW 2012). Data are available for the years 1971, 1981, 1991, 1995, 1998, 2001, 2003, 2006, 2008 and 2010. 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 derivation of the share (%) of inhabitants using septic tanks – a parameter necessary for the calculation of CH_4 emissions – had to be extrapolated from the year 2000 onwards.

8.3.2.1 CH_4 emissions

Domestic and commercial wastewater

Wastewater treatment in Austria mainly uses aerobic procedures (in 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.

For calculation, the share of population disposing via septic tanks is taken into account:

Table 279: Share of population using septic tanks (1991–2010).

1991	2001	2003	2006	2008	2010
17.8%	8.6%	6.8%	5.1%	4.4%	3.8%

CH_4 emissions from cesspools and septic tanks are calculated following the IPCC methodology:

$$CH_4\ Emissions = inhabitants_{[septic\ tanks]} * D_{dom} * EF * 365$$

Where:

inhabitants $_{[septic\ tanks]}$ *number of inhabitants not connected to sewage systems but disposing via septic tanks*

D_{dom} *degradable organic component (IPCC default – 60 g* BOD_5*/person/day)*

EF emission factor: $B_0 * MCF = 0.16$

B_0 *methane producing capacity (IPCC default: 0.6 kg* CH_4*/kg BOD)*

MCF methane conversion factor fraction (country specific: 0.27)

For the Methane Conversion Factor MCF a country specific approach is used, taking into account that the MCF is temperature dependent. The MCF defines the share of methane producing capacity (B_o) that degrades anaerobically and may vary between 0.0 (completely aerobic) to 1.0 (completely anaerobic).

(Gibbs & Woodbury 1993) identify a MCF of 100% at 30–40°C, a MCF of 35% at 20°C and a MCF of 10% at 10°C. Taking into account the temperature conditions in Austria (average temperature of 20°C for 8 months and 10°C for 4 months the year) the mean value for the whole year (0.27) has been calculated by (STEINLECHNER et al. 1994) as follows:

*MCF (mean value for whole year) = 0.35 * 2/3 + 0.10 * 1/3 = 0.27*

The MCF value has been validated by comparison with a study on 'Evaluation of Greenhouse Gas Emissions from Septic Systems' carried out by the Water Environment Research Foundation (WERF 2010), measuring emission rates of methane from septic tanks in California. According to the study, a MCF value of about 0.22 would be applicable for such systems[107]. As the measurements have been carried out under conditions (air temperatures) similar to the average temperature of Austria the results can directly be compared and the use of 0.27 be supported. Using a MCF of 0.22 is also supported by an article on 'Methane, carbon dioxide, and nitrous oxide emissions from septic tank systems' (Environmental Science & Technology 2011).

Sewage sludge treatment

In order to prevent uncontrolled putrefaction, the sludge is stabilized. In smaller facilities such a stabilization is usually carried out aerobically (open pool with oxygen input), in bigger plants stabilization is carried out anaerobically (in a digestion tower). Under aerobic conditions (stabilisation), only a negligible amount of methane emissions is produced. 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 CH_4 emissions respectively from both processes are therefore reported as „not applicable"[108].

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 *1.A*) or treated another way, in Austria mainly in composting plants or mechanical-biological treatment plants (included in *6.D*). Smaller amounts are put on agricultural soils (included in *4.D*). Small amounts are deposited after pre-treatment (included in *6.A*).

Industrial wastewater treatment

Industrial wastewater treatment and sewage sludge treatment is carried out under aerobic as well as anaerobic conditions. As CH_4 gas is usually used for energy recovery or is flared, the amount of CH_4 emissions from industrial wastewater treatment and sewage sludge treatment is negligible and therefore reported as 'not applicable'. In the energy sector sewage gas is considered as an energy source.

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[107] A MCF value of 0.22 was calculated using the mean methane emission value measured for the septic tanks from this project

[108] CH_4 emissions from domestic and commercial waste water handling reported in Table 6B solely refer to emissions from septic tanks and cesspools.

8.3.2.2 N_2O emissions

Domestic and commercial wastewater handling

N_2O emissions from domestic and commercial wastewater handling are calculated separately for wastewater arising from the population connected and the population not connected to the municipal sewage system. This approach was chosen because of a recommendation by the ERT during the in-country review of the initial report of Austria (February 2007).

N_2O emissions resulting from wastewater handling of the ***population not connected*** to the municipal sewage system were calculated according to the IPCC default method, as described in the Revised 1996 IPCC Guidelines. The data for the daily protein intake per person are taken from FAO statistics.

It should be noted that there has been a change in the FAO statistics. Data on the dietary protein consumption (g/person/day) is no longer available, instead FAO provides data on the protein supply quantity (g/capita/day), currently up to 2009. On request, the FAO explains this switch with the fact, that the definition of consumption is related to the food availability for human consumption rather than to the actual intake, which can only be measured by specific surveys. A comparison of data (historical data on protein intake with currently available data on protein supply) has shown only very slight differences (+/- 1–3 g), so historical data has not been changed and it was continued to take the value of 2007 as a proxy for 2008–2012. This also corresponds to the 2008 and 2009 data on protein supply as currently published by FAO[109], although it could be expected that the actual food consumption may be lower than the quantity shown as food availability is depending on the magnitude of wastage and losses of food.

The number of inhabitants is provided by STATISTIK AUSTRIA. The emission factor (0.01) and the fraction of nitrogen in protein (0.16) are IPCC default values.

N_2O emissions arising in waste water treatment plants (i.e. emissions from the ***population connected*** to the municipal sewage system) are calculated by using a country-specific method based on IPCC. According to a national study (ORTHOFER et al. 1995), in addition to the amount of wastewater treated in sewage plants, the amount of nitrogen that is denitrificated is considered. This approach better reflects Austrian circumstances with advanced centralized wastewater treatment plants with denitrification steps. Denitrification is obligatory in Austria for municipal waste water treatment plants (the waste water emission ordinance for municipal waste water treatment plants with an organic design capacity larger than 5 000 population equivalents[110] 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 only 10% of the nitrogen was denitrificated. In 2010 this value has increased to 80% (BMLFUW 2011b).

According to (ORTHOFER et al. 1995) 1% of the total nitrogen in the denitrification process is emitted as N_2O. The formula for estimating the N_2O emissions from wastewater treatment is:

$$N_2O \text{ Emissions} = N_2O \text{ Emissions [population connected]} + N_2O \text{ Emissions [population not connected]}$$

$$N_2O \text{ Emissions [population connected]} = (inhabitants * P * Frac_{NPR}) * cr * DF * 0.01 * F$$

$$N_2O \text{ Emissions [population not connected]} = (inhabitants * P * Frac_{NPR}) * (1-cr) * 0.01 * F$$

Where:

inhabitants	*total number of inhabitants in Austria*
P	*annual protein intake per capita [kg protein/person/a]*

[109] http://faostat.fao.org/site/609/default.aspx#ancor

[110] Abwasseremissionsverordnung für kommunales Abwasser (BGBl. 210/1996)

$Frac_{NPR}$	*fraction of nitrogen in protein (IPCC default – 0.16 kg N/kg protein)*
cr	*connection rate to public sewage system*
DF	*percentage of nitrogen that is denitrificated*
F	*factor [1.57 kg N_2O-N/kg N]*

Finally the N_2O emissions arising from waste water treatment plants (i.e. population connected) and other treatment (i.e. population not connected) are summed up.

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 treatment of urban wastewater and sludge disposal (BMLFUW 2006b, BMLFUW 2008, BMLFUW 2009, BMLFUW 2010, BMLFUW 2011b). Missing data in between were interpolated. The data for the daily protein intake are taken from FAO statistics[111], the number of inhabitants is provided by (STATISTIK AUSTRIA 2013).

Table 280: Parameters used for the calculation of N_2O emissions for 1990–2012.

	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)*	8 295 189
2008	**92.8%** *b)*	**0.79** *b)*	107	8 321 541
2009	92.8%	0.80	107	8 341 483
2010	93.9%	**0.80** *b)*	107	8 361 069
2011	93.9%	0.80	107	8 388 534
2012	93.9%	0.80	107	8 426 311

[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 2006b, BMLFUW 2008, BMLFUW 2009, BMLFUW 2010, BMLFUW 2011b, BMLFUW 2012) – values in between are inter- or extrapolated*

[c]) *Food and Agriculture Organisation of the UN*

[111] http://faostat.fao.org/site/368/default.aspx#ancor

Industrial wastewater handling

It is assumed that industrial wastewater handling additionally contributes 30% of N_2O emissions from municipal wastewater treatment plants (ORTHOFER et al. 1995). 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 N_2O emissions from industrial sources are believed to be insignificant (page 6.27).

8.3.3 Recalculations

Revised population numbers became available from Statistik Austria (STATISTIK AUSTRIA 2013), leading to slightly lower N_2O and CH_4 emissions for the years 2007–2011 (2007: −0.1%, 2008: −0.2%, 2009: −0.3%, 2010: −0.3%, 2011: −0.4%).

8.4 Waste incineration (CRF Category 6.C)

8.4.1 Source Category Description

Key source: No

In this category emissions from incineration of waste oil are included as well as emissions from municipal waste incineration without energy recovery. All CO_2 emissions from waste are caused by waste incineration. The share of 6.C. in total emissions from waste is 0.8% for the year 1990 and 0.1% for the year 2012.

In Austria waste oil has been incinerated in especially designed so called „USK-facilities" (**U**m-welt**s**chutz**k**omponenten GmbH). The emissions of waste oil combustion for energy recovery (e.g. in cement industry) are reported under fuel combustion. In 2002, the Austrian waste incineration regulation[112] came into force, introducing strong limits (from 2005 on[113]) 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.

[112] 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.

[113] Old facilities had to conform to the new regulation 2005 at the latest.

Table 281: Greenhouse gas emissions from Category 6.C.

	CO_2 [Gg]	CH_4 [Gg]	N_2O [Gg]	CO_2 equiv. [Gg]
1990	26.89	0.0032	0.0004	27.09
1991	23.40	0.0031	0.0004	23.58
1992	10.86	0.0006	0.0001	10.91
1993	10.60	0.0005	0.0001	10.64
1994	10.65	0.0003	0.0001	10.69
1995	10.97	0.0003	0.0001	11.01
1996	11.30	0.0003	0.0001	11.33
1997	11.62	0.0003	0.0001	11.66
1998	11.94	0.0003	0.0001	11.98
1999	12.26	0.0003	0.0001	12.30
2000	12.26	0.0003	0.0001	12.30
2001	12.26	0.0003	0.0001	12.30
2002	12.26	0.0003	0.0001	12.30
2003	12.26	0.0003	0.0001	12.30
2004	12.26	0.0003	0.0001	12.30
2005	12.26	0.0003	0.0001	12.30
2006	10.15	0.0003	0.0001	10.18
2007	8.12	0.0002	0.0001	8.15
2008	6.09	0.0002	0.0001	6.11
2009	4.06	0.0001	0.0000	4.07
2010	2.03	0.0001	0.0000	2.04
2011	2.03	0.0001	0.0000	2.04
2012	2.03	0.0001	0.0000	2.04
Trend 1990-2012	***−92%***	***−98%***	***−96%***	***−92%***

8.4.2 Methodological Issues

CORINAIR methodology is applied: the quantity of waste is multiplied by an emission factor for CO_2, CH_4 and N_2O.

8.4.2.1 Emission factors

National emission factors for CH_4 are derived from residual fuel oil VOC emission factors (BMWA-EB 1990, BMWA-EB 1996, UMWELTBUNDESAMT 2001a). N_2O emission factors are taken from a national study (ORTHOFER et al. 1995).

For waste oil, the same CO_2 emission factor as for *1.A.1.a* heavy oil (CO_2: 80 [t/TJ]) is used and a heating value of 40.3 GJ/Mg waste oil (source: Energy balance-residual fuel oil) is used to convert the emission factors from [kg/TJ] to [kg/Mg].

For municipal solid waste and clinical waste the CO_2 emission factor is calculated by means of default assumptions from (IPCC-GPG 2000) as presented in Table 282.

Table 282: Emission factors and parameters of IPCC Category 6.C Waste Incineration.

Waste Type	Carbon content	Share in fossil carbon	Combustion efficiency	CO_2 [kg/Mg]	CH_4 [g/Mg]	N_2O [g/Mg]
Municipal Waste	40%	40%	95%	557.70	104.40	12.18
Clinical Waste	60%	40%	95%	836.00	100.00	12.00
Waste Oil	–	–	–	3 224.00	NA	24.18

8.4.2.2 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

At current there is one facility which has the permit to incinerate hazardous waste (including hospital waste) in larger amounts which is allocated in *1.A.1.a*. Additionally there is one hospital with a permit to incinerate waste (capacity < 2 t/h) but it is not known if and how the energy is used. Assuming a capacity of 1 t/hour of plastics waste and 500 hours yearly operating time it was estimated to be 500 t/year. However, waste experts at the Umweltbundesamt doubt if this hospital makes use of the permit. Thus from the expert view this is rather an over- than an underestimate.

Under the new waste regulation 8 companies have the permit to incinerate waste oil although it is not known if they make use of their permit in reality. These companies are mostly road transport companies or car dealers which are considered not to use the energy. Each of the 8 companies is assumed to have installations with a capacity of 60.8 t waste oil/year (UMWELTBUNDESAMT 2001d). This is the same average capacity that has been used for estimating the waste oil quantity for 1990 to 2005. This results in a rounded value of 500 t waste oil/year. Activity data for the years 2006 – 2009 has been interpolated.

Table 283: 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	3 100	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
2011	0	500	500
2012	0	500	500

The following table shows activity data of waste incineration with energy recovery.

Table 284: 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
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

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]
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	226 090	22 206	15 280
2009	1 348 681	96 505	54 243	218 881	14 881	15 231
2010	1 399 474	109 772	57 002	226 875	21 911	14 568
2011	1 455 334	108 220	164 636	240 431	19 597	15 613
2012	1 439 070	98 227	176 809	262 528	12 662	13 033

1) *Umweltbundesamt, Statistik Austria 2008.*

2) *(HACKL & MAUSCHITZ 1995, 1997, 2001, 2003, 2007, MAUSCHITZ 2004), 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

No recalculations have been made since last years' submission.

8.5 Other waste (CRF Category 6.D)

Emission: CH_4, N_2O

Key Source: No

In this category biological treatment of solid waste is considered. This category includes CH_4 and N_2O emissions from mechanical-biological treatment of residual waste and composted waste. Emission data is presented in Table 285 for the period from 1990 to 2012.

Both CH_4 and N_2O emissions increased over the observed time period as a result of the increasing amount of composted as well as mechanical-biologically treated waste.

Table 285: Greenhouse gas emissions from 'other waste' 1990–2012

	CH_4 emissions [Gg]	N_2O emissions [Gg]	Total [Gg CO_2 eq.]
1990	0.52	0.08	34.57
1991	0.55	0.08	36.24
1992	0.65	0.09	42.94
1993	0.82	0.12	53.21
1994	0.98	0.14	63.12
1995	1.04	0.14	66.66
1996	1.09	0.15	69.93
1997	1.08	0.15	68.79
1998	1.12	0.15	71.27
1999	1.18	0.16	74.96
2000	1.24	0.17	78.81

	CH_4 emissions [Gg]	N_2O emissions [Gg]	Total [Gg CO_2 eq.]
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	161.54
2008	2.51	0.35	160.15
2009	2.53	0.35	161.37
2010	2.53	0.35	161.21
2011	2.52	0.35	160.57
2012	2.59	0.35	164.43
Trend 1990–2012	***398%***	***365%***	***376%***

8.5.1 Methodological Issues

Two different fractions were considered:

- waste from households and similar sources covered by the municipal waste collecting system, undergoing a bio-technical treatment (treatment in Mechanical-Biological Treatment (MBT) plants). To a smaller extent also waste from industrial sources (e.g. residues from processing of recovered paper) are included (UMWELTBUNDESAMT 2008d).
- biogenic waste composted, which in turn comprises green/bio waste collected and treated in composting plants[114] (centralised composting) and bio waste composted where it is produced ('at source', home composting).

Emissions were calculated by multiplying the quantity of waste by the corresponding emission factor (see 8.5.1.2), using a simple country specific methodology following the IPCC 2006 GL.

$CH_4\ Emissions = M_i * EF_i$

$N_2O\ Emissions = M_i * EF_i$

Where:

M_i	*mass of organic waste treated by biological treatment type i (composting, MBT)*
EF_i	*emission factor for treatment i (MBT, 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').

[114] A certain part of this waste undergoes an anaerobic treatment (digestion), but currently all bio waste generated is assumed to be treated aerobically (composted).

Table 286: Activity data and sources for 'other waste'.

	Total waste	Mechanical-biological waste treatment (MBT)		Bio waste collected separately		Loppings; gardening waste		Home composting	
	[Gg]	[Mg]	source	[Mg]	source	[Mg]	source	[Mg]	source
1990	763	345 000	BAUMELER et al. 1998	10 436	sum of data reported by the Austrian Federal Provinces, (AMLINGER 2003)	37 370	sum of data reported by the Austrian Federal Provinces, (AMLINGER 2003)	370 000	AMLINGER 2003
1991	798	345 000		27 372		50 995		375 000	
1992	942	345 000		88 243		48 464		460 000	
1993	1 161	345 000		156 936		149 470		510 000	
1994	1 373	345 000		246 375		197 130		584 985	
1995	1 446	294 739	ANGERER 1997	301 809		249 264		600 000	
1996	1 515	281 378	expert judgement	334 371		283 127		616 000	
1997	1 488	243 780	LAHL 1998	351 862		229 643		662 571	
1998	1 541	239 671	LAHL 2000	362 572		241 835		696 487	
1999	1 621	265 672	UMWELTBUNDESAMT 2001e	378 796		244 587		732 273	
2000	1 703	253 660	inter-polated	374 271		303 239	interpolated	771 773	
2001	1 928	241 648		399 090		361 890		944 412	interpolated
2002	2 150	229 636		422 126		420 542		1 117 051	
2003	2 362	217 625	UMWELTBUNDESAMT 2008d	433 911		479 194		1 289 691	
2004	2 979	487 623		491 670	BAWP (BMLFUW 2006a)	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	3 502	684 322		618 570	Status Report* 2008	713 800	Status Report* 2008	1 484 839	Status Report* 2008
2008	3 467	619 495	inter-polated	650 700	Status Report* 2009	699 400	Status Report* 2009	1 497 877	calculated on basis of Status Report 2008**
2009	3 489	554 668	BAWP (BMLFUW 2011a)	752 100	BAWP (BMLFUW 2011a)	677 400	BAWP (BMLFUW 2011a)	1 505 000	BAWP (BMLFUW 2011a)
2010	3 486	550 613	Status Report 2012	752 496	Status Report 2012	677 400	same as 2009	1 504 992	calculated on basis of BAWP (BMLFUW 2011a)**
2011	3 470	519 080	based on EDM reports***)	1 440 612			based on EDM reports***)	1 509 936	
2012	3 548	453 392	based on EDM reports***)	1 577 549			based on EDM reports***)	1 516 736	

*) *Status Reports: annual updates (2007, 2008, 2009) of the Federal Waste Management Plan 2006 (BMLFUW 2006a)*

**) *In the Status Report 2008 as well as the BAWP 2011 (BMLFUW 2011a) a value of the amount of home composted waste (in kg) per capita is given. This factor was used to calculate the emissions for the years 2004–2006 and 2010–2011 too.*

****) interim evaluation of activity data (input MBT) reported via EDM portal by facilities; conducted for status report 2013.*

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 287: Emission factors for 'other waste'

	CH_4 [kg/t FS]	N_2O [kg/t FS]	References
Mechanical-biologically treated waste	0.6	0.1	(UBA BERLIN 1999) (AMLINGER et al. 2003, 2005) (ANGERER & FRÖHLICH 2002) (DOEDENS et al. 1999)
Composted waste (bio-waste, loppings, home composting)	0.75	0.1	(AMLINGER et al. 2003, 2005)

8.5.2 Recalculations

GHG emissions have been recalculated for the following reasons:

- updated activity data (2010, 2011) of waste amounts treated in mechanical-biological treatment plants (revision downwards)
- updated activity data (2011) on biologically treated waste
- revised population numbers 2007-2011

Table 288: Recalculation with respect to previous submission in category 'other waste'

	CH_4	N_2O	GHG Total
	[Mg CH_4]	[Mg N_2O]	[Gg CO_2e]
2007	−0.8	−0.1	−0.05
2008	−2.0	−0.3	−0.13
2009	0	0	0
2010	−35.8	−5.8	−2.55
2011	−49.7	−8.3	−3.61

Recalculations for 2007 and 2008 are mainly due to revisions of population numbers. Additionally, for 2010 and 2011 updated activity data on mechanical-biologically treated waste as well as biologically treated waste (bio waste collected separately and loppings/gardening waste) became available by electronic query for the Status Report 2013 to the Federal Waste Management Plan (BMLFUW 2011a).

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 2011. The implications of the recalculations for emission levels by category for CO_2, CH_4, N_2O and FCs are presented in Annex 5.

Recalculations of previously submitted inventory data are performed following the IPCC Good Practice Guidance, Chapter 7 'Methodological Choice and Recalculation' with the only purpose to improve the GHG inventory.

9.1 Explanations and Justifications for Recalculations, including for KP-LULUCF inventory

9.1.1 GHG inventory

Compiling an emission inventory includes data collecting, data transfer and data processing. Data has to be collected from different sources, for instance national statistics, plant operators, studies, personal information or other publications. The provided data must be transferred from different data formats and units into a unique electronic format to be processed further. The calculation of emissions by applying methodologies on the collected data and the final computing of time series into a predefined format (CRF) are further steps in the preparation of the final submission. Finally the submission must be delivered in due time. Even though a QA/QC system gives assistance so that potential error sources are minimized it is sometimes necessary to make some revisions (called recalculations) under the following circumstances:

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

Detailed information on recalculations and their justifications can be found in the following subchapters as well as the corresponding Sector-specific Chapters *3 Energy – 8 Waste*, in which all methodological changes and activity data updates that led to recalculations of emissions with respect to the previous submission are listed.

9.1.1.1 Energy (Sector 1)

Combustion Activities (1.A)

Stationary sources

Update of activity data

Updates of activity data and of NCVs follow the updates of the IEA-compliant energy balance compiled by the federal statistics authority Statistik Austria.

Energy balance update and corrections

For natural gas the net calorific value calculation method has been revised from the year 2005 onwards. The previous method was: Net calorific value = gross calorific value /1.1. The new method is: Net calorific value = gross calorific value * 0.9. This new calculation method resulted in a lower inland consumption of about − 1%.

Other revisions conducted for natural gas affect the years 2009 to 2011 only. About 2.1 to 4.0 Petajoules (PJ) have been shifted from public power and district heating plants to final energy consumption. Within final energy consumption between 4.9 and 7.3 PJ has been shifted from 'other sectors' to 'manufacturing industries'. After consideration of all revisions (final energy consumption and transformation input) the overall change according to the OLI methodology results in a significant higher natural gas consumption of 'manufacturing industries' (+ 10.8 PJ) and a significant lower consumption in 'other sectors' in the year 2011 (− 7.3 PJ).

For residual fuel oil the whole time series has been revised. A big share of 'other liquid fuels', which are used in the refinery, have been reallocated as 'residual fuel oil'. While this revision does not imply a change of total gross inland consumption until 2008, the final energy consumption is affected by this revision from the year 2009 on. This causes a lower final energy consumption of − 2.2 PJ in 2011 and mainly affects 'other sectors'.

Other main revisions from 2009 onwards arise from the reallocation of log wood to 'other solid biomass' (mainly wood waste of wood processing and pulp and paper industries) as well as the separate reporting of the biomass-share of industrial waste in the manufacturing industries. Thus, the industrial waste now considers consequently the pure fossil content (carbon) only.

Revision of GHG emissions

A double counting of non-energy use of natural gas in 1.A.1.b petroleum refining has been eliminated. The CO_2 emissions from of natural gas used for hydrogen production are already considered in the ETS. In the previous inventory this consumption was considered under category 1.A.2.f gaseous fuels.

Other revisions of emission estimates followed the revisions of the energy balance. Neither emission factors nor calculation methodologies have been changed since the 2013 submission.

The implied emission factors of 1.A.2 – other fuels (industrial waste) have been revised upwards from 2008 on because the share of biomass in industrial waste has been moved to biomass fuels.

Revision according to review recommendations (ICR 2013)

According to the In Country Review 2013 the following additional sources have been estimated:

- *1.A.1.b Petroleum refining* – CH_4 emissions have been estimated which has been reported as 'IE' in the previous inventory (+ 1 Gg CO_2 equivalent in 2011).
- *1.A.4 Other sectors* – CH_4 and N_2O emissions from char coal use have been estimated (+ 1.8 Gg CO_2 equivalent in 2011).

Mobile sources

Update/Improvement of activity data

In 2013, 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

In the national energy balance the levels for liquid gas (LPG) and natural gas (CNG) were changed retrospectively for the years 2009, 2010 and 2011. LPG activity data was revised downwards, CNG activity data slightly upwards. Necessary adjustments in the inventory transport model[115] caused slightly revised GHG emission data for individual years. In total, activity data for LPG and CNG shows a reduced fuel use. This, however, has no significant effect on overall emissions due to the small absolute quantities of LPG and CNG used in sector transport.

1.A.2.f, 1.A.4.a,b,c Mobile Sources (Off-Road)

By updates due to changes in the time series of the national energy balance, diesel consumption of railways was retrospectively changed. This activity data has been adjusted for 2009, 2010 and 2011 and resulted in reduced GHG emissions from railways (− 18.9% in 2011).

Emissions from the off-road construction industry were recalculated due to a posteriori statistical change in the construction production index for the year 2011 resulting in slightly increased GHG emissions (+ 0.4% in 2011).

Revisions of the national energy balance resulted in minor adjustments of the sectorial diesel consumption data applied in the national off-road model[116].

Update of methodology and emission factors

1.A.3.b Road Transport

Road transport emission factors applied in the previous submission were based on the preliminary HBEFA V3.1 update (Handbook Emission Factors for Road Transport), whereas in this submission EFs were obtained from the final version V3.2 of the HBEFA. The official release of HBEFA V3.2 is expected by the beginning of 2014.

The use of updated EFs for Euro 5 and Euro 6 vehicles resulted in significantly lower emissions from light duty vehicles due to reduced fuel consumption data for EURO 5 (EURO 6 shows a smaller reduction) whereas emissions from heavy duty vehicles increased due to increased fuel consumption data for EURO 5 (EURO 6 had to be raised by a higher extent).

Overall revisions of the sector road transport show a slight increase of GHG emissions (+ 0.06 % for 2011).

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[115] HAUSBERGER, S. & SCHWINGSHACKL, M. (2013): Straßenverkehrsemissionen und Emissionen sonstiger mobiler Quellen Österreichs für die Jahre 1990 bis 2012 (OLI2013); erstellt im Auftrag der Umweltbundesamt GmbH, Graz, 2013.

[116] HAUSBERGER, S. & SCHWINGSHACKL, M. (2013): Straßenverkehrsemissionen und Emissionen sonstiger mobiler Quellen Österreichs für die Jahre 1990 bis 2012 (OLI2013); erstellt im Auftrag der Umweltbundesamt GmbH, Graz, 2013.

Fugitive emissions (1.B)

1.B.1.b Solid Fuel Transformation

In response to the Saturday Paper from the ERT (In-Country Review 2013) CH_4 emissions from charcoal production were estimated and reported for the first time[117], leading to slightly higher fugitive emissions over the whole time series (e.g. 2011: + 0.74 Gg CO_2e).

1.B.2.a Oil and natural gas

In response to a finding by the ERT (In-Country Review 2013) the method for estimating CH_4 emissions has been adapted using the same oil and gas production EF to achieve time series consistency, resulting in slightly lower emissions in the years 2009-2011 (e.g. 2011: −0.21 Gg CH_4) and higher emissions in the years 1990-2008 (e.g. 1990: +1.21 Gg CH_4).

9.1.1.2 Industrial Processes (Sector 2)

Update of activity data

2.A.2 Lime Production

Activity and emission data were updated based on information available from the Association of the Stone & Ceramic Industry, resulting in slightly lower emissions in the years 2002, 2003 and 2004.

2.C.1 Pig Iron

Revised coke input data became available in the energy balance for the year 2011, leading to lower CO_2 emissions (- 95 Gg) in that year.

2.F.1 Refrigeration and air conditioning equipment

Based on a new study, the number of heat pumps installed in 2011 was adjusted, resulting in slightly lower HFC emissions in that year.

Improvements of methodologies and emission factors

2.A.2 Lime Production

For the year 2006, a transcription error in the emission estimate was corrected, resulting in lower emissions in that year.

2.B.1 Ammonia Production

In response to a finding of the 2013 in-country review, the carbon inputs and outputs of Austria's integrated ammonia plant were reviewed. As CO_2 emissions from fertilizer production and nitric acid production are reported under the respective subcategories, they were subtracted from CO_2 emissions reported under ammonia production. This subtraction resulted in lower CO_2 emissions in the order of 20 to 40 Gg per year for the whole time series.

2.C.3 Aluminium Production

A transcription error in the calculation of C_2F_6 emissions was corrected, leading to lower emissions in the order of 2 to 6 tonnes of C_2F_6 in the years 1990-1992.

[117] as a resubmission of the times series 1990-2011 in November 2013 (AT_Submission_2013_v1.3_CRF)

2.F.1 Refrigeration and air conditioning equipment

In the sub-category "mobile air condition", a transcription error in the emission calculation for the year 2011 was corrected, resulting in slightly lower HFC emissions in that year.

9.1.1.3 Solvent and other Product Use (Sector 3)

Update of activity data

3.A Paint application, 3.B Degreasing and dry cleaning, 3.C Chemical products, 3.D OTHER including containing HMs and POPs – CO_2 emissions

The usage of the latest production statistics data (special reporting of solvent containing substances and products) slightly changed the CO_2 emissions 2011 (+ 0.03 Gg).

3.D.1 Use of N_2O for anesthesia – N_2O emissions

Updated information for the usage of N_2O for medical purpose leads to a reduction of N_2O emissions (– 4.5 Gg CO_2eq in 2011).

9.1.1.4 Agriculture (Sector 4)

Improvements of methodologies and emission factors

4.B Manure Management

The share of anaerobic digestion has been revised on the basis of new input data provided by the Austrian Energy Regulator E-Control. The revision caused slightly higher methane emissions in previous years and minor changes in N_2O emissions.

9.1.1.5 LULUCF (Sector 5)

Revisions of the data series for LULUCF are due to the following changes:

5.A Forest land

The areas of the LUC subcategories to forests were changed on basis of the ARD assessment that was finalised in 2013. Also the biomass stock changes and dead wood stock changes at these LUC lands were measured accurately during this assessment. So, the emission estimates for the 5.A.2 lands and for the whole time series were changed on basis of these new activity data and emission factors. These changes have also an impact on the results of 5.A.1 which are based on the results of the NFIs for all Austria minus those biomass and dead wood stock changes due to LUCs involving forests (in order to avoid double accounting). A change in 5.A.2 or in LUC categories from forest to other land uses represents also a change in subtrahends for the derivation of the results for the subcategory 5.A.1 on basis of the NFI results for all Austria.

These changes in the activity data of the 5.A.2 sub-categories led also to different mean soil C stocks to be used for the estimates of the soil C stock changes of the 5.A.2 subcategories and consequently to a change in the emission/removal figures.

Furthermore, in response to a review finding the estimates of the soil C stock changes in the LUC category WL to FL were assumed to be 0.

5.B Cropland

The areas of the LUC subcategory FL to CL were changed on basis of the ARD assessment that was finalised in 2013. Also the biomass stock changes and dead wood stock changes at these LUC lands were measured accurately during this assessment. So, the emission estimates for this subcategory and for the whole time series changed on basis of these new activity data and emission factors.

The LUCs between perennial and annual CL and the LUCs between CL and GL of the most recent years were updated on basis of an assessment of the most recent statistics. In addition, an identified error in the extrapolation factor from the assessed subsample to all Austria in previous submissions was corrected.

5.C Grassland

The areas of the LUC subcategory FL to GL were changed on basis of the ARD assessment that was finalised in 2013. Also the biomass stock changes and dead wood stock changes at these LUC lands were measured accurately during this assessment. So, the emission estimates for this subcategory and for the whole time series changed on basis of these new activity data and emission factors.

The LUCs between CL and GL of the most recent years were updated on basis of an assessment of the most recent statistics. In addition, an identified error in the extrapolation factor from the assessed subsample to all Austria in previous submission was corrected. .

5.D Wetlands

The areas of the LUC subcategory FL to WL were changed on basis of the ARD assessment that was finalised in 2013. Also the biomass stock changes and dead wood stock changes at these LUC lands were measured accurately during this assessment. So, the emission estimates for this subcategory and for the whole time series changed on basis of these new activity data and emission factors. Furthermore, in response to a review finding the soil C stock changes in the LUC-categories to WL were assumed to be 0.

An update of these LUC areas led also to different LUC lands GL to WL due to area consistency reasons. As a consequence, the related emissions/removals of this LUC category had to be revised.

5.E Settlements

The areas of the LUC subcategory FL to SL were changed on basis of the ARD assessment that was finalised in 2013. Also the biomass stock changes and dead wood stock changes at these LUC lands were measured accurately during this assessment. So, the emission estimates for this subcategory and for the whole time series changed on basis of these new activity data and emission factors.

An update of these LUC areas led also to different LUC lands CL to SL and GL to SL due to area consistency reasons. As a consequence, the related emissions/removals of these LUC subcategories had to be revised.

5.F Other lands

The areas of the LUC subcategory FL to OL were changed on basis of the ARD assessment that was finalised in 2013. Also the biomass stock changes and dead wood stock changes at these LUC lands were measured accurately during this assessment. So, the emission estimates for this subcategory and for the whole time series changed on basis of these new activity data and emission factors.

An update of these LUC areas led also to different LUC lands GL to OL due to area consistency reasons in the GL category. As a consequence, the related emissions/removals of this LUC subcategories had to be revised.

9.1.1.6 Waste (Sector 6)

Update of methodology and emission factors

6.A Managed Waste Disposal on Land

New data on the landfill gas recovery became available, leading to revised CH_4 emissions for 2008-2011. Based on a new study on landfill gas practice in Austria, less CH_4 is recovered and consequently more CH_4 emitted (recalculation 2011: + 33 Gg CO_2e).

Update of activity data

6.B Wastewater Handling

Statistics on the Austrian population have been revised downwards, leading to slightly revised emission data for 2007-2011 (recalculation 2011: − 1.1 Gg CO_2e).

6.D Other waste

GHG emissions have been recalculated (− 3.6 Gg CO_2e) for the following reasons:

- updated activity data (2010, 2011) of waste amounts treated in mechanical-biological treatment plants (revision downwards)
- updated activity data (2011) on biologically treated waste
- revised population numbers

9.1.2 KP-LULUCF inventory

The areas of the ARD activities were changed on basis of the ARD assessment that was finalised in 2013. Due to this assessment the areas of both, AR and D, are smaller than in previous submissions. The biomass stock gains and losses at the ARD lands and dead wood stock changes at the ARD lands in the Kyoto-Period were for the first time measured accurately during this assessment.

These changes in the ARD activity data led also to different mean soil C stocks to be used for the estimates of the soil C stock changes at the ARD lands. Furthermore, in response to a review finding the soil C stock changes in the AR- and D-categories with WL were assumed to be 0. AR lands from WL are more than D lands to WL, so this approach is conservative because it underestimates the net removals of both subcategories in the mineral soil pool.

In addition, in response to a review finding the emissions due to liming at D lands to CL and GL were estimated for the first time.

So, the emission estimates for the ARD lands and for the whole Kyoto-Protocol-period were changed on basis of these new activity data and emission factors. While the emissions and removals in the single activities of AR and D changed significantly, the net result of ARD represents 10 % higher average annual net removals compared to previous submissions.

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 2011 which are submitted this year differ slightly from data reported previously.

The following table presents the recalculation difference with respect to last years' NIR submission for each gas (positive values indicate that this years' estimate is higher).

Table 289: Recalculation difference of Austria's greenhouse gas emissions compared to the previous submission.

	1990 (Base year)	2011
	Recalculation Difference [%]	
Total	**− 0.09%**	**− 0.10%**
CO_2	− 0.07%	− 0.14%
CH_4	+ 0.34%	+ 0.59%
N_2O	+ 0.00%	− 0.20%
HFC, PFC, SF_6	− 3.55%	− 0.00%

Emissions without LULUCF

National total emissions (excluding LULUCF) for the **base year** have been slightly revised downwards since last years' submission (−70.4 Gg CO_2e), mainly due to the elimination of a double counting in *2.B.1 Ammonia Production* (in response to a finding of the In-Country Review 2013) as well as the correction of a transcription error in the calculation of PFC emissions (C_2F_6) in 2.B.1 Aluminium Production.

Revised total emissions for 2011 are 80.8 Gg CO_2 equivalents lower than the value submitted last year. This is mainly attributable to revisions of the energy balance. Furthermore updated data on landfill gas recovery became available, affecting the CH_4 emissions from *Solid Waste Disposal* sites (*6.A*) leading to higher emissions for 2008–2011.

A description of all recalculations by each sector is given in Chapter 9.1 as well as the relevant sectoral chapters.

Table 291 and Table 292 in Chapter 9.4 shows all improvements made in response to the UNFCCC review process.

Table 290 presents the recalculation differences of national total GHG emissions for all years. The implications of recalculations for emission levels by category for CO_2, CH_4, N_2O and FCs and the recalculation differences of national total emissions by gas are presented in Annex 5.

Table 290: Recalculation Difference of National Total GHG Emissions.

Year	National Total GHG emissions without LULUCF		
	Submission 2013 [Gg CO_2e]	Submission 2014 [Gg CO_2e]	Recalculation Difference [%]
1990*	78 156.71	78 086.35	-0.09%
1991	82 196.38	82 135.09	-0.07%
1992	75 434.73	75 410.77	-0.03%
1993	75 479.84	75 484.11	0.01%
1994	76 338.09	76 345.45	0.01%
1995	79 728.99	79 743.56	0.02%
1996	82 741.53	82 754.78	0.02%
1997	82 269.28	82 277.81	0.01%
1998	81 635.24	81 653.02	0.02%
1999	79 917.14	79 966.28	0.06%
2000	80 198.10	80 276.96	0.10%
2001	84 184.16	84 274.66	0.11%
2002	85 881.45	85 975.56	0.11%
2003	91 875.53	91 984.60	0.12%
2004	91 519.54	91 569.35	0.05%
2005	92 894.51	92 580.94	-0.34%
2006	90 092.19	89 710.79	-0.42%
2007	87 246.19	86 967.42	-0.32%
2008	86 962.39	86 882.03	-0.09%
2009	79 955.99	80 147.97	0.24%
2010	85 012.22	84 807.85	-0.24%
2011	82 841.60	82 760.84	-0.10%

**Base year is 1990 for all gases*

9.2.2 KP-LULUCF inventory

The areas of the ARD activities were changed on basis of the ARD assessment that was finalised in 2013. Due to this assessment the areas of both, AR and D, are smaller than in previous submissions. The biomass stock gains and losses at the ARD lands and dead wood stock changes at the ARD lands in the Kyoto-Period were for the first time measured accurately with this assessment.

These changes in the ARD activity data led also to different mean soil C stocks to be used for the estimates of the soil C stock changes at the ARD lands. Furthermore, in response to a review finding the soil C stock changes in the AR- and D-categories with WL were assumed to be 0. AR lands from WL are more than D lands to WL, so this approach is conservative because it underestimates the net removals of both subcategories in the mineral soil pool.

In addition, in response to a review finding the emissions due to liming at D lands to CL and GL were estimated for the first time.

So, the emission estimates for the ARD lands and for the whole Kyoto-Protocol-period were changed on basis of these new activity data and emission factors. While the emissions and removals in the single activities of AR and D changed significantly, the net result of ARD represents 10 % higher average annual net removals compared to previous submissions.

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 290 and Figure 41, Austria's greenhouse gas emissions as reported in the submission 2014 are only slightly different compared to the values reported last year due to recalculations. The national total excluding LULUCF for the base year is 0.09% lower than the value reported last year. The national total for 2011 is 0.10% lower than the value reported in last years' submission. The trend remains quite the same (+ 6.0%).

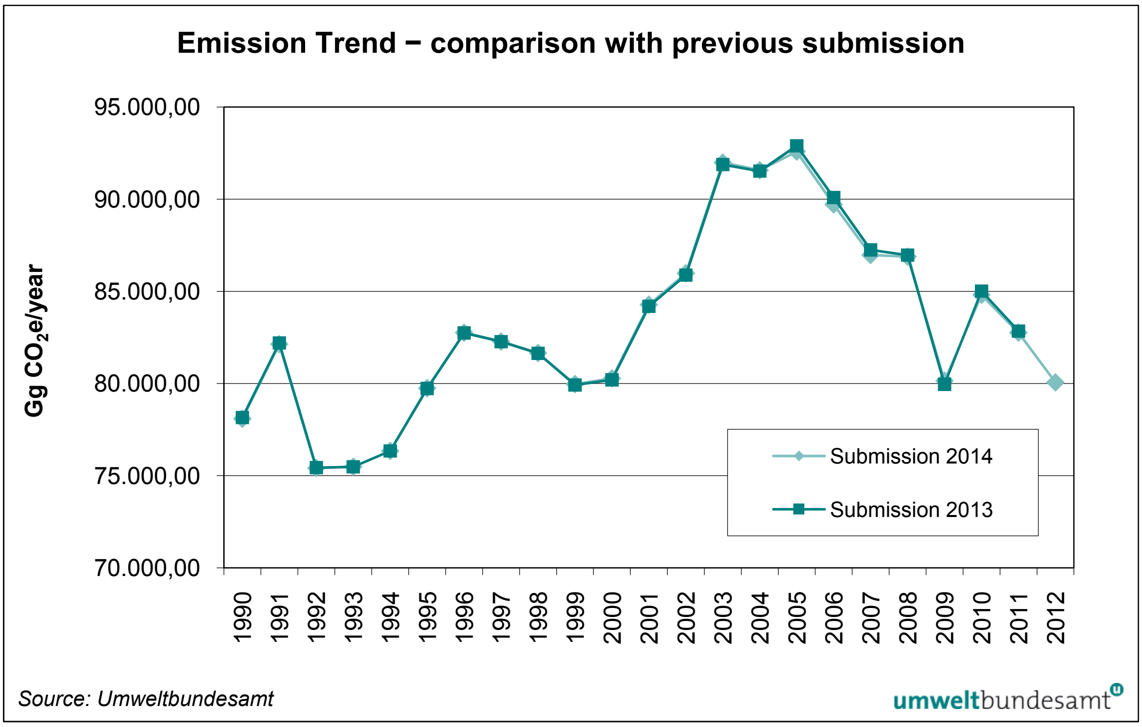

Figure 41: Comparison submission 2014 with submission 2013.

9.3.2 KP-LULUCF inventory

Data on Article 3.3. activities are only reported for the years 2008–2012.

9.4 Recalculations, including in response to the review process, and planned improvements to the inventory

9.4.1 GHG inventory

Improvements made in response to the review process

Improvements made in response to the issues raised in the UNFCCC review process are summarized in Table 291 and Table 292.

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.

Table 291: Improvements made in response to the UNFCCC review.

Finding	Reference	Improvement made	Chapter (page)
General			
Cross-cutting: The ERT recommends that Austria carry out some additional checks to reduce future inconsistencies or omissions in the use of the notation keys	ARR 2013 para 13	Inconsistencies detected during the ICR 2013 have been removed for this years' submission. For future submissions Austria's will strive to follow its 3-step procedure for QC as stipulated in the Quality Manual.	Chapter 1.6.1.1; pages 40 and 41
Cross-cutting: The ERT strongly recommends Austria to perform uncertainty analysis on all the categories of the inventory.	ARR 2013 para 14	Austria has assessed uncertainties for all the categories of the inventory and will report on the result of its uncertainty analysis in the NIR 2014.	Chapter 1.7.1; pages 44fAnnex 7; pages A-168–A-182
Cross-cutting: The ERT recommends a table containing all the recommendations from the review together with a reference to the appropriate section where it is addressed in the NIR.	ARR 2013 para 17	In the Table at hand an additional column has been added to show where the information can be found in the NIR.	Chapter 9.4; pages 469–475
Article 3, paragraph 14: The ERT recommends to more clearly show in the NIR (Chapter 14) where information on minimization of adverse impacts (Article 3, paragraph 14) has changed since last submission.	ARR 2013 para 87	An introduction about changes compared to last submission is included in the NIR 2014.	Chapter 14; page 509
Energy			
1.A.1.b Petroleum refining: It was recommended to report combustion emissions (CH_4) from petroleum refining under 1.A.1.b instead of including it under 1.B.2 (oil refining/storage).	ARR 2012 para 52	CH_4 emissions from combustion are now estimated and reported under 1.A.1.b (previously reported as 'IE')	Chapter 3.2.10.2; page100
Reference and sectoral approach: Carbon content of gasoil should be considered in the reference approach in a way that the biofuels are considered from 2005 onwards in the sectoral approach, whereby organic carbon from biofuels is accounted for separately.	ARR 2013 para 24	Austria has addressed this issue in the NIR 2014 and has calculated the carbon content of gasoil in the reference approach in a way that biofuels are considered for 2005 onwards in the sectoral approach.	Chapter 3.2.1; page 76
Stationary combustion: liquid, solid and biomass fuels – CO_2, CH_4 and N_2O: Include a carbon mass balance in the form of a process flow diagram in the reporting of CO_2 emissions from blast furnace gas.	ARR 2013 para 28	A process flow diagram will be included in the NIR 2014 for the Submission to the UNFCCC on April 15 2014.	Chapter 3.2.11.1; Figure 13; page 103
Stationary combustion: biomass – CH_4, N_2O: The ERT noted that Austria does not report emissions (CH_4, N_2O) associated with charcoal use, although this is reported in official statistics (FAOSTAT, IEA Joint Questionnaire), and considers this as a case of underestimation (potential problem).	ICR 2013 / Saturday Paper ARR para 31	Emissions from charcoal consumption are now estimated.	Chapter 3.2.13; page 150

While performing the Stage II Synthesis and Assessment (AUT_SA-II_2013), the UNFCCC secretariat has revealed an inconsistency of inventory data (CRF) with statistical data submitted to the International Energy Agency ('IEA Questionnaire') with regard to international navigation and aviation. The ERT recommends a harmonization of IEA data.	ICR 2013 ARR 2013 para 25, 26	A regular adoption of inventory data in the national statistics was agreed between Umweltbundesamt and Statistik Austria. The inconsistencies for 2011 have been removed with this years' submission of the statistics (of data 1990-2012) to the IEA. Austria reports the results of this harmonization exercise in its NIR 2014.	Chapter 3.2.12.1; page 125 and Chapter 3.2.12.4; page 144
Road transportation – CO_2, CH_4, N_2O: The ERT recommends to include information on the reporting of emissions from ground activities in airports and harbours.	ARR 2013 para 33	Emissions from ground activities in airports and harbours are now described in the NIR.	Chapter 3.2.12.1; page 125/126 and Chapter 3.2.12.4; page 144
Fugitive Emissions			
Solid fuel transformation: biomass – CH_4: During the ICR 2013 the ERT noted that CH_4 fugitive emissions from charcoal production are not reported, and considers this as a case of underestimation (potential problem). In the ARR 2013 the ERT recommends to describe the method used for estimation.	ICR 2013 / Saturday Paper ARR 2013 para 37	Charcoal production is now considered in the inventory and the method is described in the NIR.	Chapter 3.3.2.2; pages 168/169
Oil and natural gas – CH_4: The ERT noted that the calculation method changed between 2006 and 2007 due to use of different EFs and that the new methodology was not applied consistently across the whole time series. The ERT recommends Austria to recalculate the complete time series using the same oil and gas production EF.	ARR 2013 para 38	The method for estimating CH_4 emissions has been adapted accordingly to achieve time series consistency.	Chapter 3.3.3.1; pages 169/170
Industrial Processes			
Lime production – CO_2: The ERT recommends to include information in the NIR on the process of calcination of $CaCO_3$ in the sugar production, including a mass balance. The ERT strongly recommends presenting a description of the use of $CaCO_3$ obtained.	ARR 2013 para 43	The process of calcination is described in the NIR, including a description of CO_2 fluxes in the system. Carbonate and lime mass balance data are available from the company, but are not presented in the NIR for reasons of confidentiality. It is clarified that the share of CO_2 originating from lime production is contained in the limestone which leaves the system and is used as a fertilizer.	Chapter 4.2.2.2; Figure 23; pages 194/195;

2.B.1 Ammonia production: Ammonia, fertilizers and other chemicals are produced in a single integrated plant in Austria. The ERT pointed out that CO_2 emissions from fertilizer production are reported both under 'fertilizer production' and 'ammonia production', thus constituting a double-counting issue. The ERT thus recommends to subtract the emissions from fertilizers in CO_2 emission estimations from ammonia production.	ARR 2013 para 46, 47	All carbon inputs and outputs of the integrated plant were reviewed. As CO_2 emissions from fertilizer production and nitric acid production are reported under the respective subcategories, they were subtracted from the CO_2 emissions under ammonia production.	Chapter 4.3.1.5; page 208
2.F Consumption of Halocarbons and SF_6: The ERT recommends to improve the transparency of reporting by describing the model applied and specify in the next NIR: a) the years of data collected and data estimated, for all subcategories as well as b) the extrapolation and interpolation methods used for all subcategories of 2.F.1.	ARR 2013 para 44, 45	The model applied in the top-down approach for category 2.F.1 is described in more detail. For each of the sub-categories of 2.F.1 to 2.F.9, the years are specified when data were collected and the years when data were extrapolated/ interpolated, including the method used.	Chapter 4.5.2; pages 228–230
Agriculture			
Sector overview: The ERT recommends that AUT presents a table with all country specific data for all reporting years including a short indication on the sources for this data.	ARR 2013 para 49	A table giving an overview of the country specific data including a short indication on the sources for this data is included. Tables with AWMS information for all animal categories are included in the Annex to the NIR 2014	Chapter 6.1.3 – Table 156; page 278 Annex 6; pages A-145–A-164
Sector overview: In CRF table 4.B(a) allocation data for sheep, goats, horses, poultry and other livestock are missing for all reported years. The ERT hence recommends to complete background CRF tables accordingly.	ARR 2013 para 50	Background CRF table is now completed.	CRF table 4.B(a)
Sector overview: Consistency between the data for animal weight for dairy cattle presented in CRF tables 4.A and 4.B(a) and the data effectively used in the model for calculation of CH_4 emissions has to be assured.	ARR 2013 para 50	An explanation on this issue is included in the NIR.	Chapter 6.2.2.1; pages 291–293
Sector overview: To improve transparency the ERT recommends that AUT includes additional information on the derivation of the share of manure digested in biogas plants.	ARR 2013 para 49	An improved description is included in the NIR.	Chapter 6.3.2; pages 302/303

4.D Direct and indirect soil emissions – N_2O: The ERT concluded that the N-flow model, used by Austria since 2003, does not lead to an underestimation of emissions. The ERT recommends that Austria include more detailed descriptions of the country-specific method and N-flow model in its annual submission.	ARR 2013 para 51+52	Additional descriptions of the Austrian N-flow model have been included in the NIR 2014 (see Annex 6).	Annex 6; pages A-164–A-167
4.B Manure Management – N_2O: Mules and asses are reported under horses in the CRF table. The ERT recommends that Austria report "IE" only for the relevant AWMS (used for mules and asses) and "NO" for the remaining systems.	ARR 2013 para 54	Notation key NO is used instead of IE for all AWMS not relevant for horses, mules and asses	CRF table 4.B(a) and CRF table 4.B(b)
LULUCF			
Recommendation to carry out a more conservative estimate of the emissions/removals in the soils at LUC lands from or to WL (surface waters).	ICR 2013	C stock changes in mineral soils of LUC lands to and from WL were assumed to be 0. LUC lands from WL are more than LUC lands to WL, so this approach is conservative because it underestimates the net removals of both subcategories in the mineral soil pool.	Chapter 7.2.4.2; pages 371/372, Chapter 7.5.4.1; page 409 Chapter 10.3.1.1; page 488
Sector overview: The ERT recommends that Austria provides more detailed information regarding the definition of all carbon pools and how balanced carbon flows are maintained between model system boundaries to show that double counting is avoided when the YASSO model is used.	ARR 2013 para 56	Definitions of the C pools and specific information on the C pools/fluxes included in the Yasso modelling were included.	Chapter 7.1.3.2; page 344Chapter 7.2.4.1.3; pages 365–366
Forest land remaining forest land – CO_2: Report CSC estimates of CSC for "forests not in yield" using best available data. Alternatively, the Party should provide information that CSC for 'forests not in yield' is zero and report these as "NA" in its annual submission	ARR 2013 para 60	Estimates for the CSC of this category can be made on basis of the next NFI, because in NFI 2011/13 the stocks were assessed for the first time. Until then 'forests not in yield' will be reported as 'NA'.	CRF table 5.A
Land converted to forest land and grassland – CO_2: Refine the methodology used for determining SOC stocks of drained water-bodies to ensure that SOC removals for the subsequent land use are not overestimated.	ARR 2013 para 61	C stock changes in mineral soils of LUC lands to and from WL were assumed to be 0.	Chapters 7.2.4.2; pages 368ff Chapter 7.5.4.1; pages 409ff
Grassland remaining grassland – CO_2: Organic soils in grassland remaining grassland reported as IE. The ERT recommends reporting documented values separately under organic soils in CRF 5.C.1	ARR 2013 para 62	Separate reporting of areas and C stock changes in organic soils was carried out for submission 2014.	CRF Table 5.C

Biomass burning – CO_2, N_2O, CH_4: The ERT recommends that the Party report CO_2 emissions from fires as "IE" under biomass under cropland and N_2O and CH_4 emissions as "IE" under the agriculture sector.	ARR 2013 para 63	Notation key was included in CRF and information in NIR was added.	Chapter 7.3.4.1.8; page 392 CRF Table 5(V)
Waste			
Solid waste disposal on land – CH_4: The ERT noted that a rationale for the significant reduction in the CH_4 IEF was not clearly provided and noted that information on the annual waste composition could justify a reduction in DOC of disposed waste in 2011. The ERT recommends that the Party presents time series of DOC and L_0 of non-residual waste to improve the transparency of reporting.	ARR 2013 para 66	To improve transparency, information on the development/gaining importance of the non-residual waste fractions over the time series is now included in the NIR 2014.	Chapter 8.2.2; Table 272; pages 437/438
Solid waste disposal on land – CH_4: The ERT recommends the Party to provide a description on its plan to recalculate recovered landfill gas using an updated methane concentration in the NIR.	ARR 2013 para 67	Results of a new study on landfill gas recovery, also taking into account actual methane concentrations, have been considered in the NIR 2014.	Chapter 8.2.2; Figure 40; pages 442/443
Wastewater handling – CH_4: The ERT recommends the Party to include an explanation about the applicability of the used MCF.	ARR 2013 para 68	Additional explanation on the validation exercise is included in the NIR 2014.	Chapter 8.3.2.1; pages 446/447
Waste incineration – CO_2, CH_4, N_2O: The ERT recommends that the Party includes background information on the estimation of clinical waste and waste oil in the NIR.	ARR 2013 para 69	Additional information is included in the NIR 2014.	Chapter 8.4.2.2; page 452

9.4.2 KP-LULUCF inventory

Table 292: Improvements made in the KP-LULUCF inventory in response to the UNFCCC review.

Finding	Reference	Improvement made	Chapter (page)
KP LULUCF			
Overview: The ERT recommends that Austria implements its improvement plan using the NFI 2011/2013 to show how all the requirements will be met in accordance with the annexes to decisions 15 CMP/1. and 16 CMP/1.	ARR 2013 para 72	Improvement plan was implemented for submission 2014	Chapter 10; pages 478–485
Overview: Define time period threshold applied to "oscillating changeareas" and if the time period threshold is exceeded or there is clear indication of land use change, report these areas under Article 3 paragraph 3 of the Kyoto Protocol– deforestation activities and retain under this activity for the remaining and subsequent commitment period.	ARR 2013 para 73	Time period threshold definition of ARD was thoroughly controlled for the ARD areas within the ARD NFI 2011/13. Previous ARD areas due to short time land-use change oscillations below these thresholds were deleted as ARD areas.	Chapter 10.2.1; pages 479–484
Overview: Improve data and methodologies used for the calculation of activities under Article 3, paragraph 3, of the Kyoto Protocol based on best available data and ensure that the time-series data for the first commitment period are re-constructed to meet the reporting requirements.	ARR 2013 para 74	Data and methodologies used for the calculations of ARD activities were improved and re-constructed to meet the reporting requirements (e.g. on basis of the ARD NFI 2011/13)	Chapter 10.2.1; pages 479–484
Overview: Include uncertainty analysis for activities elected under Article 3, paragraph 3 of the Kyoto Protocol.	ARR 2013 para 75	Uncertainty analysis was carried out and results of this analysis described in NIR	Chapter 10.3.1.5; page 492
Afforestation and reforestation – CO_2: Estimate emissions for the deadwood pool or demonstrate and reforestation that the pool is not a source.	ARR 2013 para 76	The ARD NFI finalised in 2013 included measurements of the dead wood stock changes, biomass stock changes and biomass harvest at the ARD lands. So, the emissions/removals due to these changes were completely estimated for submission 2014	Chapter 10.3.1.1; page 487
Afforestation and reforestation – CO_2: Report biomass losses associated with afforestation of settlement areas or demonstrate that this pool is not a source.	ARR 2013 para 77	The biomass losses of this activity were estimated for submission 2014	CRF Table 5(KP-I)A.1.1
Afforestation and reforestation – CO_2: Refine and report the methodology used for determining soil organic carbon (SOC) stocks of drained water-bodies to ensure that SOC removals in afforested mineral soils are not overestimated.	ARR 2013 para 78	C stock changes in mineral soils of LUC lands to and from WL were assumed to be 0. AR lands from WL are more than D lands to WL, so this approach is conservative because it underestimates the net removals of both subcategories in the mineral soil pool.	Chapter 10.3.1.1; pages 487–490

Deforestation – CO_2: Estimate and report emissions from lime application to deforested crop and grassland.	ARR 2013 para 79	These emissions were estimated for submission 2014	Chapter 10.3.1.1; page 491 CRF Table 5(KP-II)4
Cross-cutting issue: relationship between L-FL in Convention reporting and AR land under KP LULUCF not easily compared → the ERT recommends to improve transparency	ICR 2013	Comparison of ARD areas (1 000 ha) reported under KP and areas of LUC to/from forests reported under UNFCCC (1000 ha) was included in NIR 2014.	Chapter 10.2.1; Table 296; pages 483/484

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 293.

Table 293: 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%[1]
Minimum height	2–5 m	2 m[1]
Average width		> 10 m

[1] (*in situ*, i.e. potential of the standing stock to reach this threshold)

Permanently unstocked basal areas that are directly connected with forest in terms of space and forestry enterprise and contribute directly to its management (such as forestal hauling systems, wood storage places, forest glades, forest roads) also represent forests. Areas which are used in short rotation with a rotation period of up to thirty years as well as forest arboretums, forest seed orchards, Christmas tree plantations and plantations of woody plants for the purpose of obtaining fruits such as walnut or sweet chestnut do not account as forests but represent cropland. Rows of trees and areas with woody plants in a park structure are not forest land.

10.1.2 Elected activities under Article 3.4

As reported in the Initial Report[118] Austria has decided not to elect any of the activities under Article 3.4 of the Kyoto Protocol.

[118] 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_2O	N_2O	N_2O	CO_2	CO_2	CH_4	N_2O
Article 3.3 activities	Afforestation and Reforestation	R	R	R	R	R	NO			NO	NO	NO	NO
	Deforestation	R	R	R	R	R			R	R	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 umweltbundesamt

Figure 42: 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 NFIs and the ARD NFI 2011/13 and is available for the whole time series to be reported (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 assessment regarding ARD activities/lands and their emissions was the ARD NFI 2011–13.

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 and the ARD NFI (NFI – (BFW 2013, 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 covering the total forest area. In the period 2011-2013 a reduced ARD NFI was carried out at the previous ARD areas and at the new ARD areas since the NFI period 2007-09. The NFI periods 1986/90, 1992/96, 2000/02, 2007/09 and the ARD NFI period 2011/13 are the relevant ones for reporting the ARD activities and their emissions/removals. Recently, the ARD NFI assessment 2011/13 was finalised. On basis of these new ARD NFI results, the ARD activity data, emission factors and emission/removal estimates were revised for the submission 2014.

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 since NFI 1981-85 a permanently below ground marked 4 x 4 km grid across all of Austria (see Figure 33 in UMWELTBUNDESAMT 2010a or at BFW 2005, http://www.bfw.ac.at/rz/bfwcms.web?dok=2384) with four permanent sample plots of 300 m^2 size at each grid point (see Figure 34 in UMWELTBUNDESAMT 2010a or „Abbildung 1" in the download of HAUK & SCHADAUER 2009). Details are described in HAUK & 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 ±1.2%. Each grid point shown in Figure 33 in UMWELTBUNDESAMT (2010a) or at BFW (2005, http://www.bfw.ac.at/rz/bfwcms.web?dok=2384) is terrestrially inspected during each NFI assessment for a potential af-/reforestation except grid points that are not suited to cover forests (e.g. grid points at glaciers or at permanent surface water bodies). Therefore, the spatial assessment unit for the submission of the Kyoto Protocol LULUCF tables covers the entire territory of Austria. NFIs with a grid of permanent sample plots (which allow a separate assessment of LUCs to forests and LUCs from forests) were carried out in the periods 1981–85, 1986–90, 1992–96, 2000–02, 2007–09 and – as ARD NFI – in the period 2011–13 (in the period 2011–13 no full NFI, but only a survey at NFI plots with ARD was carried out – see below). This means that starting with the results of NFI 1986-90 the ARD-areas are explicitly measured and known.

In the years 2011 to 2013 a reduced NFI was carried out only at all NFI plots which had ARD activities according to previous NFIs. In addition, all NFI grid points and plots were inspected which were suspicious for a potential ARD activity on basis of an assessment of latest aerial images for Austria for the period after the last NFI 2007/09. The NFI grid points and plots were checked in these latest aerial images for a potential ARD activity since NFI 2007/09. In clear or suspicious cases for a current ARD activity at-site-inspections of the NFI plots were carried out for clarification if a recent ARD activity in the period since the last NFI 2007/09 had occurred or not and related measurement of the new ARD areas were carried out. The ARD NFI 2011/13 had also the purpose to measure and to assess for the first time and in detail the biomass stock changes and the dead wood stock changes at all old and new ARD plots for the Kyoto-period 2008 to 2012. In previous submissions, only preliminary and rough estimates of the biomass stock changes at ARD areas on basis of NFI results were carried out and used.

With the ARD NFI 2011/13 also a thorough inspection of all ARD areas was carried out for the appropriateness of the classification as ARD areas. Areas previously accounted as ARD areas due to

- measurement or assessment errors,
- different classifications for unchanged plots by different NFI inspection teams in different NFIs or
- short time oscillations in activities below the legal time frames for accounting as afforestation or deforestation (see chapter 10.4.1.2)

could be identified and were deleted as ARD areas. On basis of the results of these thorough inspections of each ARD plot, for the submission 2014 the ARD areas of previous submissions were corrected (reduced) for these misclassified ARD areas.

ARD activities are accounted in direct connection with the forest definition (see chapters 10.1.1 and 10.4.2). At permanent sample plots with ARDs adjacent to existing forests any ARD area is accounted, even at ARD areas smaller than 0.05 ha but larger than the minimum assessment size (see below). At each permanent sample plot the ARD area is assessed. The minimum size of the sub-area with a different land use within one permanent sample plot needs to be larger than 1/10 of the total sample plot area to be assessed (> 30 m^2). If this pre-condition is met the polygon that divides the different areas of land uses within the sub-plot is measured using polar-coordinates (see examples in Figure 35 in UMWELTBUNDESAMT 2010a or „Abbildung 5" in the download of HAUK & SCHADAUER 2009). This does not mean that the sample plot is further subdivided into parcels of 30 m^2, but the 30 m^2 only represent the minimum area threshold for the measurement of a plot division in two different land uses. At site, sketches are drawn and the polygon data are entered into the geographic information system of the portable NFI input devices. If the former border line can be recognized in the follow-up NFI, it is kept. A new measurement of the border line is carried out if a minimum distance of 2 m between corner points of the lines is exceeded.

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). For the years before the observation period between NFI 1992/96 and NFI 2000/02 (as represented by the results of NFI 2000/02), i.e. for the years 1990 to 1994 only the total areas of AR-lands and D-lands are available from NFIs (observation period between 1986/90 and NFI 1992/96 as represented by the results of NFI 1992/96), but no further distribution into the different LUC subcategories. It was assumed that the total measured AR- and D-areas in the years 1990 to 1994 (as assessed by the observation period between NFI 1986/90 and NFI 1992/96) show the same relative ratio of distribution in AR- and D-subcategories as assessed by the NFI 2000/02. So, the area ratios of AR- and D-subcategories according to NFI 2000/02 could be applied directly to split the total AR- and D-areas according to the NFIs 1986/90 and 1992/96 to individual AR- and D-categories.

Furthermore, in response to the recommendations of the ERT during the ICR 2013 a detailed assessment of the NFI data was carried out for the years 1989 to 1994 covered by the NFIs 1986/90 and 1992/96 in order to provide better estimates for ARD activities that occurred after the 1st of January 1990. The data sets and LUC information out of these NFIs was split to account for the activities before 1990 and since 1990. The result showed slightly higher LUC activities from and to forests in the year 1989 than for the following years 1990-94. The time series 1990 to 1994 of the ARD areas was adjusted accordingly.

Table 294: Land use changes to forest (%, ha) observed form 1990 to 2012 (covering the NFI periods 1986/90, 1992/96, 2000/02, 2007/09 and the ARD NFI 2011/13; based on BFW 2013).

Categories of land use changes according to the IPCC GPG 2003	1990 – NFI 1992/96		NFI 1992/96 – NFI 2000/02		NFI 2000/02 – NFI 2007/09		NFI 2007/09 – ARD NFI 2011/13	
	LUC to forest land (%)	**LUC to forest land [1000 ha]**	**LUC to forest land (%)**	**LUC to forest land [1000 ha]**	**LUC to forest land (%)**	**LUC to forest land [1000 ha]**	**LUC to forest land (%)**	**LUC to forest land [1000 ha]**
Cropland (5 A.2.1)	11.9	6.9	11.9	6.5	6.2	3.4	6.2	1.8
Grassland (5 A.2.2)	55.5	32.0	55.5	30.1	50.2	27.8	48.9	14.1
Wetlands (5 A.2.3)	4.8	2.8	4.8	2.6	8.7	4.8	4.9	1.4
Settlements (5 A.2.4)	6.6	3.8	6.6	3.6	5.0	2.8	3.1	0.9
Others (5 A.2.5)	21.2	12.2	21.2	11.5	29.9	16.6	36.9	10.7
Total	**100.0**	**57.7**	**100.0**	**54.3**	**100.0**	**55.4**	**100.0**	**28.9**

Table 295: Land use changes from forest (%, ha) observed form 1990 to 2012 (covering the NFI periods 1986/90, 1992/96, 2000/02, 2007/09 and the ARD NFI 2011/13; based on BFW 2013).

Categories of land use changes according to the IPCC GPG 2003	**1990 – NFI 1992/96**		**NFI 1992/96 – NFI 2000/02**		**NFI 2000/02- NFI 2007/09**		**NFI 2007/09- ARD NFI 2011/13**	
	LUC from forest land (%)	**LUC from forest land [1000 ha]**	**LUC from forest land (%)**	**LUC from forest land [1000 ha]**	**LUC from forest land (%)**	**LUC from forest land [1000 ha]**	**LUC from forest land (%)**	**LUC from forest land [1000 ha]**
Cropland (5 A.2.1)	6.2	1.2	6.2	1.1	6.1	1.6	5.4	0.4
Grassland (5 A.2.2)	49.0	9.5	49.0	8.5	56.7	14.5	55.9	3.7
Wetlands (5 A.2.3)	2.6	0.5	2.6	0.4	2.2	0.6	14.0	0.9
Settlements (5 A.2.4)	14.8	2.9	14.8	2.6	20.0	5.1	10.3	0.7
Others (5 A.2.5)	27.4	5.3	27.4	4.7	15.0	3.8	14.4	1.0
Total	**100.0**	**19.4**	**100.0**	**17.3**	**100.0**	**25.6**	**100.0**	**6.6**

As shown in Table 294 and Table 295 ARDs mainly occur from or to grassland sites (49–56% or 49–57%, respectively). The land use changes from or to other categories are far below this value.

For reasons of accuracy and uncertainty Austria reports separately for different types of ARD activities. In addition, 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 distribution of the AR- and D-areas in these forest growth regions is also based on the NFI results 2000/02 and 2007/09 and the ARD NFI assessment 2011/13. The AR- and D-areas for the period 1990 to 1994 are accordingly distributed into forest growth regions on basis of the shares from the results of NFI 2000/02. The results are finally summed up according to the areas of LUCs as shown in Table 294 and Table 295.

Figure 43 gives an overview of the ARD areas. The NFI is designed to provide representative information for Austria in a randomized way.

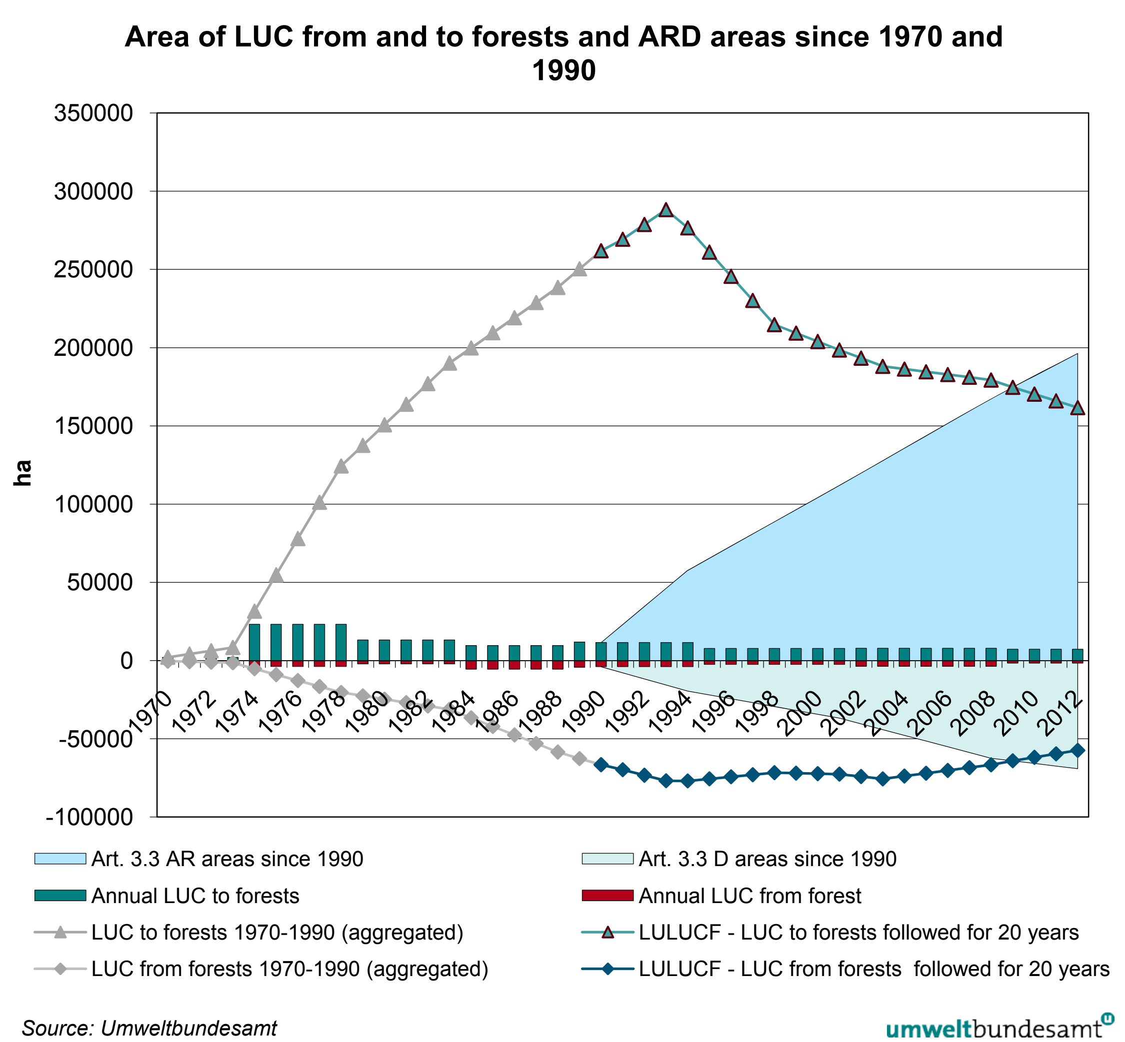

Figure 43: Areas of LUC from and to forests and ARD areas since 1970 and 1990, respectively.

Table 296: Comparison of ARD areas reported under KP and areas of LUC to/from forests reported under UNFCCC (1 000 ha). For the year 2009 (20 years of transition) the areas are the same under both reporting schemes.

	KP reporting				Reporting under the Convention		
Year	**Annual AR areas**	**Total AR areas 1990**	**Annual D areas**	**Total D areas 1990**	**5.A.2 LUC to forests, 20 yr transition period**	**LUC from forests 5.B.2 - 5.F.2, 20 yr transition period**	**Year of transition**
				1 000 ha			
1990	11.5	12	3.9	4	260	66	1
1991	11.5	23	3.9	8	269	70	2
1992	11.5	35	3.9	12	279	73	3
1993	11.5	46	3.9	16	288	77	4
1994	11.5	58	3.9	19	277	77	5
1995	7.8	65	2.5	22	261	76	6
1996	7.8	73	2.5	24	246	74	7

KP reporting					Reporting under the Convention		
Year	**Annual AR areas**	**Total AR areas 1990**	**Annual D areas**	**Total D areas 1990**	**5.A.2 LUC to forests, 20 yr transition period**	**LUC from forests 5.B.2 - 5.F.2, 20 yr transition period**	**Year of transition**
1997	7.8	81	2.5	27	230	73	8
1998	7.8	89	2.5	29	215	72	9
1999	7.8	97	2.5	32	209	72	10
2000	7.8	104	2.5	34	204	72	11
2001	7.8	112	2.5	37	199	73	12
2002	7.9	120	3.7	40	193	74	13
2003	7.9	128	3.7	44	188	76	14
2004	7.9	136	3.7	48	186	74	15
2005	7.9	144	3.7	51	185	72	16
2006	7.9	152	3.7	55	183	70	17
2007	7.9	160	3.7	59	181	68	18
2008	7.9	167	3.7	62	179	67	19
2009	7.2	**175**	1.7	**64**	**175**	**64**	20
2010	7.2	182	1.7	66	170	62	21
2011	7.2	189	1.7	67	166	60	22
2012	7.2	196	1.7	69	162	57	23

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, 2007/09 and the ARD-NFI 2011/13. 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 subcategories (forests with its sub-specifications; cropland: cropland, fallow, orchards and vineyards, biomass plantations for energy use, 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.

The following Figure 44 shows the current land use transition matrix for the years 1990 to 2012.

Land transition matrix – Area change between the current and the previous year

From previous inventory year \ To current inventory		Article 3.3 activities: Afforestation and Reforestation	Article 3.3 activities: Deforestation	Article 3.4 activities: Forest Management (if elected)	Article 3.4 activities: Cropland Management (if elected)	Article 3.4 activities: Grazing Land Management (if elected)	Article 3.4 activities: Revegetation (if elected)	Other [5]	Total area at the beginning of the current inventory year[6]
		(kha)							
Article 3.3 activities	Afforestation and Reforestation	189,14	NO						189,14
	Deforestation		67,37						67,37
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]		7,23	1,66	NA	NA	NA	NA	8.121,60	8.130,49
Total area at the end of the current inventory year		196,37	69,03	NA	NA	NA	NA	8.121,60	8.387,00

Source: CRF NIR 2 – Table

umweltbundesamt

Figure 44: 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 1992/96 and 2000/02 is given in Figure 37 in UMWELTBUNDESAMT (2010a) 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*).

As announced in NIR 2013, the submission 2014 contains estimates of the detailed assessments of the ARD activities under Article 3.3 of the Kyoto Protocol and biomass and dead wood stock changes due to these activities for the first time. The ARD assessment was carried out in the years 2011 to 2013. On the basis of these assessments the ARD areas, the emission factors at these lands and the estimates of the emissions/removals at these lands were revised.

The methods to derive the activity data were described before in chapter 10.2.

The emission factors were estimated in the following manner:

Biomass

Based on the results of the ARD NFI 2011/2013 the experts of the Federal Research and Training Centre for Forests, Natural Hazards and Landscape provided detailed, measured values for biomass increment and drain at the ARD areas (BFW, 2013) The data are available for coniferous and deciduous trees (dbh ≥ 5cm) and for two age classes of the ARD lands (long-term ARD areas which had the ARD activity already in previous NFI periods and short term ARD areas which had the ARD activity in the most recent period of assessment). For the forest biomass with a dbh < 5 cm the stock changes were estimated. The detailed data for biomass increment and biomass drain, stock changes respectively, are summarised in Table 297 and Table 298.

Table 297: Annual biomass increment and drain (DBH ≥ 5 cm) at ARD areas

	Biomass increment DBH ≥ 5 cm, total tree biomass (t/ha/a)		Biomass drain DBH ≥ 5 cm, total tree biomass (t/ha/a)	
	coniferous	deciduous	coniferous	deciduous
long term AR areas	1.88	2.01	0.35	0.97
short term AR areas	2.83	1.85	0.00	0.00
long term D areas	0.16	0.32	0.24	0.09
short term D areas	0.48	1.13	38.96	48.94

Table 298:Annual biomass stock change (DBH < 5 cm) at ARD areas

	Biomass stock changes DBH < 5 cm (t/ha/a)			
	Above ground		Below ground	
	coniferous	deciduous	coniferous	deciduous
long term AR areas	0.03	0.11	0.004	0.012
short term AR areas	0.04	0.29	0.006	0.032
long term D areas	0.001	0.060	0.0003	0.007
short term D areas	0.0003	0.116	0.00004	0.013

The biomass stock changes at the ARD lands of the whole time series were recalculated with these single values in Table 297 and Table 298. Due to these changes in emission factors and activity data the emissions/removals of all ARD in submission 2014 changed compared to those of previous submissions.

Conversion factors (BEF)

The detailed biomass assessment at the ARD areas between NFI 2007/09 and ARD NFI 2011/13 allowed the application of the same densities of single tree species and biomass functions as used in sector 5.A.1. (see chapter 7.2.4.1.1) to derive biomass increment and biomass harvest of the single trees at ARD lands with a DBH ≥ 5cm. The stock changes of biomass < 5 cm at ARD land is estimated based on counting between the last two NFI periods.

Table 299: C-conversion factors for forest biomass land use changes areas from and to forest land.

Conversion factors	increment		harvest	
	coniferous	deciduous	coniferous	deciduous
Above ground - stem	0.490	0.483	0.492	0.483
other tree compartments - branches, roots	0.473	0.480	0.473	0.481

For AR areas the calculations lead on average for 2008 to 2012 to the following result of annual net C stock change in living biomass (DBH>0cm) per ha and year:

$\Delta C_{BM} = 1.207 \text{ t C ha}^{-1} \text{ a}^{-1}$

This value is almost the same compared to that used in previous submissions (1.176 t C ha^{-1} a^{-1}).

For D areas the calculations lead to the following result of average annual C stock change in living biomass (DBH>0cm) per ha and year for the time series 2008 to 2012:

$\Delta C_{BM} = -1.237 \text{ t C ha}^{-1} \text{ a}^{-1}$

In the year of D, the following annual C stock drain in living biomass (DBH>0cm) per ha and year results:

$\Delta C_{BM\ drain} = -42.6 \text{ t C ha}^{-1} \text{ a}^{-1}$

This measured biomass drain per ha in the year of D used in submission 2014 is almost twice as high as the roughly estimated biomass drain per ha in the year of D as used in previous submissions (21.168 t C ha^{-1} a^{-1})

Dead wood

Based on ARD NFI 2011/2013 the experts of the Federal Research and Training Centre for Forests, Natural Hazards and Landscape provided detailed, measured values for stock changes of standing dead wood at ARD areas (BFW, 2013). The stock changes are summarised in Table 300.

Table 300: Annual stock changes of dead wood at ARD areas based on the ARD NFI 2011/13 (BFW, 2013).

	stock changes – dead wood (t/ha/a)
long term AR areas	0.032
short term AR areas	0.123
long term D areas	0.01
short term D areas	-0.26

Litter and soil

The soil C stock changes were stratified according to specific soil C pools of different land use changes 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 301 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.

In response to review findings the estimates of the emissions/removals in the mineral soils of ARD lands with wetlands were revised. In previous submissions wetlands (flooded land) were assumed to have a 0 soil C stock. Using the IPCC GPG approach of calculating the C stock change between a period of 20 years led to unrealistic annual C stock gains (WL to FL) or losses (FL to WL) in mineral soils for such lands. Due to a lack of information in literature for submission 2014 no C-stock changes in mineral soil are assumed at ARD lands with wetland. The AR lands WL to FL are higher than the D lands FL to WL and FL can be expected to have higher C stocks in soil. Therefore, this approach used for submission 2014 represents a conservative estimate and underestimates ARD net removals at such lands.

Table 301: 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 LANDEREGIERUNG 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) is 500 t C ha^{-1} based on 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). A thorough assessment of these areas shows that these land use changes always occur along forest boundaries and are related to a change in tree cover but not in soil conditions (bogs are protected in Austria). So, it is assumed that the soil carbon stocks at these lands do not change.

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 intensively used 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, 2007/09 and the ARD NFI 2011/13 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 301). Consequently, for each IPCC GPG land use change category from and to forest an area weighted mean value of soil C-stocks for each subcategory and growth region was calculated for each NFI period (NFI 1992/96 to 2000/02, NFI 2000/02 to 2007/09 and NFI 2007/09 to ARD NFI 2011/13). 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 236, Table 237 and Table 304.

Table 302: 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	Foothills	Alpine Ridge
Forest	91	117	109	77	88	91	117	109	77	88
Cropland	90	73	77	65	56	-	90	71	65	56
Grassland	123	125	117	85	77	116	128	115	88	75
Wetlands	0	0	0	0	0	0	0	0	0	0
Settlements	60	25	60	27	10	60	44	60	19	60
Other land	53	51	21	27	30	73	25	40	30	30

[1] *- no LUC from/to forest could be observed in these regions*

Table 303: 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	Foothills	Alpine Ridge
Forest	91	117	109	77	88	91	117	109	77	88
Cropland	90	81	78	65	57	-	88	-	68	56
Grassland	128	130	117	87	91	128	128	114	124	75
Wetlands	0	0	0	0	0	0	0	0	0	0
Settlements	-	19	60	9	39	60	46	41	27	12
Other land	46	49	49	30	39	53	41	22	13	-

[1] - no LUC from/to forest could be observed in these regions

Table 304: 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 period 2007/09 and the ARD NFI period 2011/13.

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	Foothills	Alpine Ridge
Forest	91	117	109	77	88	91	117	109	77	88
Cropland	-	77	76	65	56	-	90	-	70	-
Grassland	130	130	115	88	75	117	132	113	106	75
Wetlands	0	0	0	0	0	0	0	0	0	0
Settlements	20	60	60	-	-	60	-	60	20	60
Other land	35	81	32	21	-	-	33	79	14	-

[1] - 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 301) and mineral soil (see Table 236, Table 237 and Table 304) and follow the equations below. The changes are estimated annually on a regional basis (forest growth region) and have been summed up for each AR- and D-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:

$$\Delta SOC = A*(SOC_O – SOC_{O\text{-}T})/20$$

Δ SOC = 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 304)

$SOC_{O\text{-}T}$ = carbon stock in soils before conversion, respectively (e.g. area weighted mean value of soil C stocks from grassland converted to forest land in the Calcareous Alps: 117 t C ha^{-1}, see Table 304).

Annual carbon stock changes in litter at ARD areas:

$$\Delta C_{LT} = A^* (C_{LTo} - C_{LTo-t})/T$$

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, seeTable 304)

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)

N_2O emissions from disturbance associated with D to cropland

N_2O 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).

CO_2 emissions due to liming of D lands

In response to a review finding in the 2013 ICR, the emissions due to liming at D lands to CL and GL were estimated for the first time. The method follows exactly the approach as described in chapter 7.3.4.1.7.

Planned improvements

None

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.

There is no practice of biomass burning at ARD areas in Austria. The area affected from wild fires in the total Austrian forests is very small and ranges only between 44 and 56 ha in the years 2008 -2012 (source: statistics of the Forest Ministry, BMLFUW). No NFI plot at ARD sites was affected by wild fires in the time between 2008 and 2012 (this would have been observed and noted by the NFI team during the surveys 2011/13). Therefore, wildfire emissions at ARD lands could be excluded.

Furthermore, forests are not fertilised in Austria. So, fertilisation at AR areas and liming at AR 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)

For details see the previous chapters:

The areas of the ARD activities were changed on basis of the ARD NFI 2011/13. Due to this assessment the areas of both, AR and D, are smaller than in previous submissions. The biomass stock gains and losses at the ARD lands and dead wood stock changes at the ARD lands in the Kyoto-Period were for the first time measured accurately during this assessment.

These changes in the ARD activity data led also to different mean soil C stocks to be used for the estimates of the soil C stock changes at the ARD lands. Furthermore, in response to a review finding the soil C stock changes in the AR- and D-categories with WL were assumed to be 0. AR lands from WL are more than D lands to WL, so this approach is conservative because it underestimates the net removals of both subcategories in the mineral soil pool.

In addition, in response to a review finding the emissions due to liming at D lands to CL and GL were estimated for the first time.

So, the emission estimates for the ARD lands and for the whole Kyoto-Protocol-period were changed on basis of these new activity data and emission factors. While the emissions and removals in the single activitie s of AR and D changed significantly, the net result of ARD for submission 2014 represents 10 % higher average annual net removals compared to previous submissions.

10.3.1.5 Uncertainty estimates

On basis of the new data of the ARD NFI 2011/13 the uncertainty estimate for the emissions/removals of the Art. 3.3 ARD activities was carried out.

The uncertainties of the NFI design, measurement errors and input parameters results in an uncertainty of the net C stock changes of the biomass and dead wood at ARD areas of ±55%. Furthermore, the uncertainties of the areas of LUCs to/from forests and the uncertainties of the litter and soil C stocks as described in chapter 7.2.5 were used to derive the overall uncertainty of the emissions/removals of the ARD activities.

The Monte-Carlo-Simulations as described in chapter 7.1.5 provided the following uncertainties for the net removals of the ARD activities in the Kyoto-Protocol-Period 2008-12: ±7 857 Gg CO_2 equiv. which equals a relative uncertainty of ±116%.

Similar to sector 5.A.1, a majority of this uncertainty is attributable to the uncertainty of the soil C stock changes at ARD lands in period 2008-12 which represents in absolute figures almost the same as the absolute uncertainty of the ARD net removals in this time (±7 084 Gg CO_2). The changes in the litter pool represent also a very high absolute uncertainty which is about one third of the absolute uncertainty of the ARD net removals (±2 812 Gg CO_2). Clearly lower is the uncertainty of the net removals due to biomass changes at ARD lands in 2008-12 (±1 406 Gg CO_2).

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 2012 the following ARD activities were presumed: AR at 7 233 ha, D at 1 661 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.

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. In response to the recommendations of the ERT during the ICR 2013 a detailed assessment of the data of these two NFIs was carried in order to provide better estimates for ARD activities that occurred after the 1st of January 1990. The data sets and LUC information out of these NFIs was split to account for the activities before 1990 and since 1990. The result showed slightly higher LUC activities from and to forests in the year 1989 than for the following years 1990-94. The time series 1990 to 1994 of the ARD areas was adjusted accordingly.

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 m^2 and an average width of 10 m.

(2) Forest within the meaning of Subsection 1 also consists of basal areas of which the forestal plant cover has been temporarily reduced or removed as a result of being used for other reasons.

(3) Notwithstanding its particular use, forest within the meaning of Subsection 1 also consists of permanently unstocked basal areas where they are directly connected with forest in terms of space and forestry enterprise and contribute directly to its management (such as forestal hauling systems, wood storage places, forest glades).

(4) The following are not deemed to be forest within the meaning of Subsection 1

a) *notwithstanding other provisions of this Federal Act, basal areas which serve other purposes than that of forestry and where the plant cover of an age of at least 60 years has not reached a canopy cover of three tenths,*
b) *stocked areas which, because the structure of their plant cover is that of parks, predominantly serve purposes other than that of forestry,*
c) *shrub areas not used for forestry purposes with the exception of those which have been managed as coppice or which have been classified as protection forest (§ 23) or which have been declared protective forests (§ 30),*
d) *rows of trees where they are not shelter belts (§ 2 Subsection 3),*
e) *stocked areas which serve the immediate operation of a railway that is in existence at the time at which this Federal Act comes into force,*
f) *border areas within the meaning of § 1 paragraph 2 of the National Border Act, BGBl. No. 9/1974, insofar as they are to be kept free of plant cover based on national treaties regulating the surveying and demarcation of the national borders.*

The provisions of §§ 43 to 46 shall apply.

(5) Areas which are used in short rotation with a rotation period of up to thirty years as well as forest arboretums, forest seed orchards, Christmas tree plantations and plantations of woody plants for the purpose of obtaining fruits such as walnut or sweet chestnut, where they are not planted on forest soil and their owners have reported the intended operational use to the authority within ten years of carrying out the afforestation or establishing these facilities, shall not be deemed to be forest within the meaning of Subsection 1. Should no such report be made, § 4 shall apply.

(6) The provisions of §§ 43 to 45 shall apply to the sites listed in Subsection 5, first sentence, to forest arboretums and forest seed orchards additionally those of the Forestry Propagation Act.

(7) Forest, where the plant cover has a canopy of less than three-tenths, is referred to as a sparse stand, and forest soil with no plant cover is referred to as a clear felled area.

For the assessment of an area as forest only the definition of forest according to the Austrian Forest Act is legally binding. The Austrian forest law experts comment on basis of legal decisions the meaning of the Austrian Forest Act with respect to the land use classification in more detail: The legal consequence of the Austrian Forest Act is that any area that meets this definition becomes a forest independent from an allocation of that area to a different land use category within the property tax land register, within the borders land register or within the owners land register. In addition, any priority rights from property, ownership or servitude rights cannot change the forest status of an area that has become a forest according to the Austrian Forest Act (JÄGER 2003). The relevance of this legal binding frame for management operations is the following: Any change of land use management in a way that the resulting land cover meets the forest definition represents a legally binding land use change to forest.

The Austrian Forest Act also lays down the „public interest in the sustaining of forests", which is expressed by the fundamental ban of deforestation in §17 (1). The consequence is the following: Once an area has become a forest (see above), a following land-use change would be deforestation (and the ending of an area as „forest") in the sense of the law. However, this would be only possible under certain very limited circumstances (e.g. public interest in deforestation) and has to follow several administrative steps before being legally allowed. Therefore, the landowners have a legal need for activities to prevent an undesired re-growth of an area to a „forest" („forest force"). As a consequence, the re-growth of an area as „forest" takes only place where desired and represents therefore a „direct human induced activity".

With respect to the technique of af-/reforestation the following points are relevant: It is a frequent and often desirable forest management strategy in Austria to use the potential of natural re-growth caused, for instance, by the seed of adjacent forests (in line with the third technique of af-/reforestation listed in the Marrakesh-Accords). Reasons for that are i.a. lower economic costs and a better adaptation of the naturally re-grown trees to the local ecological conditions. Also here, the Austrian Forest Act qualifies such an activity as an appropriate management activity to reforest cleared areas (and, therefore, as a „direct human induced activity") and prioritizes it in comparison to other re-afforestation techniques:

The Austrian Forest Act §13 (BGBl. Nr 440/1975 and amendments):

§ 13. (3) Re-afforestation shall take place by means of natural regeneration, if there is a natural regeneration by seed, stool shoot or root sucker within a period of ten years, which gives rise to the expectation that the re-afforestation area will be fully stocked.

According to a decision by the „Administrative Court of Austria" (June 24th, 1996, Nr. 91/10/0168) it counts as „forest use" or „forest management" if an owner or a forest manager let an area to be re-afforested by natural regeneration.

In this context it is important to recognize, that in Austria areas are also subject to the provisions of the Forest Act in the case of natural regeneration. An area afforested by means of natural regeneration is also qualified as forest to be managed under the forest law according to Z 2 of § 4 Abs. 1 of the Forest Act:

New Afforestation

§ 4. (1) Basal areas which were not previously forest are subject to the provisions of this Federal Act in the case of:

1. *afforestation (seed or planting) ten years after it has been carried out,*
2. *natural regeneration after reaching a canopy cover of five tenths of its area with a plant cover having a height of at least 3 meters.*

The provisions of Section IV should nevertheless be applied as soon as plant cover exists.

(1a) The Federal Minister for Agriculture, Forestry, Environment and Water Management can determine, according to technical requirements in forestry, a plant cover height deviating from the provisions of Subsection 1 fig. 2

(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 offers 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 <u>all</u> 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 looses premium payments for grassland or cropland management). The provisions in the Austrian Forest Act demonstrate a general national decision by the Austrian 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 m^2:

Table 305: Tree numbers per 100 m^2.

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 m^2, while the Forest Act defines 1000 m^2. Theoretically this may result in a minor over-estimation of the af-/reforestation and deforestation area compared to the legal basis of the Forest Act. According to the statistical nature of the assessment the minor over-estimation from af-/reforestation is likely to be of the same magnitude than the over-estimation for deforestation.

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 af-/reafforestation and forest protection measures are only reduced but not cancelled. All forests in nature protected areas are managed to fulfill ecological and social functions and are subject to forest management.

The management of all the Austrian forests has to be consistent with the principles as defined in § 1 of the Austrian Forest Act.

§ 1 (2) of the Austrian Forest Act defines as aim of this law to secure the „sustainable forest management". The definition of forest management in Austria follows completely the decisions of the PAN European Process of the Forest Ministers that broadly define:

„Sustainable forest management comprises the tending and use of forests in a way and at a rate, that maintains their biodiversity, productivity, regeneration capacity, their vitality and their potential to fulfill, now and in the future relevant ecological, economic and social functions at local, national, and global levels, and that does not cause damage to other ecosystems. Notably precautions have to be taken with respect to the use of forests in view of the long production period and potential planning in order to ensure that the use of forest resources will also be preserved for future generations."

This broad definition of „forest management" is also in line with the related definitions in the IPCC GPG.

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 af-/reforestation 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 Liasion 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-/reforestated forests are under forest management).

The question on the af-/reforestation technique is in our understanding not the relevant one: The expression *„… to replant or to allow forest regeneration <u>by other means</u>"* is in our view a broad definition that includes also natural regeneration as an af-/reforestation technique (as does the definition of af-/reforestion in the Marrakech Accords). More relevant, however, may be the documentation around the issue (…*other <u>documentation</u> 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 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) 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 (windfall, 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

The new ARD NFI assessment system (2011/13) measured the biomass harvest or drain at the AR areas in the first Kyoto-period and the biomass losses due to harvest (drain) at the AR lands are reported. However, these biomass losses are due to thinnings or due to mortality and not due to clearcuts, and therefore these losses are reported in table 5(KP-I)A.1.1. So far, no deforestation of AR areas occurred in Austria ("NO" in table 5(KP-I)A.1.2).

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 45 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], [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)

Source: CRF NIR 3 – Table

Figure 45: 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 their national registries' holdings and transactions 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, lCERs, AAUs and RMUs for the year 2013 is submitted together with this report (SEF_AT_2014_1_14-10-56 13-1-2014.xls).

11.3 Discrepancies and notifications

No discrepancies occurred in 2013. Therefore, no report R-2 is submitted.

No CDM notifications occurred in 2013. Therefore, no report R-3 is submitted.

No non-replacements occurred in 2013. Therefore, no report R-4 is submitted.

No invalid units exist as of 31 December 2013. Therefore, no report R-5 is submitted.

There were no actions necessary to correct any problem causing a discrepancy because there were no discrepancies in 2013.

11.4 Publicly accessible information

Section E of the annex to Decision 15/CMP.1 outlines provisions for making available non-confidential information to the public via a user interface.. Austria makes available publicly accessible information on the website of the Austrian emissions trading registry: www.emissionshandelsregister.at. Additional up-to date public information concerning the Consolidated System of EU Registries (CSEUR) is now available at the European Union Transaction Log website http://ec.europa.eu/environment/ets/.

11.5 Calculation of the commitment period reserve (CPR)

According to paragraph 6 of the annex to Decision 11/CMP.1 each Party included in Annex I shall maintain, in its national registry, a commitment period reserve which should not drop below 90 per cent of the Party's assigned amount calculated pursuant to Article 3, paragraphs 7 and 8, of the Kyoto Protocol, or 100 per cent of five times its most recently reviewed inventory, whichever is lowest.

Austria's assigned amount was fixed at 343 866 009 tonnes CO_2 equivalent in its initial review report[119]. 90% of this assigned amount corresponds to 309 479 408 tonnes CO_2 equivalent. 100 per cent of five times Austria's emissions from its most recently reviewed inventory (emissions 2011, re-submitted in November 2013)[120] would result in 414 219 360 tonnes CO_2 equivalent (~ 82 843 872 x 5), which is higher than the level calculated using the assigned amount.

Therefore Austria's commitment period reserve is **309 479 408 tonnes CO_2 equivalent**.

11.6 KP-LULUCF accounting

Austria selected accounting of the KP-LULUCF activities at the end of the commitment period.

119 http://unfccc.int/resource/docs/2007/irr/aut.pdf

120 http://unfccc.int/files/national_reports/annex_i_ghg_inventories/national_inventories_submissions/application/zip/aut-2013-crf-18nov.zip

12 CHANGES IN THE NATIONAL SYSTEM

The national system is unchanged compared to the description given in the Austrian Initial Report under the Kyoto Protocol[121].

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

13 CHANGES IN THE NATIONAL REGISTRY

13.1 Information on changes according to Decision 15/CMP.1

The following table summarises the changes to the National Registry of Austria in 2013.

Table 306: Changes to the National Registry.

Reporting item	Description
15/CMP.1 annex II.E paragraph 32.(a) Change of name or contact	No change of the name/contact information of the registry administrator has occurred.
15/CMP.1 annex II.E paragraph 32.(b) Change regarding cooperation arrangement	No change of cooperation arrangement occurred during the reported period.
15/CMP.1 annex II.E paragraph 32.(c) Change to database structure or the capacity of national registry	An updated diagram of the database structure is submitted together with the NIR. This separate document (Annex A - CSEUR_DB_ model.pdf) shall not be published. Iteration 5 of the national registry released in January 2013 and Iteration 6 of the national registry released in June 2013 introduces changes in the structure of the database. Changes introduced in release 5 and 6 of the national registry were limited and only affected EU ETS functionality. No change was required to the database and application backup plan or to the disaster recovery plan. No change to the capacity of the national registry occurred during the reported period.
15/CMP.1 annex II.E paragraph 32.(d) Change regarding conformance to technical standards	Changes introduced in release 5 and 6 of the national registry were limited and only affected EU ETS functionality. However, each release of the registry is subject to both regression testing and tests related to new functionality. These tests also include thorough testing against the DES and were successfully carried out prior to the relevant major release of the version to Production. Annex H testing was carried out in February 2014. The reports documenting these tests are submitted together with the NIR. These separate documents (Annex B - CR2013.xlsx and Annex H test results.docx) shall not be published. No other change in the registry's conformance to the technical standards occurred for the reported period.
15/CMP.1 annex II.E paragraph 32.(e) Change to discrepancies procedures	No change of discrepancies procedures occurred during the reported period.
15/CMP.1 annex II.E paragraph 32.(f) Change regarding security	No change of security measures occurred during the reporting period
15/CMP.1 annex II.E paragraph 32.(g) Change to list of publicly available information	No change to the list of publicly available information occurred during the reporting period.
15/CMP.1 annex II.E paragraph 32.(h) Change of Internet address	No change of the registry internet address occurred during the reporting period.
15/CMP.1 annex II.E paragraph 32.(i) Change regarding data integrity measures	No change of data integrity measures occurred during the reporting period.
15/CMP.1 annex II.E paragraph 32.(j) Change regarding test results	Changes introduced in release 5 and 6 of the national registry were limited and only affected EU ETS functionality. Both regression testing and tests on the new functionality were successfully carried out prior to release of the version to Production. The site acceptance test was carried out by quality assurance consultants on behalf of and assisted by the European Commission. Annex H testing was carried out in February 2014. The reports documenting these tests are submitted together with the NIR. These separate documents (Annex B – CR2013.xlsx and Annex H test results.docx) shall not be published.

13.2 Previous Annual Review recommendations

The following table lists the findings of the 2013 Standard Independent Assessment Report and the Party's response.

Table 307: Previous Annual Review recommendations and response.

Reference	Recommendation	Response
ARR 2013 para 80, para 86	The ERT reiterated the recommendations contained in the SIAR including strong recommendation that the Party test each release thoroughly against the DES as part of each major release cycle and provide the complete results in the NIR of its next annual submission and further recommends that following major changes, the Party provide a data model which contains all DES required entities complete with descriptions in the NIR of its next annual submission. Both recommendations are caused due to problems with the centralisation of the national registry into a single European Union registry.	In response to questions raised by the ERT during the review, Austria provided information stating that the additional description of database structure and the complete reporting of test results have already been submitted to the secretariat. Each major release of the registry is subject to both regression testing and tests related to new functionality. These tests include thorough testing against the DES. The reports documenting the latest Annex H tests from February 2014 are submitted together with the NIR. These separate documents (Annex B - CR2013.xlsx and Annex H test results.docx) shall not be published. An updated diagram of the database structure is submitted together with the NIR. This separate document (Annex A – CSEUR_DB_ model.pdf) shall not be published.

14 INFORMATION ON MINIMIZATION OF ADVERSE IMPACTS IN ACCORDANCE WITH ARTICLE 3, PARAGRAPH 14

The following information is provided in accordance with the guidelines for the preparation of the information required under Article 7 of the Kyoto Protocol (Decision 15/CMP.1, Section H.).

The information has been updated. Information concerning para 23 has been taken from Austria's Sixth National Communication. Information concerning para 24 has been updated according to recent developments (especially on fiscal incentives) and slightly abridged.

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 effects 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 contains, Austria is naturally working to minimize any adverse effects due to the reduction of greenhouse gas emissions.

Austria is acting together with other Parties in the EU to jointly fulfil the commitments under the Protocol. Key climate policies and measures (e.g. the EU Emissions Trading System, EU-ETS) are established at an EU level. While these policies are executed at the national level, they are not monitored and assessed by individual Member States, but by the EU as a whole. The EU reports in detail on how it strives to minimize adverse effects in its annual national inventory report in chapter 15, to which we hereby refer for further information.

Austria also seeks to ensure that response measures designed and implemented entirely at the national level are as targeted and effective as possible. Since 2013, we have compulsory, government-wide impact assessments concerning environmental, economic and social consequences of policies and measures – including, where appropriate, effects on other countries. In addition, there are legally-binding standards for Austrian JI/CDM projects. The stringent social and environmental criteria include favoured project categories, a focus on environmental co-benefits, on social standards and on technology transfer.

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 2013 (Mineralölsteuergesetz 2013) and the Normverbrauchsabgabegesetz (NoVA) were changed. Since 2011 the air traffic has also to contribute through the introduction of a flight fee (Flight Fee Law, December 2010).

- **NoVA (from 1 March 2011, NoVA Ökologisierungsgesetz: BGBl. I Nr. 46/2008)**

(1) newly authorized automobiles with a CO_2 emission of at most 120 g/km get a bonus of 360 Euro, (2) alternativly operated vehicles – Hybrid, E 85, Methan in form of natural gas, hydrogen or liquefied gas – get a general bonus of 600 Euro and (3) newly authorized automobiles with a CO_2 emission of more than 160 g/km will have to pay 30 Euro for each gram over the threshold, newly authorized automobiles with a CO_2 emission of more than 180 g/km will have to pay additionally 30 Euro for each gram over the threshold). This threshold was lowered to 160 g/km in January 2010 and to 150 g/km by January 2013.

The incentives have produced significant results insofar as the share of alternative and low-carbon vehicles has increased up to 40 % of all new cars in 2013, while only 10% of the newly registered cars have CO_2 emissions above the threshold.

- **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 have to pay a fee at a specific amount per passenger (very few exceptions are granted, e.g. like military or humanitary flights):

Short distance (within Austria, as well as e.g. Sweden, Cyprus): 8 Euros

Medium Distance (e.g. Iraq, Sudan): 20 Euros

Long Distance (Brazil, Indonesia): 35 Euros

An amendment of the Act has led to slight changes of the fee in 2013.

Agricultural subsidies

ÖPUL 2007 (Österreichisches Programm für umweltgerechte Landwirtschaft)

Austria provides subsidies for farmes according to the programme for the promotion of agriculture that is extensive, appropriate to the environment, and protective of nature. The subsidised measures also lead to decreasing greenhouse gas emissions.
(http://land.lebensministerium.at/article/articleview/62457/1/21409/)

(b) Removing subsidies associated with the use of environmentally unsound and unsafe technologies

No subsidies for environmentally unsound technologies have been identified.

(c) Cooperating in the technological development of non-energy uses of fossil fuels, and supporting developing country Parties to this end

This technological field is not a high priority in the Austrian research policy.

(d) Cooperating in the development, diffusion and transfer of less-greenhouse-gas-emitting advanced fossil-fuel technologies, and/or technologies, relating to fossil fuels, that capture and store greenhouse gases, and encouraging their wider use; and facilitating the participation of the least developed countries and other non-Annex I Parties in this effort

Regarding the development, diffusion and transfer of technology which causes no or less greenhouse gas emissions Austria puts its focus is on renewable energy sources.

(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

No action is taken in this context.

(f) Assisting developing county Parties which are highly dependent on the export and consumption of fossil fuels in diversifying their economies.

Austria is a member of institutions and initiatives that have the exchange of research results and transfer of technology as a main target, e. g. the International Energy Agency and the Climate Technology Initiative. Bilateral assistance projects are another important means for transfer of technology which helps countries reducing their dependence on the consumption of fossil fuels.

- **International Energy Agency (IEA)**

Austria is a founding member of the International Energy Agency (IEA), which was founded in 1974. A lot of climate change issues are processed in so-called joint Implementation Agreements, where international partners collaborate on different research topics.

- **Climate Technology Initiative**

Austria is member of the Climate Technology, which was established in 1995 at the Conference of Parties to the UNFCCC and has a new status as an IEA Implementing Agreement since 2003. Its mission is to promote the objectives of the UNFCCC by fostering international cooperation for accelerated development and diffusion of climate friendly technologies and practises for all activities and greenhouse gases. The main principles of CTI are close collaboration with developing countries and economies in transition and partnership with stakeholders, including the private sector, non-government organisations (NGOs), and other international organisations. CTI performs a. o. capacity building and technical assistance for technology needs assessments as well as technology implementation activities and organizes seminars, symposia and training courses. (http://www.climatetech.net)

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 (renamed as BMWFJ)

BMWFJ ....Bundesministerium für Wirtschaft, Familie und Jugend
Federal Ministry of Economy, Family and Youth (formerly called BMWA)

BUWAL ....Bundesamt für Umwelt, Wald und Landschaft, Bern
The Swiss Agency for the Environment, Forests and Landscape (SAEFL), Bern

COP ....Conference of the Parties

CORINAIR ....Core Inventory Air

CORINE................Coordination d´information Environmentale

CRF ....Common Reporting Format

DKDB....................Dampfkesseldatenbank
Austrian annual steam boiler inventory

DOC......................Degradable Organic Carbon

EC.........................European Community

EEA.......................European Environment Agency

EFTA.....................European Free Trade Association

EIONET ....European Environment Information and Observation NETwork

EMEP....................Cooperative Programme for Monitoring and Evaluation of the Long-range Transmission of Air Pollutants in Europe

EN.........................European Norm

EPER ....European Pollutant Emission Register

ETC/AE.................European Topic Centre on Air Emissions

EU.........................European Union

ERT.......................Expert Review Team (in context of the UNFCCC review process)

FAO ....Food and Agricultural Organisation of the United Nations

GHG......................Greenhouse Gas

GLOBEMI ....Globale Modellbildung für Emissions- und Verbrauchsszenarien im Verkehrssektor (Global Modelling for Emission- and Fuel consumption Scenarios of the Transport Sector) see (HAUSBERGER 1998)

GPG......................Good Practice Guidance [IPCC GPG, 2000]

GWP ....Global Warming Potential

IPCC ....Intergovernmental Panel on Climate Change

ICR.......................In-Country Review (by the UNFCCC)

IEA ....International Energy Agency

ISO.......................International Standards Organisation

LTO......................Landing/Take-Off cycle

LULUCF ....Land Use, Land-Use Change and Forestry – IPCC-CRF Category 5

NACE...................Nomenclature des activites economiques de la Communaute Europeenne

NAPFUE ....Nomenclature for Air Pollution Fuels

NFI ....National Forest Inventory

NFR ....Nomenclature for Reporting (Format of Reporting under the UNECE/CLRTAP Convention)

NISA ....National Inventory System Austria

OECD ....Organisation for Economic Co-operation and Development

OLI ....Österreichische Luftschadstoff Inventur
Austrian Air Emission Inventory

OMV.....................Österreichische Mineralölverwaltung
Austrian Mineraloil Company

PHARE ....Phare is the acronym of the Programme's original name:
'**P**oland and **H**ungary: **A**ction for the **R**estructuring of the **E**conomy'.
It covers now 14 partner countries: Albania, Bosnia and Herzegovina, Bulgaria, Croatia, the Czech Republic, Estonia, the Former Yugoslav Republic of Macedonia (FYROM), Hungary, Latvia, Lithuania, Poland, Romania, Slovakia and Slovenia. (However, Croatia was suspended from the Phare Programme in July 1995.)

QA/QC ....Quality Assurance/Quality Control

QMS.....................Quality Management System

RWA ....Raiffeisen Ware Austria (see www.rwa.at)

SNAP ....Selected Nomenclature on Air Pollutants

UNECE/CLRTAP ..United Nations Economic Commission for Europe,
Convention on Long-range Transboundary Air Pollution

UNFCCC..............United Nations Framework Convention on Climate Change

Notation Keys

According to UNFCCC guidelines on reporting and review (FCCC/CP/2002/8)

„NO“ (not occurring)	for activities or processes in a particular source or sink category that do not occur within a country;
„NE“ (not estimated)	for existing emissions by sources and removals by sinks of greenhouse gases which have not been estimated. Where „NE” is used in an inventory for emissions or removals of CO_2, CH_4, N_2O, HFCs, PFCs, or SF_6, the Party should indicate in both the NIR and the CRF completeness table why emissions or removals have not been estimated
„NA“ (not applicable)	for activities in a given source/sink category that do not result in emissions or removals of a specific gas. If categories in the CRF for which „NA” is applicable are shaded, they do not need to be filled in
„IE“ (included elsewhere)	for emissions by sources and removals by sinks of greenhouse gases estimated but included elsewhere in the inventory instead of the expected source/sink category. Where „IE” is used in an inventory, the Annex I Party should indicate, using the CRF completeness table, where in the inventory the emissions or removals from the displaced source/sink category have been included and the Annex I Party should explain such a deviation from the expected category
„C“ (confidential)	for emissions by sources and removals by sinks of greenhouse gases which could lead to the disclosure of confidential information, given the provisions of paragraph 27 of above

Chemical Symbols

Symbol................Name

Greenhouse gases

CH_4................Methane

CO_2................Carbon Dioxide

N_2O................Nitrous Oxide

HFCs ....Hydroflurocarbons

PFCs ....Perfluorocarbons

SF_6 ....Sulphur hexafluoride

Further chemical compounds

CO ....Carbon Monoxide

Cd ....Cadmium

NH_3................Ammonia

Hg ....Mercury

NO_X................Nitrogen Oxides (NO plus NO_2)

NO_2................Nitrogen Dioxide

NMVOC ....Non-Methane Volatile Organic Compounds

PAH ....Polycyclic Aromatic Hydrocarbons

Pb ....Lead

POP ....Persistent Organic Pollutants

SO_2................Sulfur Dioxide

SO_X................Sulfur Oxides

Units and Metric Symbols

UNIT	Name	Unit for
g	gram	mass
t	ton	mass
W	watt	power
J	joule	calorific value
m	meter	length
Mass Unit Conversion		
1g		
1kg	= 1 000 g	
1t	= 1 000 kg	= 1 Mg
1kt	= 1 000 t	= 1 Gg
1Mt	= 1 Mio t	= 1 Tg

Metric Symbol	Prefix	Factor
P	peta	10^{15}
T	tera	10^{12}
G	giga	10^{9}
M	mega	10^{6}
k	kilo	10^{3}
h	hecto	10^{2}
da	deca	10^{1}
d	deci	10^{-1}
c	centi	10^{-2}
m	milli	10^{-3}
µ	micro	10^{-6}
n	nano	10^{-9}

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ANNEX

ANNEX 1: KEY CATEGORY ANALYSIS

Methodology for identification of key categories

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

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

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

The identification of key categories consists of six steps:

- Identifying categories
- Level Assessment excluding LULUCF (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 CH_4 from LULUCF, total N_2O from LULUCF and *5.B* net CO_2 from lime application.

Table A 17 of Annex 1 presents the 258 source/sink categories (incl. LULUCF) considered in the key category analysis, and their greenhouse gas emissions expressed in CO_2 equivalent emissions for the years 1990 to 2012.

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 CO_2 equivalent emissions) of each category to national total emissions was calculated. The calculation was performed for the years 1990 and 2012 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 2012 43 source categories comprised > 95% of the cumulative total and were thus rated as key categories. For the year 1990 47 source categories were identified as key categories in the level assessment in Tier 1 approach. The result of each level assessment is presented in Tables A 1 and A 2.

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 2012 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. 44 sources were identified as key categories in the trend assessment according to Tier 1 approach. Results are presented in Table A 3.

Level Assessment including LULUCF

The level assessment was repeated for the full inventory including the LULUCF categories for the years 1990 and 2012 according to Equation 5.4.1 of the GPG-LULUCF. 6 (1990) respectively 7 (2012) LULUCF key categories were identified by this analysis additionally. The result of each level assessment is presented in Tables A 4 and A 5.

Trend Assessment including LULUCF

Also the trend assessment was repeated for the full inventory including the LULUCF categories for the years 1990 and 2012 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 Tier 1 is presented in Table A 6.

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% (Tier 1) respectively 90% (Tier 2) 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 2012, and for the trend assessment 1990-2012, 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 2012 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	GHG	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	CO2	7 936	10.2%	10.2%
1 A 1 a solid	Public Electricity and Heat Production	CO2	6 247	8.0%	18.2%
1 A 4 b liquid	Residential	CO2	5 605	7.2%	25.3%
1 A 3 b diesel oil	Road Transportation	CO2	5 361	6.9%	32.2%
1 A 2 a solid	Iron and Steel	CO2	3 846	4.9%	37.1%
4 A 1	Cattle	CH4	3 551	4.5%	41.7%
2 C 1	Iron and Steel Production	CO2	3 546	4.5%	46.2%
6 A	SOLID WASTE DISPOSAL ON LAND	CH4	3 314	4.2%	50.5%
1 A 1 a gaseous	Public Electricity and Heat Production	CO2	3 294	4.2%	54.7%
1 A 4 b solid	Residential	CO2	2 512	3.2%	57.9%
2 A 1	Cement Production	CO2	2 033	2.6%	60.5%
1 A 1 b liquid	Petroleum refining	CO2	1 958	2.5%	63.0%
4 D 1	Direct Soil Emissions	N2O	1 909	2.4%	65.5%
1 A 4 b gaseous	Residential	CO2	1 847	2.4%	67.8%
1 A 2 f gaseous	Other	CO2	1 573	2.0%	69.8%
1 A 4 a liquid	Commercial/Institutional	CO2	1 421	1.8%	71.7%
1 A 2 f liquid	Other	CO2	1 376	1.8%	73.4%
4 D 3	Indirect Emissions	N2O	1 352	1.7%	75.1%
1 A 1 a liquid	Public Electricity and Heat Production	CO2	1 229	1.6%	76.7%
1 A 4 c liquid	Agriculture/Forestry/Fisheries	CO2	1 181	1.5%	78.2%
2 C 3	Aluminium production	PFC	994	1.3%	79.5%
1 A 2 d gaseous	Pulp, Paper and Print	CO2	943	1.2%	80.7%
2 B 2	Nitric Acid Production	N2O	912	1.2%	81.9%
1 A 2 d liquid	Pulp, Paper and Print	CO2	853	1.1%	83.0%
4 B 1	Cattle	N2O	759	1.0%	83.9%
1 A 4 a gaseous	Commercial/Institutional	CO2	707	0.9%	84.9%
1 A 2 a gaseous	Iron and Steel	CO2	650	0.8%	85.7%
1 A 2 f solid	Other	CO2	625	0.8%	86.5%
1 A 2 c gaseous	Chemicals	CO2	519	0.7%	87.1%
1 A 2 e gaseous	Food Processing, Beverages and Tobacco	CO2	507	0.6%	87.8%
1 A 1 c gaseous	Manufacture of Solid fuels and Other Energy	CO2	506	0.6%	88.4%
2 A 7 b	Sinter Production	CO2	481	0.6%	89.1%
2 B 1	Ammonia Production	CO2	472	0.6%	89.7%
1 A 2 a liquid	Iron and Steel	CO2	448	0.6%	90.2%
1 A 1 b gaseous	Petroleum refining	CO2	437	0.6%	90.8%
1 A 2 d solid	Pulp, Paper and Print	CO2	397	0.5%	91.3%
2 A 2	Lime Production	CO2	396	0.5%	91.8%
1 A 4 a other	Commercial/Institutional	CO2	350	0.4%	92.3%
1 A 2 e liquid	Food Processing, Beverages and Tobacco	CO2	345	0.4%	92.7%
1 A 4 b biomass	Residential	CH4	314	0.4%	93.1%
4 B 1	Cattle	CH4	283	0.4%	93.5%
2 C 4	SF6 used in Al and Mg Foundries	SF6	253	0.3%	93.8%
3 D	OTHER	N2O	233	0.3%	94.1%
1 A 3 e gaseous	Other	CO2	224	0.3%	94.4%
2 A 3	Limestone and Dolomite Use	CO2	203	0.3%	94.6%
1 A 2 c other	Chemicals	CO2	174	0.2%	94.9%
1 A 3 c liquid	Railways	CO2	171	0.2%	95.1%

Table A 2: Tier 1 - Level Assessment of the key category analysis excluding LULUCF for the year 2012.

IPCC Category Code	IPCC Category	GHG	Year 2012 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	CO2	15 808	19.7%	19.7%
2 C 1	Iron and Steel Production	CO2	5 454	6.8%	26.6%
1 A 3 b gasoline	Road Transportation	CO2	4 950	6.2%	32.7%
1 A 2 a solid	Iron and Steel	CO2	4 196	5.2%	38.0%
1 A 1 a gaseous	Public Electricity and Heat Production	CO2	4 021	5.0%	43.0%
1 A 4 b liquid	Residential	CO2	3 880	4.8%	47.9%
1 A 1 a solid	Public Electricity and Heat Production	CO2	3 454	4.3%	52.2%
4 A 1	Cattle	CH4	2 985	3.7%	55.9%
1 A 4 b gaseous	Residential	CO2	2 851	3.6%	59.5%
1 A 1 b liquid	Petroleum refining	CO2	2 368	3.0%	62.4%
1 A 2 f gaseous	Other	CO2	1 955	2.4%	64.9%
4 D 1	Direct Soil Emissions	N2O	1 807	2.3%	67.1%
1 A 2 f liquid	Other	CO2	1 784	2.2%	69.3%
2 A 1	Cement Production	CO2	1 673	2.1%	71.4%
1 A 2 d gaseous	Pulp, Paper and Print	CO2	1 582	2.0%	73.4%
2 F 1	Refrigeration and Air Conditioning Equipment	HFC	1 389	1.7%	75.1%
1 A 1 a other	Public Electricity and Heat Production	CO2	1 288	1.6%	76.7%
1 A 2 a gaseous	Iron and Steel	CO2	1 279	1.6%	78.3%
1 A 4 a gaseous	Commercial/Institutional	CO2	1 217	1.5%	79.9%
6 A	SOLID WASTE DISPOSAL ON LAND	CH4	1 201	1.5%	81.4%
1 A 2 c gaseous	Chemicals	CO2	1 199	1.5%	82.9%
4 D 3	Indirect Emissions	N2O	1 154	1.4%	84.3%
1 A 2 e gaseous	Food Processing, Beverages and Tobacco	CO2	767	1.0%	85.3%
1 A 4 c liquid	Agriculture/Forestry/Fisheries	CO2	759	0.9%	86.2%
4 B 1	Cattle	N2O	731	0.9%	87.1%
2 A 2	Lime Production	CO2	569	0.7%	87.8%
1 A 2 f other	Other	CO2	527	0.7%	88.5%
2 B 1	Ammonia Production	CO2	511	0.6%	89.1%
1 A 1 c gaseous	Manufacture of Solid fuels and Other Energy Industries	CO2	506	0.6%	89.8%
1 A 1 b gaseous	Petroleum refining	CO2	468	0.6%	90.3%
1 A 3 e gaseous	Other	CO2	394	0.5%	90.8%
1 A 2 c other	Chemicals	CO2	392	0.5%	91.3%
1 A 2 a liquid	Iron and Steel	CO2	383	0.5%	91.8%
1 A 2 d solid	Pulp, Paper and Print	CO2	348	0.4%	92.2%
2 A 7 b	Sinter Production	CO2	305	0.4%	92.6%
1 A 2 f solid	Other	CO2	288	0.4%	93.0%
6 B	WASTEWATER HANDLING	N2O	266	0.3%	93.3%
2 A 3	Limestone and Dolomite Use	CO2	256	0.3%	93.6%
2 F 9	Other Sources of SF6	SF6	247	0.3%	93.9%
4 B 1	Cattle	CH4	224	0.3%	94.2%
1 A 1 a liquid	Public Electricity and Heat Production	CO2	219	0.3%	94.5%
1 A 2 b gaseous	Non-ferrous Metals	CO2	216	0.3%	94.8%
1 A 2 e liquid	Food Processing, Beverages and Tobacco	CO2	198	0.2%	95.0%

Table A 3: Tier 1 - Trend Assessment of the key category analysis excluding LULUCF for the trend 1990–2012.

IPCC Category Code	IPCC Category	GHG	Base Year (1990) Estimate $E_{x,0}$	Latest Year (2012) 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	CO2	5 361	15 808	0.126	23.4%	23.4%
1 A 3 b gasoline	Road Transportation	CO2	7 936	4 950	0.039	7.2%	30.7%
1 A 1 a solid	Public Electricity and Heat Production	CO2	6 247	3 454	0.036	6.7%	37.4%
1 A 4 b solid	Residential	CO2	2 512	149	0.030	5.5%	42.9%
6 A	SOLID WASTE DISPOSAL ON LAND	CH4	3 314	1 201	0.027	5.0%	47.9%
1 A 4 b liquid	Residential	CO2	5 605	3 880	0.023	4.2%	52.1%
2 C 1	Iron and Steel Production	CO2	3 546	5 454	0.022	4.1%	56.3%
2 F 1	Refrigeration and Air Conditioning Equipment	HFC	0	1 389	0.017	3.2%	59.4%
1 A 4 a liquid	Commercial/Institutional	CO2	1 421	189	0.015	2.9%	62.3%
1 A 1 a other	Public Electricity and Heat Production	CO2	118	1 288	0.014	2.7%	65.0%
1 A 1 a liquid	Public Electricity and Heat Production	CO2	1 229	219	0.013	2.4%	67.3%
1 A 4 b gaseous	Residential	CO2	1 847	2 851	0.012	2.2%	69.5%
2 B 2	Nitric Acid Production	N2O	912	53	0.011	2.0%	71.5%
1 A 2 d liquid	Pulp, Paper and Print	CO2	853	41	0.010	1.9%	73.4%
1 A 2 c gaseous	Chemicals	CO2	519	1 199	0.008	1.5%	74.9%
4 A 1	Cattle	CH4	3 551	2 985	0.008	1.5%	76.4%
1 A 1 a gaseous	Public Electricity and Heat Production	CO2	3 294	4 021	0.008	1.5%	77.9%
1 A 2 d gaseous	Pulp, Paper and Print	CO2	943	1 582	0.007	1.4%	79.3%
1 A 2 a gaseous	Iron and Steel	CO2	650	1 279	0.007	1.4%	80.7%
1 A 4 a gaseous	Commercial/Institutional	CO2	707	1 217	0.006	1.1%	81.8%
1 A 2 f other	Other	CO2	70	527	0.006	1.0%	82.8%
1 A 4 c liquid	Agriculture/Forestry/Fisheries	CO2	1 181	759	0.006	1.0%	83.8%
2 A 1	Cement Production	CO2	2 033	1 673	0.005	0.9%	84.8%
1 A 2 f liquid	Other	CO2	1 376	1 784	0.005	0.8%	85.6%
1 A 1 b liquid	Petroleum refining	CO2	1 958	2 368	0.004	0.8%	86.4%
1 A 4 a other	Commercial/Institutional	CO2	350	2	0.004	0.8%	87.3%
1 A 2 f solid	Other	CO2	625	288	0.004	0.8%	88.1%
1 A 2 f gaseous	Other	CO2	1 573	1 955	0.004	0.8%	88.8%
2 C 4	SF6 used in Al and Mg Foundries	SF6	253	5	0.003	0.6%	89.4%
1 A 2 a solid	Iron and Steel	CO2	3 846	4 196	0.003	0.6%	90.0%
1 A 2 e gaseous	Food Processing, Beverages and Tobacco	CO2	507	767	0.003	0.6%	90.6%
4 D 3	Indirect Emissions	N2O	1 352	1 154	0.003	0.5%	91.1%
1 A 2 c other	Chemicals	CO2	174	392	0.003	0.5%	91.6%
2 A 7 b	Sinter Production	CO2	481	305	0.002	0.4%	92.0%
1 A 3 e gaseous	Other	CO2	224	394	0.002	0.4%	92.4%
2 A 2	Lime Production	CO2	396	569	0.002	0.4%	92.7%
1 A 2 e liquid	Food Processing, Beverages and Tobacco	CO2	345	198	0.002	0.4%	93.1%
6 B	WASTEWATER HANDLING	N2O	109	266	0.002	0.3%	93.4%
4 D 1	Direct Soil Emissions	N2O	1 909	1 807	0.002	0.3%	93.8%
1 A 4 b biomass	Residential	CH4	314	179	0.002	0.3%	94.1%
1 A 2 b gaseous	Non-ferrous Metals	CO2	75	216	0.002	0.3%	94.4%
2 F 9	Other Sources of SF6	SF6	127	247	0.001	0.3%	94.7%
1 B 2 a	Oil	CO2	43	145	0.001	0.2%	94.9%
3 D	OTHER	N2O	233	146	0.001	0.2%	95.1%

Table A 4: Tier 1 - Level Assessment of the key category analysis including LULUCF for the base year 1990.

IPCC Category Code	IPCC Category	GHG	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	CO2	7 936	7 936	8.8%	8.8%
5 A 1	Forest land remaining forest land	CO2	-7 849	7 849	8.7%	17.5%
1 A 1 a solid	Public Electricity and Heat Production	CO2	6 247	6 247	6.9%	24.4%
1 A 4 b liquid	Residential	CO2	5 605	5 605	6.2%	30.6%
1 A 3 b diesel oil	Road Transportation	CO2	5 361	5 361	5.9%	36.5%
1 A 2 a solid	Iron and Steel	CO2	3 846	3 846	4.3%	40.8%
4 A 1	Cattle	CH4	3 551	3 551	3.9%	44.7%
2 C 1	Iron and Steel Production	CO2	3 546	3 546	3.9%	48.6%
6 A	SOLID WASTE DISPOSAL ON LAND	CH4	3 314	3 314	3.7%	52.3%
1 A 1 a gaseous	Public Electricity and Heat Production	CO2	3 294	3 294	3.6%	55.9%
5 A 2	Land converted to forest land	CO2	-3 081	3 081	3.4%	59.3%
1 A 4 b solid	Residential	CO2	2 512	2 512	2.8%	62.1%
2 A 1	Cement Production	CO2	2 033	2 033	2.2%	64.4%
1 A 1 b liquid	Petroleum refining	CO2	1 958	1 958	2.2%	66.5%
4 D 1	Direct Soil Emissions	N2O	1 909	1 909	2.1%	68.6%
1 A 4 b gaseous	Residential	CO2	1 847	1 847	2.0%	70.7%
1 A 2 f gaseous	Other	CO2	1 573	1 573	1.7%	72.4%
1 A 4 a liquid	Commercial/Institutional	CO2	1 421	1 421	1.6%	74.0%
1 A 2 f liquid	Other	CO2	1 376	1 376	1.5%	75.5%
4 D 3	Indirect Emissions	N2O	1 352	1 352	1.5%	77.0%
1 A 1 a liquid	Public Electricity and Heat Production	CO2	1 229	1 229	1.4%	78.4%
1 A 4 c liquid	Agriculture/Forestry/Fisheries	CO2	1 181	1 181	1.3%	79.7%
2 C 3	Aluminium production	PFC	994	994	1.1%	80.8%
1 A 2 d gaseous	Pulp, Paper and Print	CO2	943	943	1.0%	81.8%
2 B 2	Nitric Acid Production	N2O	912	912	1.0%	82.8%
1 A 2 d liquid	Pulp, Paper and Print	CO2	853	853	0.9%	83.8%
4 B 1	Cattle	N2O	759	759	0.8%	84.6%
1 A 4 a gaseous	Commercial/Institutional	CO2	707	707	0.8%	85.4%
1 A 2 a gaseous	Iron and Steel	CO2	650	650	0.7%	86.1%
1 A 2 f solid	Other	CO2	625	625	0.7%	86.8%
1 A 2 c gaseous	Chemicals	CO2	519	519	0.6%	87.4%
1 A 2 e gaseous	Food Processing, Beverages and Tobacco	CO2	507	507	0.6%	87.9%
1 A 1 c gaseous	Manufacture of Solid fuels and Other Energy	CO2	506	506	0.6%	88.5%
2 A 7 b	Sinter Production	CO2	481	481	0.5%	89.0%
2 B 1	Ammonia Production	CO2	472	472	0.5%	89.5%
5 F 2	Land converted to Other land	CO2	451	451	0.5%	90.0%
1 A 2 a liquid	Iron and Steel	CO2	448	448	0.5%	90.5%
1 A 1 b gaseous	Petroleum refining	CO2	437	437	0.5%	91.0%
1 A 2 d solid	Pulp, Paper and Print	CO2	397	397	0.4%	91.5%
2 A 2	Lime Production	CO2	396	396	0.4%	91.9%
1 A 4 a other	Commercial/Institutional	CO2	350	350	0.4%	92.3%
1 A 2 e liquid	Food Processing, Beverages and Tobacco	CO2	345	345	0.4%	92.7%
5 C 2	Land converted to grassland	CO2	321	321	0.4%	93.0%
1 A 4 b biomass	Residential	CH4	314	314	0.3%	93.4%
4 B 1	Cattle	CH4	283	283	0.3%	93.7%
2 C 4	SF6 used in Al and Mg Foundries	SF6	253	253	0.3%	94.0%
3 D	OTHER	N2O	233	233	0.3%	94.2%
1 A 3 e gaseous	Other	CO2	224	224	0.2%	94.5%
2 A 3	Limestone and Dolomite Use	CO2	203	203	0.2%	94.7%
5 B 2	Land converted to cropland	CO2	199	199	0.2%	94.9%
5 E 2	Land converted to Settlements	CO2	184	184	0.2%	95.1%

Table A 5: Tier 1 - Level Assessment of the key category analysis including LULUCF for the year 2012.

IPCC Category Code	IPCC Category	GHG	Year 2012 Estimate $E_{x,t}$ [t CO_2-e units]	Absolute Value of Year 2012 Estimate $E_{x,t}$	Level Assessment $L_{x,t}$	Cumulative Total of $L_{x,t}$
1 A 3 b diesel oil	Road Transportation	CO2	15 808	15 808	18.6%	18.6%
2 C 1	Iron and Steel Production	CO2	5 454	5 454	6.4%	25.0%
1 A 3 b gasoline	Road Transportation	CO2	4 950	4 950	5.8%	30.8%
1 A 2 a solid	Iron and Steel	CO2	4 196	4 196	4.9%	35.7%
1 A 1 a gaseous	Public Electricity and Heat Production	CO2	4 021	4 021	4.7%	40.4%
1 A 4 b liquid	Residential	CO2	3 880	3 880	4.6%	45.0%
1 A 1 a solid	Public Electricity and Heat Production	CO2	3 454	3 454	4.1%	49.0%
4 A 1	Cattle	CH4	2 985	2 985	3.5%	52.5%
1 A 4 b gaseous	Residential	CO2	2 851	2 851	3.3%	55.9%
5 A 1	Forest land remaining forest land	CO2	-2 608	2 608	3.1%	58.9%
1 A 1 b liquid	Petroleum refining	CO2	2 368	2 368	2.8%	61.7%
1 A 2 f gaseous	Other	CO2	1 955	1 955	2.3%	64.0%
5 A 2	Land converted to forest land	CO2	-1 879	1 879	2.2%	66.2%
4 D 1	Direct Soil Emissions	N2O	1 807	1 807	2.1%	68.3%
1 A 2 f liquid	Other	CO2	1 784	1 784	2.1%	70.4%
2 A 1	Cement Production	CO2	1 673	1 673	2.0%	72.4%
1 A 2 d gaseous	Pulp, Paper and Print	CO2	1 582	1 582	1.9%	74.2%
2 F 1	Refrigeration and Air Conditioning Equipment	HFC	1 389	1 389	1.6%	75.9%
1 A 1 a other	Public Electricity and Heat Production	CO2	1 288	1 288	1.5%	77.4%
1 A 2 a gaseous	Iron and Steel	CO2	1 279	1 279	1.5%	78.9%
1 A 4 a gaseous	Commercial/Institutional	CO2	1 217	1 217	1.4%	80.3%
6 A	SOLID WASTE DISPOSAL ON LAND	CH4	1 201	1 201	1.4%	81.7%
1 A 2 c gaseous	Chemicals	CO2	1 199	1 199	1.4%	83.1%
4 D 3	Indirect Emissions	N2O	1 154	1 154	1.4%	84.5%
1 A 2 e gaseous	Food Processing, Beverages and Tobacco	CO2	767	767	0.9%	85.4%
1 A 4 c liquid	Agriculture/Forestry/Fisheries	CO2	759	759	0.9%	86.3%
4 B 1	Cattle	N2O	731	731	0.9%	87.1%
2 A 2	Lime Production	CO2	569	569	0.7%	87.8%
1 A 2 f other	Other	CO2	527	527	0.6%	88.4%
2 B 1	Ammonia Production	CO2	511	511	0.6%	89.0%
1 A 1 c gaseous	Manufacture of Solid fuels and Other Energy Industries	CO2	506	506	0.6%	89.6%
1 A 1 b gaseous	Petroleum refining	CO2	468	468	0.5%	90.2%
1 A 3 e gaseous	Other	CO2	394	394	0.5%	90.6%
1 A 2 c other	Chemicals	CO2	392	392	0.5%	91.1%
1 A 2 a liquid	Iron and Steel	CO2	383	383	0.4%	91.5%
1 A 2 d solid	Pulp, Paper and Print	CO2	348	348	0.4%	91.9%
2 A 7 b	Sinter Production	CO2	305	305	0.4%	92.3%
1 A 2 f solid	Other	CO2	288	288	0.3%	92.6%
6 B	WASTEWATER HANDLING	N2O	266	266	0.3%	93.0%
2 A 3	Limestone and Dolomite Use	CO2	256	256	0.3%	93.3%
2 F 9	Other Sources of SF6	SF6	247	247	0.3%	93.5%
4 B 1	Cattle	CH4	224	224	0.3%	93.8%
1 A 1 a liquid	Public Electricity and Heat Production	CO2	219	219	0.3%	94.1%
1 A 2 b gaseous	Non-ferrous Metals	CO2	216	216	0.3%	94.3%
1 A 2 e liquid	Food Processing, Beverages and Tobacco	CO2	198	198	0.2%	94.6%
5 F 2	Land converted to Other land	CO2	194	194	0.2%	94.8%
1 A 4 a liquid	Commercial/Institutional	CO2	189	189	0.2%	95.0%

Table A 6: Tier 1 - Trend Assessment of the key category analysis including LULUCF for the trend 1990–2012.

IPCC Category Code	IPCC Category	GHG	Base Year (1990) Estimate $E_{x,0}$	Latest Year (2012) 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	CO2	5 361	15 808	0.124	21.2%	21.2%
5 A 1	Forest land remaining forest land	CO2	7 849	2 608	0.059	10.1%	31.2%
1 A 3 b gasoline	Road Transportation	CO2	7 936	4 950	0.032	5.5%	36.8%
1 A 1 a solid	Public Electricity and Heat Production	CO2	6 247	3 454	0.031	5.2%	42.0%
1 A 4 b solid	Residential	CO2	2 512	149	0.027	4.6%	46.6%
6 A	SOLID WASTE DISPOSAL ON LAND	CH4	3 314	1 201	0.024	4.0%	50.6%
2 C 1	Iron and Steel Production	CO2	3 546	5 454	0.023	4.0%	54.7%
1 A 4 b liquid	Residential	CO2	5 605	3 880	0.018	3.1%	57.8%
2 F 1	Refrigeration and Air Conditioning Equipment	HFC	0	1 389	0.016	2.8%	60.6%
1 A 4 a liquid	Commercial/Institutional	CO2	1 421	189	0.014	2.4%	63.0%
1 A 1 a other	Public Electricity and Heat Production	CO2	118	1 288	0.014	2.3%	65.3%
5 A 2	Land converted to forest land	CO2	3 081	1 879	0.013	2.2%	67.5%
1 A 4 b gaseous	Residential	CO2	1 847	2 851	0.012	2.1%	69.7%
1 A 1 a liquid	Public Electricity and Heat Production	CO2	1 229	219	0.011	2.0%	71.6%
2 B 2	Nitric Acid Production	N2O	912	53	0.010	1.7%	73.3%
1 A 1 a gaseous	Public Electricity and Heat Production	CO2	3 294	4 021	0.010	1.6%	74.9%
1 A 2 d liquid	Pulp, Paper and Print	CO2	853	41	0.009	1.6%	76.5%
1 A 2 c gaseous	Chemicals	CO2	519	1 199	0.008	1.4%	77.9%
1 A 2 d gaseous	Pulp, Paper and Print	CO2	943	1 582	0.008	1.3%	79.2%
1 A 2 a gaseous	Iron and Steel	CO2	650	1 279	0.008	1.3%	80.5%
1 A 4 a gaseous	Commercial/Institutional	CO2	707	1 217	0.006	1.1%	81.6%
4 A 1	Cattle	CH4	3 551	2 985	0.005	0.9%	82.5%
1 A 1 b liquid	Petroleum refining	CO2	1 958	2 368	0.005	0.9%	83.4%
1 A 2 f other	Other	CO2	70	527	0.005	0.9%	84.3%
1 A 2 a solid	Iron and Steel	CO2	3 846	4 196	0.005	0.9%	85.2%
1 A 2 f liquid	Other	CO2	1 376	1 784	0.005	0.9%	86.1%
1 A 2 f gaseous	Other	CO2	1 573	1 955	0.005	0.8%	87.0%
1 A 4 c liquid	Agriculture/Forestry/Fisheries	CO2	1 181	759	0.005	0.8%	87.8%
1 A 4 a other	Commercial/Institutional	CO2	350	2	0.004	0.7%	88.4%
1 A 2 f solid	Other	CO2	625	288	0.004	0.6%	89.1%
2 A 1	Cement Production	CO2	2 033	1 673	0.004	0.6%	89.7%
1 A 2 e gaseous	Food Processing, Beverages and Tobacco	CO2	507	767	0.003	0.5%	90.2%
5 C 2	Land converted to grassland	CO2	321	40	0.003	0.5%	90.8%
5 F 2	Land converted to Other land	CO2	451	194	0.003	0.5%	91.3%
2 C 4	SF6 used in Al and Mg Foundries	SF6	253	5	0.003	0.5%	91.8%
1 A 2 c other	Chemicals	CO2	174	392	0.003	0.4%	92.2%
2 A 2	Lime Production	CO2	396	569	0.002	0.4%	92.6%
1 A 3 e gaseous	Other	CO2	224	394	0.002	0.4%	92.9%
2 A 7 b	Sinter Production	CO2	481	305	0.002	0.3%	93.2%
4 D 3	Indirect Emissions	N2O	1 352	1 154	0.002	0.3%	93.6%
6 B	WASTEWATER HANDLING	N2O	109	266	0.002	0.3%	93.9%
1 A 2 b gaseous	Non-ferrous Metals	CO2	75	216	0.002	0.3%	94.2%
1 A 2 e liquid	Food Processing, Beverages and Tobacco	CO2	345	198	0.002	0.3%	94.4%
1 A 4 b biomass	Residential	CH4	314	179	0.001	0.3%	94.7%
2 F 9	Other Sources of SF6	SF6	127	247	0.001	0.2%	94.9%
5 B 1	Cropland remaining cropland	CO2	165	43	0.001	0.2%	95.2%

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	Level Assessment 1990	Level Assesment 2012	Trend Assessment 1990-2012	Base Year (1990) Estimate $E_{x,0}$	Latest Year (2012) Estimate Ex,t	Share Latest Year (2012)
1 A 1 a gaseous	Public Electricity and Heat Production	CO2	9	5	17	3 294	4 021	5.0%
1 A 1 a liquid	Public Electricity and Heat Production	CO2	19	41	11	1 229	219	0.3%
1 A 1 a other	Public Electricity and Heat Production	CO2		17	10	118	1 288	1.6%
1 A 1 a solid	Public Electricity and Heat Production	CO2	2	7	3	6 247	3 454	4.3%
1 A 1 b gaseous	Petroleum refining	CO2	35	30		437	468	0.6%
1 A 1 b liquid	Petroleum refining	CO2	12	10	25	1 958	2 368	3.0%
1 A 1 c gaseous	Manufacture of Solid fuels and Other Energy Industries	CO2	31	29		506	506	0.6%
1 A 2 a gaseous	Iron and Steel	CO2	27	18	19	650	1 279	1.6%
1 A 2 a liquid	Iron and Steel	CO2	34	33		448	383	0.5%
1 A 2 a solid	Iron and Steel	CO2	5	4	30	3 846	4 196	5.2%
1 A 2 b gaseous	Non-ferrous Metals	CO2		42	41	75	216	0.3%
1 A 2 c gaseous	Chemicals	CO2	29	21	15	519	1 199	1.5%
1 A 2 c other	Chemicals	CO2	46	32	33	174	392	0.5%
1 A 2 d gaseous	Pulp, Paper and Print	CO2	22	15	18	943	1 582	2.0%
1 A 2 d liquid	Pulp, Paper and Print	CO2	24		14	853	41	0.1%
1 A 2 d solid	Pulp, Paper and Print	CO2	36	34		397	348	0.4%
1 A 2 e gaseous	Food Processing, Beverages and Tobacco	CO2	30	23	31	507	767	1.0%
1 A 2 e liquid	Food Processing, Beverages and Tobacco	CO2	39	43	37	345	198	0.2%
1 A 2 f gaseous	Other	CO2	15	11	28	1 573	1 955	2.4%
1 A 2 f liquid	Other	CO2	17	13	24	1 376	1 784	2.2%
1 A 2 f other	Other	CO2		27	21	70	527	0.7%
1 A 2 f solid	Other	CO2	28	36	27	625	288	0.4%
1 A 3 b diesel oil	Road Transportation	CO2	4	1	1	5 361	15 808	19.7%
1 A 3 b gasoline	Road Transportation	CO2	1	3	2	7 936	4 950	6.2%
1 A 3 c liquid	Railways	CO2	47			171	123	0.2%
1 A 3 e gaseous	Other	CO2	44	31	35	224	394	0.5%
1 A 4 a gaseous	Commercial/Institutional	CO2	26	19	20	707	1 217	1.5%
1 A 4 a liquid	Commercial/Institutional	CO2	16		9	1 421	189	0.2%
1 A 4 a other	Commercial/Institutional	CO2	38		26	350	2	0.0%
1 A 4 b biomass	Residential	CH4	40		40	314	179	0.2%
1 A 4 b gaseous	Residential	CO2	14	9	12	1 847	2 851	3.6%
1 A 4 b liquid	Residential	CO2	3	6	6	5 605	3 880	4.8%
1 A 4 b solid	Residential	CO2	10		4	2 512	149	0.2%
1 A 4 c liquid	Agriculture/Forestry/Fisheries	CO2	20	24	22	1 181	759	0.9%
1 B 2 a	Oil	CO2			43	43	145	0.2%
2 A 1	Cement Production	CO2	11	14	23	2 033	1 673	2.1%
2 A 2	Lime Production	CO2	37	26	36	396	569	0.7%
2 A 3	Limestone and Dolomite Use	CO2	45	38		203	256	0.3%
2 A 7 b	Sinter Production	CO2	32	35	34	481	305	0.4%
2 B 1	Ammonia Production	CO2	33	28		472	511	0.6%
2 B 2	Nitric Acid Production	N2O	23		13	912	53	0.1%
2 C 1	Iron and Steel Production	CO2	7	2	7	3 546	5 454	6.8%
2 C 3	Aluminium production	PFC	21			994	0	0.0%
2 C 4	SF6 used in Al and Mg Foundries	SF6	42		29	253	5	0.0%
2 F 1	Refrigeration and Air Conditioning Equipment	HFC		16	8	0	1 389	1.7%
2 F 9	Other Sources of SF6	SF6		39	42	127	247	0.3%
3 D	OTHER	N2O	43		44	233	146	0.2%
4 A 1	Cattle	CH4	6	8	16	3 551	2 985	3.7%
4 B 1	Cattle	CH4	41	40		283	224	0.3%
4 B 1	Cattle	N2O	25	25		759	731	0.9%
4 D 1	Direct Soil Emissions	N2O	13	12	39	1 909	1 807	2.3%
4 D 3	Indirect Emissions	N2O	18	22	32	1 352	1 154	1.4%
6 A	SOLID WASTE DISPOSAL ON LAND	CH4	8	20	5	3 314	1 201	1.5%
6 B	WASTEWATER HANDLING	N2O		37	38	109	266	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	GHG	Level Assessment 1990	Level Assesment 2012	Trend Assessment 1990-2012	Base Year (1990) Estimate $E_{x,0}$	Latest Year (2012) Estimate Ex,t
1 A 1 a gaseous	Public Electricity and Heat Production	CO2	10	5	16	3 294	4 021
1 A 1 a liquid	Public Electricity and Heat Production	CO2	21	41	14	1 229	219
1 A 1 a other	Public Electricity and Heat Production	CO2		17	11	118	1 288
1 A 1 a solid	Public Electricity and Heat Production	CO2	3	7	4	6 247	3 454
1 A 1 b gaseous	Petroleum refining	CO2	38	30		437	468
1 A 1 b liquid	Petroleum refining	CO2	14	10	23	1 958	2 368
1 A 1 c gaseous	Manufacture of Solid fuels and Other Energy Industries	CO2	33	29		506	506
1 A 2 a gaseous	Iron and Steel	CO2	29	18	20	650	1 279
1 A 2 a liquid	Iron and Steel	CO2	37	33		448	383
1 A 2 a solid	Iron and Steel	CO2	6	4	25	3 846	4 196
1 A 2 b gaseous	Non-ferrous Metals	CO2		42	42	75	216
1 A 2 c gaseous	Chemicals	CO2	31	21	18	519	1 199
1 A 2 c other	Chemicals	CO2		32	36	174	392
1 A 2 d gaseous	Pulp, Paper and Print	CO2	24	15	19	943	1 582
1 A 2 d liquid	Pulp, Paper and Print	CO2	26		17	853	41
1 A 2 d solid	Pulp, Paper and Print	CO2	39	34		397	348
1 A 2 e gaseous	Food Processing, Beverages and Tobacco	CO2	32	23	32	507	767
1 A 2 e liquid	Food Processing, Beverages and Tobacco	CO2	42	43	43	345	198
1 A 2 f gaseous	Other	CO2	17	11	27	1 573	1 955
1 A 2 f liquid	Other	CO2	19	13	26	1 376	1 784
1 A 2 f other	Other	CO2		27	24	70	527
1 A 2 f solid	Other	CO2	30	36	30	625	288
1 A 3 b diesel oil	Road Transportation	CO2	5	1	1	5 361	15 808
1 A 3 b gasoline	Road Transportation	CO2	1	3	3	7 936	4 950
1 A 3 e gaseous	Other	CO2	48	31	38	224	394
1 A 4 a gaseous	Commercial/Institutional	CO2	28	19	21	707	1 217
1 A 4 a liquid	Commercial/Institutional	CO2	18	45	10	1 421	189
1 A 4 a other	Commercial/Institutional	CO2	41		29	350	2
1 A 4 b biomass	Residential	CH4	44		44	314	179
1 A 4 b gaseous	Residential	CO2	16	9	13	1 847	2 851
1 A 4 b liquid	Residential	CO2	4	6	8	5 605	3 880
1 A 4 b solid	Residential	CO2	12		5	2 512	149
1 A 4 c liquid	Agriculture/Forestry/Fisheries	CO2	22	24	28	1 181	759
2 A 1	Cement Production	CO2	13	14	31	2 033	1 673
2 A 2	Lime Production	CO2	40	26	37	396	569
2 A 3	Limestone and Dolomite Use	CO2	49	38		203	256
2 A 7 b	Sinter Production	CO2	34	35	39	481	305
2 B 1	Ammonia Production	CO2	35	28		472	511
2 B 2	Nitric Acid Production	N2O	25		15	912	53
2 C 1	Iron and Steel Production	CO2	8	2	7	3 546	5 454
2 C 3	Aluminium production	PFC	23			994	0
2 C 4	SF6 used in Al and Mg Foundries	SF6	46		35	253	5
2 F 1	Refrigeration and Air Conditioning Equipment	HFC		16	9	0	1 389
2 F 9	Other Sources of SF6	SF6		39	45	127	247
3 D	OTHER	N2O	47			233	146
4 A 1	Cattle	CH4	7	8	22	3 551	2 985
4 B 1	Cattle	CH4	45	40		283	224
4 B 1	Cattle	N2O	27	25		759	731
4 D 1	Direct Soil Emissions	N2O	15	12		1 909	1 807
4 D 3	Indirect Emissions	N2O	20	22	40	1 352	1 154
5 A 1	Forest land remaining forest land	CO2	2	47	2	-7 849	-2 608
5 A 2	Land converted to forest land	CO2	11	46	12	-3 081	-1 879
5 B 1	Cropland remaining cropland	CO2			46	-165	43
5 B 2	Land converted to cropland	CO2	50			199	182
5 C 2	Land converted to grassland	CO2	43		33	321	40
5 E 2	Land converted to Settlements	CO2	51			184	88
5 F 2	Land converted to Other land	CO2	36	44	34	451	194
6 A	SOLID WASTE DISPOSAL ON LAND	CH4	9	20	6	3 314	1 201
6 B	WASTEWATER HANDLING	N2O		37	41	109	266

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 LUx,t	Cumulative Total of $L_{x,t}$
4 D 1	Direct Soil Emissions	N2O	1 909	0.253	25.3%
4 D 3	Indirect Emissions	N2O	1 352	0.179	43.3%
6 A	SOLID WASTE DISPOSAL ON LAND	CH4	3 314	0.081	51.4%
4 A 1	Cattle	CH4	3 551	0.070	58.4%
4 B 1	Cattle	N2O	759	0.067	65.1%
2 C 3	Aluminium production	PFC	994	0.044	69.5%
1 A 3 b gasoline	Road Transportation	CO2	7 936	0.030	72.5%
4 D 2	Pasture, Range and Paddock Manure	N2O	169	0.022	74.7%
1 A 3 b diesel oil	Road Transportation	CO2	5 361	0.020	76.7%
1 A 4 b biomass	Residential	CH4	314	0.014	78.2%
4 B 1	Cattle	CH4	283	0.013	79.4%
2 A 1	Cement Production	CO2	2 033	0.010	80.4%
1 A 3 b gasoline	Road Transportation	N2O	133	0.008	81.2%
1 A 4 b gaseous	Residential	CO2	1 847	0.008	82.0%
4 B 8	Swine	N2O	87	0.008	82.8%
2 A 2	Lime Production	CO2	396	0.007	83.5%
1 A 2 f gaseous	Other	CO2	1 573	0.007	84.2%
1 A 4 a other	Commercial/Institutional	CO2	350	0.007	84.9%
2 F 9	Other Sources of SF6	SF6	127	0.006	85.6%
1 A 1 a gaseous	Public Electricity and Heat Production	CO2	3 294	0.006	86.2%
1 B 2 a	Oil	CH4	126	0.006	86.7%
1 A 4 b liquid	Residential	CO2	5 605	0.006	87.3%
4 B 8	Swine	CH4	123	0.006	87.8%
6 B	WASTEWATER HANDLING	N2O	109	0.005	88.3%
6 B	WASTEWATER HANDLING	CH4	102	0.005	88.8%
2 B 2	Nitric Acid Production	N2O	912	0.004	89.3%
3 D	OTHER	N2O	233	0.004	89.7%
1 A 2 d gaseous	Pulp, Paper and Print	CO2	943	0.004	90.1%

Table A 10: Tier 2 - Level Assessment of the key category analysis excluding LULUCF for the year 2012.

IPCC Category Code	IPCC Category	Greenhouse Gas	Latest Year (2012) Estimate Ex,t	Level Assessment with Uncertainty $LU_{x,t}$	Cumulative Total of $L_{x,t}$
4 D 1	Direct Soil Emissions	N2O	1 807	0.249	24.9%
4 D 3	Indirect Emissions	N2O	1 154	0.159	40.9%
2 F 1	Refrigeration and Air Conditioning Equipment	HFC	1 389	0.069	47.7%
4 B 1	Cattle	N2O	731	0.068	54.5%
1 A 3 b diesel oil	Road Transportation	CO2	15 808	0.062	60.7%
4 A 1	Cattle	CH4	2 985	0.061	66.8%
6 A	SOLID WASTE DISPOSAL ON LAND	CH4	1 201	0.031	69.9%
1 A 1 a other	Public Electricity and Heat Production	CO2	1 288	0.026	72.5%
1 A 3 b gasoline	Road Transportation	CO2	4 950	0.019	74.4%
6 B	WASTEWATER HANDLING	N2O	266	0.013	75.8%
1 A 4 b gaseous	Residential	CO2	2 851	0.013	77.1%
4 D 2	Pasture, Range and Paddock Manure	N2O	94	0.013	78.4%
2 F 9	Other Sources of SF6	SF6	247	0.013	79.7%
1 A 2 f other	Other	CO2	527	0.011	80.7%
4 B 1	Cattle	CH4	224	0.011	81.8%
1 A 2 f gaseous	Other	CO2	1 955	0.009	82.7%
1 A 4 b biomass	Residential	CH4	179	0.008	83.5%
1 A 2 c other	Chemicals	CO2	392	0.008	84.3%
1 A 1 a gaseous	Public Electricity and Heat Production	CO2	4 021	0.008	85.1%
1 A 2 d gaseous	Pulp, Paper and Print	CO2	1 582	0.007	85.8%
4 B 9	Poultry	N2O	71	0.007	86.5%
1 B 2 a	Oil	CH4	133	0.006	87.1%
1 A 2 a gaseous	Iron and Steel	CO2	1 279	0.006	87.7%
1 A 4 a gaseous	Commercial/Institutional	CO2	1 217	0.006	88.2%
1 A 2 c gaseous	Chemicals	CO2	1 199	0.006	88.8%
4 B 8	Swine	N2O	55	0.005	89.3%
2 A 3	Limestone and Dolomite Use	CO2	256	0.005	89.8%
1 A 2 a solid	Iron and Steel	CO2	4 196	0.004	90.2%

Table A 11: Tier 2 - Trend Assessment of the key category analysis excluding LULUCF for the trend 1990–2012.

IPCC Category Code	IPCC Category	Greenhouse Gas	Base Year (1990) Estimate $E_{x,0}$	Latest Year (2012) Estimate $E_{x,t}$	Trend Assessment with Uncertainty $TU_{x,t}$	% Contribution to Trend	Cumulative Total of $TU_{x,t}$
2 F 1	Refrigeration and Air Conditioning Equipment	HFC	0	1 389	0.911	16.4%	16.4%
6 A	SOLID WASTE DISPOSAL ON LAND	CH4	3 314	1 201	0.742	13.4%	29.7%
1 A 3 b diesel oil	Road Transportation	CO2	5 361	15 808	0.533	9.6%	39.3%
4 D 3	Indirect Emissions	N2O	1 352	1 154	0.424	7.6%	47.0%
1 A 1 a other	Public Electricity and Heat Production	CO2	118	1 288	0.318	5.7%	52.7%
4 D 1	Direct Soil Emissions	N2O	1 909	1 807	0.275	4.9%	57.6%
4 A 1	Cattle	CH4	3 551	2 985	0.179	3.2%	60.8%
1 A 3 b gasoline	Road Transportation	CO2	7 936	4 950	0.165	3.0%	63.8%
4 D 2	Pasture, Range and Paddock Manure	N2O	169	94	0.144	2.6%	66.4%
1 A 2 f other	Other	CO2	70	527	0.124	2.2%	68.6%
6 B	WASTEWATER HANDLING	N2O	109	266	0.101	1.8%	70.4%
1 A 4 a other	Commercial/Institutional	CO2	350	2	0.097	1.7%	72.2%
1 A 4 b biomass	Residential	CH4	314	179	0.089	1.6%	73.8%
2 F 9	Other Sources of SF6	SF6	127	247	0.080	1.4%	75.2%
1 A 3 b gasoline	Road Transportation	N2O	133	58	0.067	1.2%	76.4%
1 A 4 b gaseous	Residential	CO2	1 847	2 851	0.059	1.1%	77.5%
1 A 2 c other	Chemicals	CO2	174	392	0.058	1.0%	78.5%
2 B 2	Nitric Acid Production	N2O	912	53	0.058	1.0%	79.6%
4 B 1	Cattle	N2O	759	731	0.058	1.0%	80.6%
6 B	WASTEWATER HANDLING	CH4	102	23	0.053	1.0%	81.6%
4 B 8	Swine	N2O	87	55	0.042	0.8%	82.3%
1 A 2 c gaseous	Chemicals	CO2	519	1 199	0.041	0.7%	83.1%
4 B 1	Cattle	CH4	283	224	0.041	0.7%	83.8%
1 A 1 a biomass	Public Electricity and Heat Production	N2O	1	66	0.039	0.7%	84.5%
1 A 2 d gaseous	Pulp, Paper and Print	CO2	943	1 582	0.038	0.7%	85.2%
1 A 2 a gaseous	Iron and Steel	CO2	650	1 279	0.038	0.7%	85.9%
1 A 4 b solid	Residential	CH4	59	3	0.035	0.6%	86.5%
1 A 4 b solid	Residential	CO2	2 512	149	0.033	0.6%	87.1%
4 B 8	Swine	CH4	123	73	0.032	0.6%	87.7%
1 A 3 b diesel oil	Road Transportation	N2O	41	129	0.032	0.6%	88.2%
1 A 4 a gaseous	Commercial/Institutional	CO2	707	1 217	0.030	0.5%	88.8%
4 B 9	Poultry	N2O	46	71	0.029	0.5%	89.3%
1 A 4 b liquid	Residential	CO2	5 605	3 880	0.025	0.5%	89.8%
1 A 1 a solid	Public Electricity and Heat Production	CO2	6 247	3 454	0.025	0.5%	90.2%

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,t	Cumulative Total of $L_{x,t}$
5 A 1	Forest land remaining forest land	CO2	-7 849	7 849	0.359	35.9%
5 F 2	Land converted to Other land	CO2	451	451	0.153	51.2%
5 A 2	Land converted to forest land	CO2	-3 081	3 081	0.102	61.4%
5 C 2	Land converted to grassland	CO2	321	321	0.085	69.9%
4 D 1	Direct Soil Emissions	N2O	1 909	1 909	0.064	76.3%
4 D 3	Indirect Emissions	N2O	1 352	1 352	0.045	80.8%
6 A	SOLID WASTE DISPOSAL ON LAND	CH4	3 314	3 314	0.021	82.9%
5 B 2	Land converted to cropland	CO2	199	199	0.020	84.9%
4 A 1	Cattle	CH4	3 551	3 551	0.018	86.6%
4 B 1	Cattle	N2O	759	759	0.017	88.3%
5 E 2	Land converted to Settlements	CO2	184	184	0.014	89.7%
2 C 3	Aluminium production	PFC	994	994	0.011	90.8%

Table A 13: Tier 2 - Level Assessment of the key category analysis including LULUCF for the year 2012

IPCC Category Code	IPCC Category	Greenhouse Gas	Latest Year (2012) Estimate $E_{x,t}$	Absolute Value of Year 2012 Estimate Ex,t	Level Assessment with Uncertainty LUx,t	Cumulative Total of $L_{x,t}$
5 A 1	Forest land remaining forest land	CO2	-2 608	2 608	0.417	41.7%
5 F 2	Land converted to Other land	CO2	194	194	0.081	49.8%
4 D 1	Direct Soil Emissions	N2O	1 807	1 807	0.070	56.8%
5 A 2	Land converted to forest land	CO2	-1 879	1 879	0.059	62.7%
5 C 2	Land converted to grassland	CO2	40	40	0.054	68.1%
4 D 3	Indirect Emissions	N2O	1 154	1 154	0.045	72.5%
5 B 1	Cropland remaining cropland	CO2	43	43	0.041	76.6%
5 B 2	Land converted to cropland	CO2	182	182	0.026	79.2%
5 E 2	Land converted to Settlements	CO2	88	88	0.022	81.4%
2 F 1	Refrigeration and Air Conditioning Equipment	HFC	1 389	1 389	0.019	83.4%
4 B 1	Cattle	N2O	731	731	0.019	85.2%
1 A 3 b diesel oil	Road Transportation	CO2	15 808	15 808	0.017	87.0%
4 A 1	Cattle	CH4	2 985	2 985	0.017	88.7%
5 D 2	Land converted to Wetlands	CO2	75	75	0.017	90.4%

Table A 14: Tier 2 - Trend Assessment of the key category analysis including LULUCF for the trend 1990–2012.

IPCC Category Code	IPCC Category	Greenhouse Gas	Base Year (1990) Estimate $E_{x,0}$	Latest Year (2012) 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	7 849	2 608	36.577	51.4%	51.4%
5 C 2	Land converted to grassland	CO2	321	40	16.921	23.8%	75.2%
5 B 1	Cropland remaining cropland	CO2	165	43	5.028	7.1%	82.3%
5 F 2	Land converted to Other land	CO2	451	194	4.616	6.5%	88.8%
5 A 2	Land converted to forest land	CO2	3 081	1 879	1.598	2.2%	91.0%

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	Level Assessment 1990	Level Assessment 2012	Trend Assessment 1990-2012	Level Assessment 1990	Level Assessment 2012	Trend Assessment 1990-2012
1 A 1 a biomass	Public Electricity and Heat Production	N2O						24
1 A 1 a gaseous	Public Electricity and Heat Production	CO2	9	5	17	6	4	
1 A 1 a liquid	Public Electricity and Heat Production	CO2	19	41	11			
1 A 1 a other	Public Electricity and Heat Production	CO2		17	10		11	5
1 A 1 a solid	Public Electricity and Heat Production	CO2	2	7	3			34
1 A 1 b gaseous	Petroleum refining	CO2	35	30				
1 A 1 b liquid	Petroleum refining	CO2	12	10	25			
1 A 1 c gaseous	Manufacture of Solid fuels and Other Energy Industries	CO2	31	29				
1 A 2 a gaseous	Iron and Steel	CO2	27	18	19		12	26
1 A 2 a liquid	Iron and Steel	CO2	34	33				
1 A 2 a solid	Iron and Steel	CO2	5	4	30		3	
1 A 2 b gaseous	Non-ferrous Metals	CO2		42	41			
1 A 2 c gaseous	Chemicals	CO2	29	21	15		15	22
1 A 2 c other	Chemicals	CO2	46	32	33		19	17
1 A 2 d gaseous	Pulp, Paper and Print	CO2	22	15	18	13	9	25
1 A 2 d liquid	Pulp, Paper and Print	CO2	24		14			
1 A 2 d solid	Pulp, Paper and Print	CO2	36	34				
1 A 2 e gaseous	Food Processing, Beverages and Tobacco	CO2	30	23	31			
1 A 2 e liquid	Food Processing, Beverages and Tobacco	CO2	39	43	37			
1 A 2 f gaseous	Other	CO2	15	11	28	10	7	
1 A 2 f liquid	Other	CO2	17	13	24			
1 A 2 f other	Other	CO2		27	21		18	10
1 A 2 f solid	Other	CO2	28	36	27			
1 A 3 b diesel oil	Road Transportation	CO2	4	1	1	3	1	3
1 A 3 b diesel oil	Road Transportation	N2O						30
1 A 3 b gasoline	Road Transportation	CO2	1	3	2	1	2	8
1 A 3 b gasoline	Road Transportation	N2O				22		15
1 A 3 c liquid	Railways	CO2	47					
1 A 3 e gaseous	Other	CO2	44	31	35			
1 A 4 a gaseous	Commercial/Institutional	CO2	26	19	20		13	31
1 A 4 a liquid	Commercial/Institutional	CO2	16		9			
1 A 4 a other	Commercial/Institutional	CO2	38		26	17		12
1 A 4 b biomass	Residential	CH4	40		40	18	24	13
1 A 4 b gaseous	Residential	CO2	14	9	12	9	6	16
1 A 4 b liquid	Residential	CO2	3	6	6	2		33
1 A 4 b solid	Residential	CO2	10		4			28
1 A 4 b solid	Residential	CH4						27
1 A 4 c liquid	Agriculture/Forestry/Fisheries	CO2	20	24	22			
1 B 2 a	Oil	CO2			43			
1 B 2 a	Oil	CH4				24	25	
2 A 1	Cement Production	CO2	11	14	23	7		
2 A 2	Lime Production	CO2	37	26	36	16		
2 A 3	Limestone and Dolomite Use	CO2	45	38			21	
2 A 7 b	Sinter Production	CO2	32	35	34			
2 B 1	Ammonia Production	CO2	33	28				
2 B 2	Nitric Acid Production	N2O	23		13	14		18
2 C 1	Iron and Steel Production	CO2	7	2	7			
2 C 3	Aluminium production	PFC	21			12		
2 C 4	SF6 used in Al and Mg Foundries	SF6	42		29			
2 F 1	Refrigeration and Air Conditioning Equipment	HFC		16	8		10	1
2 F 9	Other Sources of SF6	SF6		39	42	23	22	14
3 D	OTHER	N2O	43		44	20		
4 A 1	Cattle	CH4	6	8	16	4	5	7
4 B 1	Cattle	CH4	41	40		19	23	23
4 B 1	Cattle	N2O	25	25		15	17	19
4 B 8	Swine	N2O				28	28	21
4 B 8	Swine	CH4				25		29
4 B 9	Poultry	N2O					27	32
4 D 1	Direct Soil Emissions	N2O	13	12	39	8	8	6
4 D 2	Pasture, Range and Paddock Manure	N2O				21	26	9
4 D 3	Indirect Emissions	N2O	18	22	32	11	16	4
6 A	SOLID WASTE DISPOSAL ON LAND	CH4	8	20	5	5	14	2
6 B	WASTEWATER HANDLING	N2O		37	38	26	20	11
6 B	WASTEWATER HANDLING	CH4				27		20

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	Level Assessment 1990	Level Assesment 2012	Trend Assessment 1990-2012	Level Assessment 1990	Level Assesment 2012	Trend Assessment 1990-2012
1 A 1 a gaseous	Public Electricity and Heat Production	CO_2	10	5	16			
1 A 1 a liquid	Public Electricity and Heat Production	CO_2	21	41	14			
1 A 1 a other	Public Electricity and Heat Production	CO_2		17	11			
1 A 1 a solid	Public Electricity and Heat Production	CO_2	3	7	4			
1 A 1 b gaseous	Petroleum refining	CO_2	38	30				
1 A 1 b liquid	Petroleum refining	CO_2	14	10	23			
1 A 1 c gaseous	Manufacture of Solid fuels and Other Energy Industries	CO_2	33	29				
1 A 2 a gaseous	Iron and Steel	CO_2	29	18	20			
1 A 2 a liquid	Iron and Steel	CO_2	37	33				
1 A 2 a solid	Iron and Steel	CO_2	6	4	25			
1 A 2 b gaseous	Non-ferrous Metals	CO_2		42	42			
1 A 2 c gaseous	Chemicals	CO_2	31	21	18			
1 A 2 c other	Chemicals	CO_2		32	36			
1 A 2 d gaseous	Pulp, Paper and Print	CO_2	24	15	19			
1 A 2 d liquid	Pulp, Paper and Print	CO_2	26		17			
1 A 2 d solid	Pulp, Paper and Print	CO_2	39	34				
1 A 2 e gaseous	Food Processing, Beverages and Tobacco	CO_2	32	23	32			
1 A 2 e liquid	Food Processing, Beverages and Tobacco	CO_2	42	43	43			
1 A 2 f gaseous	Other	CO_2	17	11	27			
1 A 2 f liquid	Other	CO_2	19	13	26			
1 A 2 f other	Other	CO_2		27	24			
1 A 2 f solid	Other	CO_2	30	36	30			
1 A 3 b diesel oil	Road Transportation	CO_2	5	1	1		1	
1 A 3 b gasoline	Road Transportation	CO_2	1	3	3			
1 A 3 e gaseous	Other	CO_2	48	31	38			
1 A 4 a gaseous	Commercial/Institutional	CO_2	28	19	21			
1 A 4 a liquid	Commercial/Institutional	CO_2	18	45	10			
1 A 4 a other	Commercial/Institutional	CO_2	41		29			
1 A 4 b biomass	Residential	CH_4	44		44			
1 A 4 b gaseous	Residential	CO_2	16	9	13			
1 A 4 b liquid	Residential	CO_2	4	6	8			
1 A 4 b solid	Residential	CO_2	12		5			
1 A 4 c liquid	Agriculture/Forestry/Fisheries	CO_2	22	24	28			
2 A 1	Cement Production	CO_2	13	14	31			
2 A 2	Lime Production	CO_2	40	26	37			
2 A 3	Limestone and Dolomite Use	CO_2	49	38				
2 A 7 b	Sinter Production	CO_2	34	35	39			
2 B 1	Ammonia Production	CO_2	35	28				
2 B 2	Nitric Acid Production	N_2O	25		15			
2 C 1	Iron and Steel Production	CO_2	8	2	7			
2 C 3	Aluminium production	PFC	23			7		
2 C 4	SF_6 used in Al and Mg Foundries	SF_6	46		35			
2 F 1	Refrigeration and Air Conditioning Equipment	HFC		16	9		4	
2 F 9	Other Sources of SF_6	SF_6		39	45			
3 D	OTHER	N_2O	47					
4 A 1	Cattle	CH_4	7	8	22	2	2	
4 B 1	Cattle	CH_4	45	40				
4 B 1	Cattle	N_2O	27	25		8	6	
4 D 1	Direct Soil Emissions	N_2O	15	12		5	3	
4 D 3	Indirect Emissions	N_2O	20	22	40	6	5	
5 A 1	Forest land remaining forest land	CO_2	2	47	2	1	14	1
5 A 2	Land converted to forest land	CO_2	11	46	12	4	13	5
5 B 1	Cropland remaining cropland	CO_2			46		11	3
5 B 2	Land converted to cropland	CO_2	50			11	8	
5 D 2	Land converted to Wetlands	CO_2					10	
5 C 2	Land converted to grassland	CO_2	43		33	10	12	2
5 E 2	Land converted to Settlements	CO_2	51			12	9	
5 F 2	Land converted to Other land	CO_2	36	44	34	9	7	4
6 A	SOLID WASTE DISPOSAL ON LAND	CH_4	9	20	6	3		
6 B	WASTEWATER HANDLING	N_2O		37	41			

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	2011	2012
1 A 1 a liquid	Public Electricity and Heat Production	CO2	Gg	1 229	1 498	1 482	2 052	1 902	1 558	1 550	1 926	2 212	1 757	1 183	1 574	818	1 126	1 174
1 A 1 a solid	Public Electricity and Heat Production	CO2	Gg	6 247	6 817	4 009	3 089	3 279	4 530	4 696	5 002	3 498	3 789	4 824	5 873	5 510	6 916	6 674
1 A 1 a gaseous	Public Electricity and Heat Production	CO2	Gg	3 294	3 188	2 742	2 986	3 232	3 439	4 418	3 790	4 073	4 195	3 455	3 501	3 807	4 477	4 284
1 A 1 a other	Public Electricity and Heat Production	CO2	Gg	118	142	170	184	187	191	233	239	234	232	227	325	427	493	587
1 A 1 b liquid	Petroleum refining	CO2	Gg	1 958	1 909	1 917	2 184	2 325	2 169	2 182	2 156	2 172	1 867	1 847	1 810	2 207	2 304	2 505
1 A 1 b gaseous	Petroleum refining	CO2	Gg	437	519	473	547	384	421	464	484	461	285	352	409	358	384	339
1 A 1 c liquid	Manufacture of Solid fuels and Other Energy Industries	CO2	Gg	4	3	0	0	0	0	NO	NO	NO	NO	NO	NO	NO	NO	NO
1 A 1 c gaseous	Manufacture of Solid fuels and Other Energy Industries	CO2	Gg	506	547	522	424	452	611	261	277	352	402	333	334	346	588	762
1 A 2 a liquid	Iron and Steel	CO2	Gg	448	449	435	458	483	557	464	518	667	653	822	885	658	557	704
1 A 2 a solid	Iron and Steel	CO2	Gg	3 846	3 495	2 859	3 121	3 280	3 460	3 270	3 685	2 983	3 202	3 417	3 311	3 819	4 052	4 025
1 A 2 a gaseous	Iron and Steel	CO2	Gg	650	671	639	611	678	757	932	1 084	1 065	1 007	978	996	1 035	1 020	1 126
1 A 2 b liquid	Non-ferrous Metals	CO2	Gg	35	34	31	32	40	41	49	70	61	48	47	53	44	41	37
1 A 2 b solid	Non-ferrous Metals	CO2	Gg	22	18	8	19	15	10	16	20	17	22	18	10	16	16	16
1 A 2 b gaseous	Non-ferrous Metals	CO2	Gg	75	67	88	106	206	205	112	131	127	119	128	144	148	156	167
1 A 2 c liquid	Chemicals	CO2	Gg	82	87	61	75	93	88	92	130	108	72	49	76	59	65	63
1 A 2 c solid	Chemicals	CO2	Gg	107	136	184	189	152	150	186	254	250	308	248	252	251	250	237
1 A 2 c gaseous	Chemicals	CO2	Gg	519	462	489	603	552	572	573	602	581	811	874	857	828	837	838
1 A 2 c other	Chemicals	CO2	Gg	174	221	252	167	186	224	274	214	179	157	203	232	300	388	384
1 A 2 d liquid	Pulp, Paper and Print	CO2	Gg	853	1 110	664	685	654	523	399	516	436	231	171	179	152	166	132
1 A 2 d solid	Pulp, Paper and Print	CO2	Gg	397	530	450	428	366	381	369	443	443	359	446	381	460	421	441
1 A 2 d gaseous	Pulp, Paper and Print	CO2	Gg	943	1 016	1 024	887	1 502	1 361	1 564	1 855	1 748	1 733	1 763	1 680	1 636	1 830	1 698
1 A 2 d other	Pulp, Paper and Print	CO2	Gg	20	20	28	24	33	50	84	7	7	14	NO	12	13	21	26
1 A 2 e liquid	Food Processing, Beverages and Tobacco	CO2	Gg	345	396	343	387	353	342	253.9	312	248	163	166	237	179	225	255
1 A 2 e solid	Food Processing, Beverages and Tobacco	CO2	Gg	18	20	11	21	19	6	12.0	14	12	8	22	12	16	16	13
1 A 2 e gaseous	Food Processing, Beverages and Tobacco	CO2	Gg	507	517	500	478	545	583	621.4	715	682	655	694	677	906	704	681
1 A 2 e other	Food Processing, Beverages and Tobacco	CO2	Gg	NO	NO	NO	NO	NO	NO	0.6	1	1	NO	NO	NO	NO	NO	NO
1 A 2 f liquid	Other	CO2	Gg	1 376	1 485	1 298	1 680	1 602	1 496	1 692	2 105	1 935	1 417	1 356	1 362	1 185	1 474	1 661
1 A 2 f solid	Other	CO2	Gg	625	562	628	542	408	452	547	603	573	478	534	469	357	323	303
1 A 2 f gaseous	Other	CO2	Gg	1 573	1 631	1 789	1 624	1 862	2 038	2 012	1 670	1 639	1 487	1 712	1 621	1 704	1 802	1 898
1 A 2 f other	Other	CO2	Gg	70	149	167	108	207	194	180	292	230	270	242	302	325	368	424
1 A 3 a aviation gaso-line	Civil Aviation	CO2	Gg	8	8	8	9	9	7	7	8	8	9	6	6	8	8	8
1 A 3 a jet kerosene	Civil Aviation	CO2	Gg	24	29	35	40	45	51	57	63	69	72	61	54	55	54	57
1 A 3 b gasoline	Road Transportation	CO2	Gg	7 936	8 704	8 322	7 981	7 693	7 432	6 871	6 507	6 807	6 325	6 110	6 153	6 622	6 770	6 588
1 A 3 b diesel oil	Road Transportation	CO2	Gg	5 361	6 063	6 419	6 898	7 232	7 765	9 874	9 260	10 933	10 796	11 914	13 210	14 831	16 429	17 139
1 A 3 b LPG	Road Transportation	CO2	Gg	27	27	28	29	30	32	43	34	38	40	43	46	63	72	60
1 A 3 b gaseous	Road Transportation	CO2	Gg	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	1
1 A 3 c liquid	Railways	CO2	Gg	171	157	156	152	154	143	129	130	128	133	133	128	139	139	139
1 A 3 c solid	Railways	CO2	Gg	7	6	6	6	6	6	6	3	3	3	2	2	2	1	1
1 A 3 d gas/diesel oil	Navigation	CO2	Gg	4	4	4	4	3	4	4	4	5	4	4	4	3	3	5
1 A 3 d gasoline	Navigation	CO2	Gg	10	10	10	10	10	10	10	10	10	10	10	10	10	9	9
1 A 3 e gaseous	Other	CO2	Gg	224	225	220	214	209	227	234	233	351	434	338	497	277	371	372
1 A 4 a liquid	Commercial/Institutional	CO2	Gg	1 421	1 348	1 359	1 311	1 152	1 315	1 788	2 064	1 853	2 082	1 337	1 776	1 858	2 273	1 720

IPCC Category Code	IPCC Category	Gas	Unit	1990	1995	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012
1 A 4 a solid	Commercial/Institutional	CO2	Gg	90	121	85	82	78	62	62	88	69	87	105	117	80	113	82
1 A 4 a gaseous	Commercial/Institutional	CO2	Gg	707	866	1 342	1 599	1 237	1 706	1 374	1 159	1 184	1 430	1 398	1 941	1 755	1 983	2 370
1 A 4 a other	Commercial/Institutional	CO2	Gg	350	273	339	191	206	181	302	264	168	152	144	65	64	68	54
1 A 4 b liquid	Residential	CO2	Gg	5 605	6 102	5 619	5 704	5 333	5 818	6 438	5 247	5 490	5 625	5 580	5 506	5 307	5 323	5 132
1 A 4 b solid	Residential	CO2	Gg	2 512	2 756	2 374	1 957	1 741	1 650	1 563	1 181	1 036	961	851	805	652	546	519
1 A 4 b gaseous	Residential	CO2	Gg	1 847	2 206	2 149	2 347	2 226	2 392	2 691	2 688	2 846	2 820	2 631	2 942	2 751	2 906	2 836
1 A 4 c liquid	Agriculture/Forestry/Fisheries	CO2	Gg	1 181	1 129	1 098	1 000	946	927	979	1 026	1 024	1 054	1 000	1 021	983	973	986
1 A 4 c solid	Agriculture/Forestry/Fisheries	CO2	Gg	51	58	52	41	36	34	33	25	22	21	18	16	12	9	9
1 A 4 c gaseous	Agriculture/Forestry/Fisheries	CO2	Gg	20	24	24	26	25	27	30	31	34	32	30	33	31	33	32
1 A 5 b liquid	Mobile	CO2	Gg	35	37	34	39	42	33	39	37	42	42	41	41	42	42	43
1 B 2 a	Oil	CO2	Gg	43	43	40	37	48	38	41	31	61	90	72	88	84	133	122
1 B 2 b	Natural gas	CO2	Gg	59	68	80	75	80	89	30	90	81	81	93	95	83	100	88
2 A 1	Cement Production	CO2	Gg	2 033	2 005	2 105	2 032	2 102	1 631	1 634	1 761	1 599	1 607	1 712	1 720	1 736	1 754	1 790
2 A 2	Lime Production	CO2	Gg	396	361	355	365	390	395	383	412	454	453	498	507	543	572	595
2 A 3	Limestone and Dolomite Use	CO2	Gg	203	203	186	186	199	230	206	235	245	226	258	250	272	272	282
2 A 4	Soda Ash Production and use	CO2	Gg	5	4	5	6	5	6	6	6	7	6	8	7	8	8	16
2 A 7 a	Bricks and Tiles (decarbonizing)	CO2	Gg	116	122	126	135	140	149	149	137	134	122	116	124	120	116	134
2 A 7 b	Sinter Production	CO2	Gg	481	392	336	325	323	410	355	384	345	350	339	334	374	311	329
2 A 7 c	Glass Production	CO2	Gg	39	44	39	39	42	42	42	39	39	43	36	43	38	42	28
2 B 1	Ammonia Production	CO2	Gg	472	498	448	500	476	517	520	514	506	513	499	455	465	504	505
2 B 2	Nitric Acid Production	CO2	Gg	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2 B 4	Carbide Production	CO2	Gg	38	35	41	33	25	26	33	33	35	32	48	47	41	41	36
2 B 5	Other	CO2	Gg	31	28	38	34	23	20	18	18	19	20	21	20	24	24	24
2 C 1	Iron and Steel Production	CO2	Gg	3 546	3 509	3 075	3 145	3 411	3 921	3 703	4 100	3 900	3 734	4 202	4 159	4 609	4 526	4 448
2 C 2	Ferroalloys Production	CO2	Gg	21	21	21	21	21	21	19	19	19	19	19	18	17	17	17
2 C 3	Aluminium production	CO2	Gg	158	158	63	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
3 A	PAINT APPLICATION	CO2	Gg	118	96	74	71	63	67	60	64	56	50	59	62	67	68	59
3 B	DEGREASING AND DRY CLEANING	CO2	Gg	36	29	23	22	20	21	20	23	21	20	25	28	30	32	28
3 C	CHEMICAL PRODUCTS, MANUFACTURE AND PROCESSING	CO2	Gg	28	22	15	15	13	15	13	15	13	12	15	15	16	16	13
3 D	OTHER	CO2	Gg	98	87	73	77	74	86	80	90	83	77	94	99	105	105	89
6 C	WASTE INCINERATION	CO2	Gg	27	23	11	11	11	11	11	12	12	12	12	12	12	12	12
1 A 1 a liquid	Public Electricity and Heat Production	CH4	Gg CO2 e	0	0	0	1	0	0	0	1	1	0	0	0	0	0	0
1 A 1 a solid	Public Electricity and Heat Production	CH4	Gg CO2 e	2	2	1	1	1	1	0	0	0	0	0	0	0	0	0
1 A 1 a gaseous	Public Electricity and Heat Production	CH4	Gg CO2 e	0	0	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	0	0	0	0	0	0	0	0	1	1	1	1	1
1 A 1 a other	Public Electricity and Heat Production	CH4	Gg CO2 e	1	1	1	1	1	1	1	1	1	1	1	1	2	2	3
1 A 1 c liquid	Manufacture of Solid fuels and Other Energy Industries	CH4	Gg CO2 e	0	0	0	0	0	0	NO	NO	NO	NO	NO	NO	NO	NO	NO
1 A 1 c gaseous	Manufacture of Solid fuels and Other Energy Industries	CH4	Gg CO2 e	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1 A 1 b gaseous	Petroleum refining	CH4	Gg CO2 e	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1 A 1 b liquid	Petroleum refining	CH4	Gg CO2 e	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
1 A 2 a liquid	Iron and Steel	CH4	Gg CO2 e	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1 A 2 a solid	Iron and Steel	CH4	Gg CO2 e	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1
1 A 2 a gaseous	Iron and Steel	CH4	Gg CO2 e	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1
1 A 2 a biomass	Iron and Steel	CH4	Gg CO2 e	NO	NO	NO	NO	NO	NO	0	NO	NO	0	NO	NO	NO	NO	NO
1 A 2 b liquid	Non-ferrous Metals	CH4	Gg CO2 e	0	0	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	2011	2012
1 A 2 b solid	Non-ferrous Metals	CH4	Gg CO2 e	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1 A 2 b gaseous	Non-ferrous Metals	CH4	Gg CO2 e	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1 A 2 c liquid	Chemicals	CH4	Gg CO2 e	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1 A 2 c solid	Chemicals	CH4	Gg CO2 e	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1 A 2 c gaseous	Chemicals	CH4	Gg CO2 e	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1 A 2 c biomass	Chemicals	CH4	Gg CO2 e	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1 A 2 c other	Chemicals	CH4	Gg CO2 e	0	1	1	0	0	1	1	1	0	0	1	1	1	1	2
1 A 2 d liquid	Pulp, Paper and Print	CH4	Gg CO2 e	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0
1 A 2 d solid	Pulp, Paper and Print	CH4	Gg CO2 e	1	1	1	1	1	1	0	1	1	0	1	0	1	1	1
1 A 2 d gaseous	Pulp, Paper and Print	CH4	Gg CO2 e	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
1 A 2 d biomass	Pulp, Paper and Print	CH4	Gg CO2 e	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
1 A 2 d other	Pulp, Paper and Print	CH4	Gg CO2 e	0	0	0	0	0	0	0	0	0	0	NO	0	0	0	0
1 A 2 e liquid	Food Processing, Beverages and Tobacco	CH4	Gg CO2 e	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1 A 2 e solid	Food Processing, Beverages and Tobacco	CH4	Gg CO2 e	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1 A 2 e gaseous	Food Processing, Beverages and Tobacco	CH4	Gg CO2 e	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0
1 A 2 e biomass	Food Processing, Beverages and Tobacco	CH4	Gg CO2 e	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1 A 2 e other	Food Processing, Beverages and Tobacco	CH4	Gg CO2 e	NO	NO	NO	NO	NO	NO	0.0	0	0	NO	NO	NO	NO	NO	NO
1 A 2 f liquid	Other	CH4	Gg CO2 e	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
1 A 2 f solid	Other	CH4	Gg CO2 e	1	1	1	1	0	0	1	1	1	0	1	1	0	0	0
1 A 2 f gaseous	Other	CH4	Gg CO2 e	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
1 A 2 f biomass	Other	CH4	Gg CO2 e	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1 A 2 f other	Other	CH4	Gg CO2 e	0	1	1	1	1	1	1	1	1	1	1	1	1	1	2
1 A 3 a aviation gaso-line	Civil Aviation	CH4	Gg CO2 e	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
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	0	0
1 A 3 b gasoline	Road Transportation	CH4	Gg CO2 e	62	68	68	68	66	62	54	49	47	41	37	34	33	31	28
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	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	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	0	0
1 A 3 d gas/diesel oil	Navigation	CH4	Gg CO2 e	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1 A 3 d gasoline	Navigation	CH4	Gg CO2 e	0	0	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	0	0
1 A 4 a liquid	Commercial/Institutional	CH4	Gg CO2 e	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1 A 4 a solid	Commercial/Institutional	CH4	Gg CO2 e	2	2	2	2	2	1	1	2	1	2	2	2	2	2	2
1 A 4 a gaseous	Commercial/Institutional	CH4	Gg CO2 e	1	1	1	1	1	1	0	0	0	0	0	1	1	1	1
1 A 4 a biomass	Commercial/Institutional	CH4	Gg CO2 e	1	1	1	1	1	1	1	7	7	12	13	7	6	7	7
1 A 4 a other	Commercial/Institutional	CH4	Gg CO2 e	1	1	1	0	0	0	1	1	0	0	0	0	0	0	0
1 A 4 b liquid	Residential	CH4	Gg CO2 e	2	2	2	2	2	2	2	2	2	2	2	1	1	1	1
1 A 4 b solid	Residential	CH4	Gg CO2 e	59	63	52	47	43	41	40	25	22	21	18	17	14	12	11
1 A 4 b gaseous	Residential	CH4	Gg CO2 e	3	3	3	2	1	1	1	1	1	1	1	1	1	1	1
1 A 4 b biomass	Residential	CH4	Gg CO2 e	314	341	316	316	286	302	323	228	221	224	210	220	203	198	188
1 A 4 c liquid	Agriculture/Forestry/Fisheries	CH4	Gg CO2 e	2	1	1	1	1	1	1	1	1	1	1	1	1	1	1
1 A 4 c solid	Agriculture/Forestry/Fisheries	CH4	Gg CO2 e	1	1	1	1	1	1	1	1	0	0	0	0	0	0	0
1 A 4 c gaseous	Agriculture/Forestry/Fisheries	CH4	Gg CO2 e	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1 A 4 c biomass	Agriculture/Forestry/Fisheries	CH4	Gg CO2 e	2	2	2	2	2	2	2	16	16	16	16	17	15	15	14
1 A 5 b liquid	Mobile	CH4	Gg CO2 e	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1 B 1 a	Coal Mining	CH4	Gg CO2 e	11	9	8	8	6	6	5	5	5	5	6	5	6	5	1
1 B 1 b	Solid fuel transformation	CH4	Gg CO2 e	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1

IPCC Category Code	IPCC Category	Gas	Unit	1990	1995	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012
1 B 2 a	Oil	CH4	Gg CO2 e	126	136	135	136	127	129	128	124	129	139	140	146	148	148	143
1 B 2 b	Natural gas	CH4	Gg CO2 e	96	96	115	118	112	122	120	119	119	113	115	109	104	108	104
2 B 1	Ammonia Production	CH4	Gg CO2 e	1	1	1	1	1	1	1	2	2	1	1	1	1	1	1
2 B 5	Other	CH4	Gg CO2 e	13	13	13	13	14	13	13	13	13	13	13	13	13	14	13
2 C 1	Iron and Steel Production	CH4	Gg CO2 e	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
4 A 1	Cattle	CH4	Gg CO2 e	3 551	3 491	3 336	3 325	3 330	3 390	3 331	3 263	3 237	3 220	3 206	3 159	3 097	3 062	3 065
4 A 3	Sheep	CH4	Gg CO2 e	52	55	52	56	57	61	64	64	61	59	57	54	51	55	55
4 A 4	Goats	CH4	Gg CO2 e	4	4	4	5	5	6	6	6	6	6	6	6	6	6	6
4 A 6	Horses	CH4	Gg CO2 e	19	22	23	25	25	27	28	28	28	31	31	31	31	33	33
4 A 8	Swine	CH4	Gg CO2 e	116	115	117	120	117	117	115	116	120	108	105	108	104	102	98
4 A 9	Poultry	CH4	Gg CO2 e	6	6	6	6	6	6	5	6	6	6	5	5	5	5	5
4 A-10	Other	CH4	Gg CO2 e	6	6	6	6	6	7	7	9	8	7	6	6	6	7	7
4 B 1	Cattle	CH4	Gg CO2 e	283	278	266	265	264	267	262	255	251	249	248	243	238	233	232
4 B 3	Sheep	CH4	Gg CO2 e	1	1	1	1	1	1	2	2	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	0	0
4 B 6	Horses	CH4	Gg CO2 e	1	2	2	2	2	2	2	2	2	2	2	2	2	2	2
4 B 8	Swine	CH4	Gg CO2 e	123	119	120	122	118	116	113	112	113	101	96	98	93	90	84
4 B 9	Poultry	CH4	Gg CO2 e	23	24	22	24	23	23	21	24	23	23	19	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	0	0
4 D 1	Direct Soil Emissions	CH4	Gg CO2 e	7	7	7	10	8	9	9	9	9	9	9	9	8	9	8
4 F	FIELD BURNING OF AGRICULTURAL RESIDUES	CH4	Gg CO2 e	1	1	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	3 302	3 208	3 157	2 978	2 806	2 646	2 512	2 412	2 303	2 206	2 123	2 134	2 176	2 034
6 B	WASTEWATER HANDLING	CH4	Gg CO2 e	102	102	99	96	92	88	81	74	67	62	56	51	46	41	38
6 C	WASTE INCINERATION	CH4	Gg CO2 e	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
6 D	OTHER WASTE	CH4	Gg CO2 e	11	11	14	17	21	22	23	23	24	25	26	30	33	37	45
1 A 1 a liquid	Public Electricity and Heat Production	N2O	Gg CO2 e	7	8	7	10	9	7	8	10	12	10	6	7	4	6	6
1 A 1 a solid	Public Electricity and Heat Production	N2O	Gg CO2 e	23	27	17	15	15	20	15	14	15	17	21	24	23	27	29
1 A 1 a gaseous	Public Electricity and Heat Production	N2O	Gg CO2 e	9	9	8	8	9	10	10	8	10	10	8	9	9	10	10
1 A 1 a biomass	Public Electricity and Heat Production	N2O	Gg CO2 e	1	3	3	3	4	4	7	7	8	7	9	12	15	16	19
1 A 1 a other	Public Electricity and Heat Production	N2O	Gg CO2 e	1	1	2	2	2	2	2	2	2	2	2	2	3	3	4
1 A 1 b liquid	Petroleum refining	N2O	Gg CO2 e	4	5	5	5	5	5	5	5	5	4	4	4	5	5	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	0	0
1 A 1 c liquid	Manufacture of Solid fuels and Other Energy Industries	N2O	Gg CO2 e	0	0	0	0	0	0	NO	NO	NO	NO	NO	NO	NO	NO	NO
1 A 1 c gaseous	Manufacture of Solid fuels and Other Energy Industries	N2O	Gg CO2 e	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1 A 2 a liquid	Iron and Steel	N2O	Gg CO2 e	2	2	2	2	2	2	2	2	3	3	3	4	3	2	3
1 A 2 a solid	Iron and Steel	N2O	Gg CO2 e	11	11	9	10	10	12	11	12	12	12	13	12	13	14	14
1 A 2 a gaseous	Iron and Steel	N2O	Gg CO2 e	0	0	0	0	0	0	1	1	1	1	1	1	1	1	1
1 A 2 a biomass	Iron and Steel	N2O	Gg CO2 e	NO	NO	NO	NO	NO	NO	0	NO	NO	0	NO	NO	NO	NO	NO
1 A 2 b liquid	Non-ferrous Metals	N2O	Gg CO2 e	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1 A 2 b solid	Non-ferrous Metals	N2O	Gg CO2 e	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1 A 2 b gaseous	Non-ferrous Metals	N2O	Gg CO2 e	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1 A 2 c liquid	Chemicals	N2O	Gg CO2 e	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1 A 2 c solid	Chemicals	N2O	Gg CO2 e	0	1	1	1	1	1	1	1	1	1	1	1	1	1	1
1 A 2 c gaseous	Chemicals	N2O	Gg CO2 e	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1 A 2 c biomass	Chemicals	N2O	Gg CO2 e	4	4	4	3	2	2	3	4	3	6	5	2	2	2	2
1 A 2 c other	Chemicals	N2O	Gg CO2 e	1	1	1	1	1	1	1	1	1	1	1	1	2	3	3

IPCC Category Code	IPCC Category	Gas	Unit	1990	1995	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012
1 A 2 d liquid	Pulp, Paper and Print	N2O	Gg CO2 e	3	4	3	3	2	2	1	2	2	1	1	1	1	1	1
1 A 2 d solid	Pulp, Paper and Print	N2O	Gg CO2 e	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2
1 A 2 d gaseous	Pulp, Paper and Print	N2O	Gg CO2 e	1	1	1	0	1	1	1	1	1	1	1	1	1	1	1
1 A 2 d biomass	Pulp, Paper and Print	N2O	Gg CO2 e	13	13	14	18	20	20	16	20	16	20	16	22	16	17	17
1 A 2 d other	Pulp, Paper and Print	N2O	Gg CO2 e	0	0	0	0	0	0	0	0	0	0	NO	0	0	0	0
1 A 2 e liquid	Food Processing, Beverages and Tobacco	N2O	Gg CO2 e	1	1	1	1	1	1	1	1	1	0	1	1	1	1	1
1 A 2 e solid	Food Processing, Beverages and Tobacco	N2O	Gg CO2 e	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1 A 2 e gaseous	Food Processing, Beverages and Tobacco	N2O	Gg CO2 e	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0
1 A 2 e biomass	Food Processing, Beverages and Tobacco	N2O	Gg CO2 e	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1 A 2 e other	Food Processing, Beverages and Tobacco	N2O	Gg CO2 e	NO	NO	NO	NO	NO	NO	0.0	0	0	NO	NO	NO	NO	NO	NO
1 A 2 f liquid	Other	N2O	Gg CO2 e	32	36	37	40	42	45	56	56	65	62	72	68	66	68	69
1 A 2 f solid	Other	N2O	Gg CO2 e	3	3	3	2	2	2	3	3	3	2	2	2	2	1	1
1 A 2 f gaseous	Other	N2O	Gg CO2 e	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
1 A 2 f biomass	Other	N2O	Gg CO2 e	6	6	6	6	6	5	6	1	3	11	10	11	10	12	12
1 A 2 f other	Other	N2O	Gg CO2 e	1	1	1	1	1	1	1	2	2	2	2	2	2	2	3
1 A 3 a aviation gasoline	Civil Aviation	N2O	Gg CO2 e	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1 A 3 a jet kerosene	Civil Aviation	N2O	Gg CO2 e	0	0	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	163	172	180	194	196	191	187	203	194	193	191	200	198	183
1 A 3 b diesel oil	Road Transportation	N2O	Gg CO2 e	41	46	49	52	54	58	72	70	84	85	95	105	120	134	142
1 A 3 c liquid	Railways	N2O	Gg CO2 e	19	17	17	16	17	16	14	14	14	15	15	14	16	16	16
1 A 3 c solid	Railways	N2O	Gg CO2 e	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1 A 3 d gas/diesel oil	Navigation	N2O	Gg CO2 e	0	0	0	0	0	0	0	0	1	0	0	0	0	0	1
1 A 3 d gasoline	Navigation	N2O	Gg CO2 e	0	0	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	0	0
1 A 4 a liquid	Commercial/Institutional	N2O	Gg CO2 e	5	5	5	5	4	4	6	8	8	8	5	6	7	9	7
1 A 4 a solid	Commercial/Institutional	N2O	Gg CO2 e	1	1	1	1	1	1	0	1	1	1	1	1	1	1	1
1 A 4 a gaseous	Commercial/Institutional	N2O	Gg CO2 e	4	5	8	9	7	10	8	6	7	8	8	11	10	11	13
1 A 4 a biomass	Commercial/Institutional	N2O	Gg CO2 e	2	2	2	2	2	2	2	2	2	4	4	3	3	3	4
1 A 4 a other	Commercial/Institutional	N2O	Gg CO2 e	1	1	1	1	1	1	1	1	1	1	1	0	0	0	0
1 A 4 b liquid	Residential	N2O	Gg CO2 e	27	30	28	29	28	30	33	28	29	29	29	29	28	28	27
1 A 4 b solid	Residential	N2O	Gg CO2 e	19	21	18	15	13	13	12	9	8	7	6	6	5	4	4
1 A 4 b gaseous	Residential	N2O	Gg CO2 e	10	12	12	13	12	13	15	15	16	16	15	16	15	16	16
1 A 4 b biomass	Residential	N2O	Gg CO2 e	80	88	82	84	77	82	90	83	80	81	76	81	76	76	73
1 A 4 c liquid	Agriculture/Forestry/Fisheries	N2O	Gg CO2 e	80	80	81	81	82	80	85	90	90	92	90	94	93	87	87
1 A 4 c solid	Agriculture/Forestry/Fisheries	N2O	Gg CO2 e	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1 A 4 c gaseous	Agriculture/Forestry/Fisheries	N2O	Gg CO2 e	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1 A 4 c biomass	Agriculture/Forestry/Fisheries	N2O	Gg CO2 e	5	5	5	5	4	5	6	6	7	7	7	8	7	8	9
1 A 5 b liquid	Mobile	N2O	Gg CO2 e	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
2 B 2	Nitric Acid Production	N2O	Gg CO2 e	912	927	837	879	825	857	874	863	897	923	952	786	807	883	281
3 D	OTHER	N2O	Gg CO2 e	233	233	233	233	233	233	233	233	233	233	233	221	209	197	185
4 B 1	Cattle	N2O	Gg CO2 e	759	751	725	726	734	759	752	744	746	747	748	741	731	729	735
4 B 3	Sheep	N2O	Gg CO2 e	20	21	20	21	22	23	24	24	23	22	22	20	19	21	21
4 B 4	Goats	N2O	Gg CO2 e	2	2	2	3	3	3	3	3	3	3	3	4	3	3	3
4 B 6	Horses	N2O	Gg CO2 e	18	22	23	24	25	27	27	27	28	30	30	29	29	31	31
4 B 8	Swine	N2O	Gg CO2 e	87	85	86	87	85	85	83	82	83	74	71	73	70	68	64
4 B 9	Poultry	N2O	Gg CO2 e	46	51	49	54	54	54	52	58	59	60	51	54	55	58	59
4 B-10	Other	N2O	Gg CO2 e	2	2	2	2	2	3	3	4	3	2	2	2	2	3	3

IPCC Category Code	IPCC Category	Gas	Unit	1990	1995	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012
4 D 1	Direct Soil Emissions	N2O	Gg CO2 e	1 909	2 083	1 938	1 785	2 129	2 167	1 887	1 932	1 968	1 940	1 822	1 842	1 846	1 721	1 681
4 D 2	Pasture, Range and Paddock Manure	N2O	Gg CO2 e	169	164	154	153	150	153	149	145	137	133	130	123	116	113	111
4 D 3	Indirect Emissions	N2O	Gg CO2 e	1 352	1 435	1 320	1 226	1 386	1 411	1 300	1 306	1 310	1 268	1 240	1 231	1 226	1 183	1 126
4 F	FIELD BURNING OF AGRICULTURAL RESIDUES	N2O	Gg CO2 e	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
6 B	WASTEWATER HANDLING	N2O	Gg CO2 e	109	109	103	98	110	125	141	151	164	179	205	229	229	227	226
6 C	WASTE INCINERATION	N2O	Gg CO2 e	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
6 D	OTHER WASTE	N2O	Gg CO2 e	24	25	29	36	43	45	47	46	48	50	53	60	67	73	92
2 C 3	Aluminium production	PFC	Gg CO2 e	994	994	395	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	277	253	277	373	443	611	349	164	22	37	29	7	4	0
2 F 1	Refrigeration and Air Conditioning Equipment	HFC	Gg CO2 e	0	0	0	1	13	33	61	107	184	256	351	466	542	664	753
2 F 2	Foam Blowing	HFC	Gg CO2 e	0	0	0	208	217	275	299	321	344	348	266	270	294	253	227
2 F 3	Fire Extinguishers	HFC	Gg CO2 e	0	0	0	0	0	0	0	0	0	0	0	3	2	0	4
2 F 4	Aerosols	HFC	Gg CO2 e	20	21	21	21	22	22	22	23	23	24	25	29	31	30	31
2 F 5	Solvents	HFC	Gg CO2 e	0	1	1	1	1	1	1	1	1	1	1	1	2	2	1
2 F 7	Semiconductor Manufacture	SF6	Gg CO2 e	102	175	239	302	365	429	328	488	430	387	333	359	358	378	380
2 F 7	Semiconductor Manufacture	HFC	Gg CO2 e	2	3	4	6	7	9	10	9	3	3	4	4	4	4	4
2 F 7	Semiconductor Manufacture	PFC	Gg CO2 e	29	37	45	53	58	68	66	96	44	64	67	90	83	102	125
2 F 8	Electrical equipment	SF6	Gg CO2 e	11	12	13	14	14	15	15	15	17	17	18	19	20	20	21
2 F 9	Other Sources of SF6	PFC	Gg CO2 e	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2 F 9	Other Sources of SF6	SF6	Gg CO2 e	127	179	183	187	218	266	280	287	300	284	215	253	258	174	105
5 A 1	Forest land remaining forest land	CO2	Gg	-7 849	-13 472	-8 602	-8 957	-8 035	-9 230	-6 379	-15 299	-13 654	-16 637	-13 613	-15 630	-9 944	-25	-5 135
5 A 2	Land converted to forest land	CO2	Gg	-3 081	-3 187	-3 294	-3 412	-3 269	-3 066	-2 895	-2 725	-2 554	-2 487	-2 421	-2 355	-2 288	-2 219	-2 193
5 B 1	Cropland remaining cropland	CO2	Gg	-165	-165	-143	-125	-118	-78	-61	-42	-31	-27	-18	-9	-1	11	33
5 B 2	Land converted to cropland	CO2	Gg	199	199	199	199	197	173	172	170	169	168	168	167	178	177	176
5 C 1	Grassland remaining grassland	CO2	Gg	0	0	0	0	1	1	1	0	1	1	1	1	1	1	1
5 C 2	Land converted to grassland	CO2	Gg	321	316	311	306	306	139	141	143	144	144	144	144	352	347	349
5 D 2	Land converted to Wetlands	CO2	Gg	42	42	42	42	42	36	36	36	36	36	36	36	47	47	47
5 E 2	Land converted to Settlements	CO2	Gg	184	187	191	195	193	144	139	134	130	128	87	99	204	220	231
5 F 2	Land converted to Other land	CO2	Gg	451	460	469	477	477	378	374	369	365	365	366	368	336	338	330
5	Total land use categories	CH4	Gg CO2 e	1	0	0	0	0	0	0	0	0	0	0	0	1	1	0
5	Total land use categories	N2O	Gg CO2 e	20	20	20	20	20	20	19	19	19	19	19	19	19	19	18

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_2O [Gg]	CO_2 equiv. [Gg]
1990	10 888	0.15	0.13	10 932
1991	11 645	0.17	0.15	11 697
1992	8 403	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	12 711	0.24	0.25	12 793
2006	11 623	0.27	0.27	11 711
2007	10 418	0.29	0.28	10 512
2008	10 312	0.30	0.31	10 414
2009	9 281	0.35	0.31	9 383
2010	10 760	0.38	0.37	10 883
2011	10 434	0.42	0.36	10 555
2012	8 983	0.43	0.34	9 097
Trend 1990-2012	-17.5%	194.1%	156.0%	-16.8%

Solid fossil fuels and natural gas are dominant compared to other fuel types. Since 2000 liquid fossil fuels became less important. The share in CO_2 emissions from waste incineration in district heating plants which are reported as 'other fuels' increased from 1% in 1990 to 11% in 2011.

Table A 19: Share of fuel types on total CO_2 emissions from Category 1.A.1.a

	Liquid	Solid	Gaseous	Other
1990	11%	57%	30%	1%
1991	13%	59%	27%	1%
1992	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%	49%	37%	6%
2007	7%	49%	38%	7%
2008	7%	43%	43%	7%
2009	7%	33%	50%	11%
2010	7%	36%	48%	9%
2011	4%	41%	44%	11%
2012	2%	38%	45%	14%

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_2O [Gg]	CO_2 equiv. [Gg]
1990	2 394	0.05	0.015	2 399
1991	2 428	0.05	0.016	2 433
1992	2 389	0.05	0.016	2 394
1993	2 732	0.05	0.018	2 737
1994	2 709	0.05	0.018	2 715
1995	2 590	0.05	0.018	2 596
1996	2 647	0.05	0.017	2 652
1997	2 640	0.05	0.017	2 645
1998	2 633	0.05	0.017	2 639
1999	2 152	0.04	0.015	2 156

	CO_2 [Gg]	CH_4 [Gg]	N_2O [Gg]	CO_2 equiv. [Gg]
2000	2 199	0.04	0.015	2 204
2001	2 219	0.04	0.015	2 224
2002	2 565	0.04	0.017	2 570
2003	2 687	0.04	0.017	2 693
2004	2 844	0.03	0.016	2 848
2005	2 827	0.05	0.020	2 833
2006	2 830	0.05	0.019	2 836
2007	2 868	0.05	0.021	2 874
2008	2 806	0.05	0.019	2 812
2009	2 809	0.04	0.018	2 815
2010	2 724	0.05	0.015	2 729
2011	2 768	0.05	0.016	2 773
2012	2 836	0.05	0.019	2 842
Trend 1990-2012	18.5%	4.2%	24.3%	18.5%

Table A 21 presents the share of CO_2 emissions on the different fuel types.

Table A 21: Share of fuel types on total CO_2 emissions from Category 1.A.1.b.

	Liquid	Gaseous
1990	82%	18%
1991	79%	21%
1992	80%	20%
1993	80%	20%
1994	86%	14%
1995	84%	16%
1996	82%	18%
1997	82%	18%
1998	82%	18%
1999	87%	13%
2000	84%	16%
2001	82%	18%
2002	86%	14%
2003	86%	14%
2004	88%	12%
2005	82%	18%
2006	83%	17%
2007	84%	16%
2008	82%	18%
2009	92%	8%
2010	82%	18%
2011	82%	18%
2012	83%	17%

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_2O [Gg]	CO_2 equiv. [Gg]
1990	510	0.014	0.0010	511
1991	549	0.015	0.0010	550
1992	522	0.014	0.0009	523
1993	424	0.011	0.0008	425
1994	453	0.012	0.0008	453
1995	611	0.017	0.0011	612
1996	261	0.007	0.0005	261
1997	277	0.008	0.0005	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	684	0.019	0.0012	685
2006	623	0.017	0.0011	623
2007	550	0.015	0.0010	551
2008	514	0.014	0.0009	514
2009	508	0.014	0.0009	508
2010	462	0.013	0.0008	462
2011	522	0.014	0.0009	522
2012	506	0.014	0.0009	507
Trend 1990-2012	-0.8%	-0.1%	-6.3%	-0.8%

Almost all emissions of category 1.A.1.c originated from natural gas combustion.

Table A 23: Share of fuel types on total CO_2 emissions from Category 1.A.1.c.

	Liquid	Gaseous
1990	1%	99%
1991	0%	100%
1992	0%	100%
1993	0%	100%
1994	0%	100%
1995	0%	100%
1996	NO	100%
1997	NO	100%
1998	NO	100%
1999	NO	100%
2000	NO	100%
2001	NO	100%
2002	NO	100%

	Liquid	Gaseous
2003	NO	100%
2004	NO	100%
2005	NO	100%
2006	NO	100%
2007	NO	100%
2008	NO	100%
2009	NO	100%
2010	NO	100%
2011	NO	100%
2012	NO	100%

1.A.2.a Iron and Steel

Table A 24: Greenhouse gas emissions from Category 1.A.2.a.

	CO_2 [Gg]	CH_4 [Gg]	N_2O [Gg]	CO_2 equiv. [Gg]
1990	4 944	0.025	0.043	4 958
1991	4 615	0.023	0.043	4 628
1992	3 933	0.020	0.036	3 944
1993	4 191	0.022	0.038	4 203
1994	4 441	0.026	0.041	4 455
1995	4 774	0.026	0.047	4 789
1996	4 666	0.030	0.043	4 680
1997	5 287	0.035	0.048	5 303
1998	4 715	0.033	0.048	4 731
1999	4 863	0.030	0.049	4 879
2000	5 217	0.038	0.056	5 235
2001	5 192	0.036	0.053	5 209
2002	5 512	0.038	0.053	5 529
2003	5 628	0.078	0.054	5 646
2004	5 855	0.089	0.055	5 874
2005	6 449	0.101	0.059	6 470
2006	6 344	0.108	0.062	6 366
2007	6 216	0.101	0.063	6 238
2008	6 189	0.091	0.061	6 210
2009	4 820	0.088	0.047	4 837
2010	5 925	0.083	0.059	5 945
2011	5 941	0.095	0.056	5 960
2012	5 859	0.094	0.055	5 877
Trend 1990-2012	18.5%	269.6%	27.5%	18.5%

CO_2 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 CO_2 emissions from Category 1.A.2.a.

	Liquid	Solid	Gaseous
1990	9.1%	77.8%	13.1%
1991	9.7%	75.7%	14.5%
1992	11.1%	72.7%	16.2%
1993	10.9%	74.5%	14.6%
1994	10.9%	73.8%	15.3%
1995	11.7%	72.5%	15.9%
1996	9.9%	70.1%	20.0%
1997	9.8%	69.7%	20.5%
1998	14.1%	63.3%	22.6%
1999	13.4%	65.8%	20.7%
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%	68.7%	19.2%
2005	12.3%	69.7%	18.0%
2006	12.1%	69.6%	18.3%
2007	13.9%	68.9%	17.3%
2008	12.9%	70.5%	16.6%
2009	8.3%	71.6%	20.0%
2010	11.4%	70.2%	18.4%
2011	7.5%	71.3%	21.2%
2012	6.5%	71.6%	21.8%

1.A.2.b Non-Ferrous Metals

Table A 26: Greenhouse gas emissions from Category 1.A.2.b.

	CO_2 [Gg]	CH_4 [Gg]	N_2O [Gg]	CO_2 equiv. [Gg]
1990	132	0.003	0.0009	132
1991	119	0.003	0.0008	119
1992	127	0.003	0.0007	127
1993	158	0.004	0.0008	158
1994	261	0.007	0.0011	262
1995	255	0.006	0.0010	255
1996	177	0.004	0.0009	177
1997	221	0.005	0.0012	222
1998	205	0.004	0.0011	206
1999	190	0.004	0.0011	190
2000	193	0.004	0.0010	193
2001	207	0.005	0.0010	207
2002	208	0.005	0.0010	208
2003	213	0.005	0.0010	213
2004	220	0.005	0.0009	221
2005	219	0.005	0.0008	219
2006	224	0.005	0.0008	224

	CO_2 [Gg]	CH_4 [Gg]	N_2O [Gg]	CO_2 equiv. [Gg]
2007	252	0.006	0.0009	253
2008	255	0.006	0.0008	255
2009	233	0.006	0.0008	234
2010	235	0.006	0.0006	235
2011	257	0.006	0.0007	257
2012	245	0.006	0.0007	245
Trend 1990-2012	85.6%	98.5%	-24.9%	85.4%

CO_2 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%	9%	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	12%	6%	83%
2008	9%	6%	85%
2009	8%	7%	85%
2010	8%	3%	89%
2011	9%	3%	89%
2012	9%	2%	88%

1.A.2.c Chemicals

Table A 28: Greenhouse gas emissions from Category 1.A.2.c.

	CO_2 [Gg]	CH_4 [Gg]	N_2O [Gg]	CO_2 equiv. [Gg]
1990	883	0.045	0.017	889
1991	905	0.051	0.018	912
1992	986	0.059	0.021	994
1993	1 034	0.049	0.015	1 040
1994	984	0.048	0.014	989
1995	1 033	0.053	0.014	1 039

	CO_2 [Gg]	CH_4 [Gg]	N_2O [Gg]	CO_2 equiv. [Gg]
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	1 375	0.071	0.023	1 384
2001	1 416	0.074	0.016	1 423
2002	1 438	0.088	0.017	1 445
2003	1 541	0.109	0.021	1 550
2004	1 523	0.125	0.022	1 532
2005	1 643	0.108	0.020	1 651
2006	1 371	0.090	0.018	1 378
2007	1 274	0.072	0.018	1 281
2008	1 564	0.119	0.023	1 573
2009	1 403	0.100	0.020	1 411
2010	1 505	0.112	0.024	1 515
2011	1 764	0.120	0.024	1 774
2012	1 793	0.114	0.022	1 803
Trend 1990-2012	103.2%	153.5%	30.6%	102.8%

In 2011 natural gas was still the main source of CO_2 emissions from category *1.A.2.c* while CO_2 emissions from solid and liquid fossil fuel combustion got less important.

Table A 29: Share of fuel types in total CO_2 emissions from Category 1.A.2.c

	Liquid	Solid	Gaseous	Other
1990	9%	12%	59%	20%
1991	10%	15%	51%	24%
1992	6%	19%	50%	26%
1993	7%	18%	58%	16%
1994	9%	15%	56%	19%
1995	9%	15%	55%	22%
1996	8%	17%	51%	24%
1997	11%	21%	50%	18%
1998	10%	22%	52%	16%
1999	5%	23%	60%	12%
2000	4%	18%	64%	15%
2001	5%	18%	60%	16%
2002	4%	17%	58%	21%
2003	4%	16%	54%	25%
2004	4%	16%	55%	25%
2005	5%	9%	63%	23%
2006	5%	8%	63%	25%
2007	6%	6%	67%	20%
2008	6%	5%	61%	29%
2009	9%	5%	59%	27%
2010	10%	5%	57%	28%
2011	7%	4%	65%	24%

	Liquid	Solid	Gaseous	Other
2012	7%	4%	67%	22%

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_2O [Gg]	CO_2 equiv.[Gg]
1990	2 213	0.12	0.06	2 234
1991	2 676	0.13	0.06	2 699
1992	2 167	0.12	0.06	2 188
1993	2 024	0.12	0.08	2 050
1994	2 555	0.14	0.08	2 582
1995	2 315	0.14	0.08	2 342
1996	2 417	0.14	0.07	2 440
1997	2 821	0.15	0.08	2 849
1998	2 635	0.14	0.07	2 658
1999	2 338	0.14	0.08	2 364
2000	2 380	0.13	0.06	2 402
2001	2 252	0.14	0.08	2 280
2002	2 260	0.13	0.06	2 282
2003	2 438	0.14	0.07	2 461
2004	2 296	0.14	0.07	2 320
2005	2 290	0.15	0.09	2 321
2006	2 191	0.14	0.08	2 218
2007	2 187	0.14	0.08	2 215
2008	2 190	0.14	0.08	2 217
2009	2 240	0.14	0.08	2 268
2010	2 351	0.15	0.08	2 380
2011	2 042	0.14	0.08	2 070
2012	1 978	0.14	0.08	2 006
Trend 1990-2012	-10.6%	22.3%	38.5%	-10.2%

Natural gas combustion is the main source of CO_2 emissions from category 1.A.2.d. Liquid fuel consumption decreased since 1990 whereas the share of solid fuels in total CO_2 emissions is quite constant.

Table A 31: Share of fuel types in total CO_2 emissions from Category 1.A.2.d.

	Liquid	Solid	Gaseous	Other
1990	41%	20%	38%	1%
1991	31%	21%	47%	1%
1992	34%	21%	44%	1%
1993	26%	14%	59%	1%
1994	23%	16%	59%	2%
1995	17%	15%	65%	3%
1996	18%	16%	66%	0%
1997	17%	17%	66%	0%

	Liquid	Solid	Gaseous	Other
1998	10%	15%	74%	1%
1999	7%	19%	74%	NO
2000	8%	17%	75%	1%
2001	7%	20%	72%	1%
2002	7%	17%	75%	1%
2003	6%	19%	74%	1%
2004	6%	19%	75%	0%
2005	6%	21%	73%	0%
2006	4%	17%	78%	1%
2007	4%	15%	81%	0%
2008	5%	15%	80%	0%
2009	3%	14%	83%	0%
2010	3%	17%	80%	0%
2011	2%	18%	80%	0%
2012	41%	20%	38%	1%

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_2O [Gg]	CO_2 equiv. [Gg]
1990	870	0.018	0.005	872
1991	933	0.020	0.006	935
1992	854	0.018	0.005	856
1993	886	0.016	0.005	888
1994	916	0.019	0.005	918
1995	931	0.019	0.005	933
1996	888	0.019	0.004	889
1997	1 042	0.022	0.004	1 043
1998	943	0.021	0.004	944
1999	826	0.020	0.004	828
2000	882	0.022	0.004	884
2001	926	0.022	0.005	928
2002	1 100	0.028	0.005	1 103
2003	945	0.022	0.005	946
2004	948	0.021	0.005	950
2005	957	0.022	0.005	959
2006	926	0.022	0.005	928
2007	882	0.021	0.005	884
2008	874	0.021	0.004	876
2009	908	0.022	0.005	910
2010	1 026	0.024	0.005	1 028
2011	958	0.023	0.004	960
2012	981	0.024	0.005	983
Trend 1990-2012	12.8%	32.6%	-9.4%	12.8%

The share of natural gas consumption is increasing and is the main source of CO_2 emissions from category *1.A.2.e*. The share of liquid fossil fuel combustion in total CO_2 emissions decreased since 1990.

Table A 33: Share of fuel types in total CO_2 emissions from Category 1.A.2.e.

	Liquid	Solid	Gaseous	Other
1990	40%	2%	58%	NO
1991	42%	2%	55%	NO
1992	40%	1%	59%	NO
1993	44%	2%	54%	NO
1994	38%	2%	59%	NO
1995	37%	1%	63%	NO
1996	29%	1%	70%	0.07%
1997	30%	1%	69%	0.06%
1998	26%	1%	72%	0.07%
1999	20%	1%	79%	NO
2000	19%	2%	79%	NO
2001	26%	1%	73%	NO
2002	16%	1%	82%	NO
2003	24%	2%	75%	NO
2004	27%	1%	72%	NO
2005	25%	1%	73%	NO
2006	26%	1%	72%	NO
2007	24%	1%	75%	NO
2008	22%	1%	77%	NO
2009	23%	2%	76%	NO
2010	26%	1%	73%	0.05%
2011	21%	2%	78%	0.02%
2012	20%	2%	78%	0.02%

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

Table A 34: Greenhouse gas emissions from Category 1.A.2.f.

	CO_2 [Gg]	CH_4 [Gg]	N_2O [Gg]	CO_2 equiv. [Gg]
1990	3 644	0.130	0.137	3 689
1991	3 827	0.143	0.152	3 877
1992	3 882	0.154	0.156	3 934
1993	3 955	0.146	0.163	4 008
1994	4 080	0.150	0.167	4 135
1995	4 180	0.155	0.174	4 237
1996	4 431	0.167	0.218	4 502
1997	4 670	0.163	0.201	4 736
1998	4 377	0.172	0.238	4 454
1999	3 651	0.161	0.252	3 733
2000	3 844	0.176	0.282	3 935
2001	3 754	0.186	0.271	3 842

	CO_2 [Gg]	CH_4 [Gg]	N_2O [Gg]	CO_2 equiv. [Gg]
2002	3 570	0.178	0.263	3 655
2003	3 966	0.182	0.275	4 055
2004	4 286	0.203	0.278	4 377
2005	4 603	0.220	0.324	4 708
2006	4 822	0.245	0.342	4 933
2007	4 853	0.272	0.353	4 968
2008	4 861	0.271	0.354	4 977
2009	4 624	0.281	0.338	4 735
2010	4 732	0.267	0.330	4 840
2011	4 593	0.277	0.334	4 702
2012	4 553	0.262	0.346	4 666
Trend 1990-2012	24.9%	101.7%	152.6%	26.5%

Natural gas and liquid fossil fuel combustion is the main source of CO_2 emissions from category *1.A.2.f*. The share of fossil fuel types on total CO_2 emissions is quite constant over the years.

Table A 35: Share of fuel types in total CO_2 emissions from category 1.A.2.f.

	Liquid	Solid	Gaseous	Other
1990	38%	17%	43%	2%
1991	39%	15%	43%	4%
1992	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%	14%	45%	6%
2001	36%	12%	43%	8%
2002	33%	10%	48%	9%
2003	37%	8%	45%	9%
2004	39%	7%	44%	10%
2005	39%	10%	42%	8%
2006	40%	12%	40%	8%
2007	38%	14%	39%	9%
2008	38%	13%	40%	9%
2009	38%	10%	42%	10%
2010	37%	7%	46%	10%
2011	39%	6%	44%	10%
2012	39%	6%	43%	12%

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_2O [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	3 180	0.14	0.06	3 203
2000	3 293	0.15	0.06	3 315
2001	3 237	0.16	0.06	3 259
2002	3 066	0.16	0.06	3 088
2003	3 429	0.16	0.07	3 454
2004	3 695	0.18	0.07	3 722
2005	3 794	0.20	0.09	3 826
2006	3 847	0.22	0.10	3 882
2007	3 802	0.25	0.12	3 845
2008	3 710	0.24	0.12	3 753
2009	3 516	0.25	0.13	3 561
2010	3 663	0.24	0.14	3 710
2011	3 520	0.25	0.15	3 571
2012	3 440	0.24	0.16	3 496
Trend 1990-2012	1.5%	103.8%	248.1%	2.7%

Natural gas and liquid fossil fuel combustion is the main stationary source of CO_2 emissions from category *1.A.2.f*. Solid and liquid fuels got less important but CO_2 emissions from combustion of natural gas and industrial waste which is reported as "Other fuels" are increasing.

Table A 37: Share of fuel types on total CO_2 emissions from Category 1.A.2.f stationary sources.

	Liquid	Solid	Gaseous	Other
1990	33%	18%	46%	2%
1991	34%	16%	46%	4%
1992	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%

	Liquid	Solid	Gaseous	Other
2001	26%	14%	50%	10%
2002	22%	11%	56%	12%
2003	27%	8%	53%	12%
2004	29%	7%	51%	12%
2005	25%	12%	54%	9%
2006	24%	15%	52%	10%
2007	21%	17%	52%	11%
2008	18%	16%	54%	12%
2009	17%	14%	56%	12%
2010	19%	9%	59%	12%
2011	22%	10%	55%	13%

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_2O [Gg]	CO_2 equiv. [Gg]
1990	1 055	0.06	0.02	1 061
1991	1 038	0.06	0.02	1 044
1992	1 107	0.06	0.02	1 114
1993	1 038	0.06	0.02	1 045
1994	1 089	0.06	0.02	1 095
1995	867	0.05	0.01	872
1996	848	0.06	0.01	853
1997	932	0.06	0.01	938
1998	853	0.07	0.02	859
1999	826	0.06	0.01	832
2000	866	0.07	0.02	873
2001	807	0.08	0.02	813
2002	830	0.08	0.02	837
2003	821	0.07	0.02	827
2004	920	0.09	0.02	929
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	0.10	0.03	1 098
2009	931	0.10	0.02	940
2010	820	0.09	0.02	829
2011	802	0.09	0.02	811
2012	824	0.09	0.02	834
Trend 1990-2012	-21.8%	63.4%	45.9%	-21.4%

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_2O [Gg]	CO_2 equiv. [Gg]
1990	256	0.01	0.09	284
1991	289	0.02	0.10	321
1992	306	0.02	0.11	340
1993	322	0.02	0.11	358
1994	338	0.02	0.12	376
1995	358	0.02	0.13	399
1996	446	0.02	0.17	498
1997	420	0.02	0.16	471
1998	494	0.02	0.19	555
1999	471	0.02	0.19	530
2000	551	0.02	0.22	620
2001	518	0.02	0.21	583
2002	504	0.02	0.20	567
2003	537	0.02	0.21	602
2004	591	0.02	0.20	655
2005	809	0.02	0.23	882
2006	975	0.03	0.24	1 051
2007	1 051	0.03	0.23	1 124
2008	1 151	0.03	0.23	1 223
2009	1 108	0.03	0.21	1 174
2010	1 070	0.02	0.19	1 130
2011	1 072	0.02	0.19	1 131
2012	1 113	0.02	0.18	1 170
Trend 1990-2012	335.1%	83.8%	102.7%	312.0%

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_2O [Gg]	CO_2 equiv. [Gg]
1990	224	0.006	0.0004	225
1991	225	0.006	0.0004	226
1992	220	0.006	0.0004	220
1993	214	0.006	0.0004	214
1994	209	0.006	0.0004	210
1995	227	0.006	0.0004	227
1996	234	0.006	0.0004	234
1997	233	0.006	0.0004	233
1998	351	0.010	0.0006	352

	CO_2 [Gg]	CH_4 [Gg]	N_2O [Gg]	CO_2 equiv. [Gg]
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	362	0.010	0.0007	362
2006	471	0.013	0.0009	472
2007	447	0.012	0.0008	447
2008	569	0.015	0.0010	569
2009	419	0.011	0.0008	419
2010	317	0.009	0.0006	317
2011	397	0.011	0.0007	398
2012	394	0.011	0.0007	394
Trend 1990-2012	75.4%	75.4%	75.4%	75.4%

All emissions pipeline compressors arise from liquid fuels.

1.A.4 Other sectors

Table A 41: Greenhouse gas emissions from Category 1.A.4.

	CO_2 [Gg]	CH_4 [Gg]	N_2O [Gg]	CO_2 equiv. [Gg]
1990	13 786	18.44	0.76	14 407
1991	14 884	19.95	0.81	15 554
1992	14 440	18.17	0.79	15 065
1993	14 259	17.84	0.79	14 879
1994	12 979	16.15	0.75	13 551
1995	14 113	16.81	0.78	14 707
1996	15 261	17.81	0.83	15 893
1997	13 774	13.50	0.81	14 309
1998	13 726	13.03	0.80	14 247
1999	14 264	13.36	0.82	14 798
2000	13 095	12.60	0.78	13 601
2001	14 224	12.78	0.82	14 748
2002	13 492	11.63	0.79	13 982
2003	14 227	11.35	0.79	14 709
2004	13 740	10.80	0.78	14 209
2005	13 177	11.11	0.81	13 659
2006	12 674	10.08	0.76	13 121
2007	10 863	9.58	0.72	11 288
2008	11 523	9.82	0.73	11 956
2009	10 713	9.22	0.68	11 118
2010	10 995	10.22	0.70	11 426

	CO_2 [Gg]	CH_4 [Gg]	N_2O [Gg]	CO_2 equiv. [Gg]
2011	9 782	8.89	0.65	10 170
2012	9 097	9.60	0.64	9 498
Trend 1990-2012	-34.0%	-47.9%	-14.9%	-34.1%

As can be seen from Table A 42 liquid fossil fuels are the main source of CO_2 emissions from category *1.A.4* with a quite constant share over the time series. Since 1990 solid fossil fuels became less important whereas the share of CO_2 emissions from natural gas combustion more than doubled.

Table A 42: Share of fuel types on total CO_2 emissions from Category 1.A.4.

	Liquid	Solid	Gaseous	Other
1990	60%	19%	19%	3%
1991	58%	20%	21%	2%
1992	56%	17%	24%	2%
1993	56%	15%	28%	1%
1994	57%	14%	27%	2%
1995	57%	12%	29%	1%
1996	60%	11%	27%	2%
1997	61%	9%	28%	2%
1998	61%	8%	30%	1%
1999	61%	7%	30%	1%
2000	60%	7%	31%	1%
2001	58%	7%	35%	0%
2002	60%	6%	34%	0%
2003	60%	5%	35%	0%
2004	57%	4%	38%	0%
2005	60%	4%	36%	0%
2006	59%	3%	38%	0%
2007	57%	3%	40%	0%
2008	59%	3%	38%	0%
2009	56%	2%	42%	0%
2010	53%	2%	44%	0%
2011	53%	2%	45%	0%
2012	53%	2%	45%	0%

1.A.4 Other sectors – stationary sources

Table A 43: Greenhouse gas emissions from Category 1.A.4 Other sectors - stationary sources.

	CO_2 [Gg]	CH_4 [Gg]	N_2O [Gg]	CO_2 equiv. [Gg]
1990	12 870	18.30	0.48	13 403
1991	13 971	19.82	0.53	14 552
1992	13 519	18.03	0.50	14 054
1993	13 334	17.70	0.51	13 862
1994	12 048	16.01	0.46	12 527
1995	13 215	16.68	0.50	13 720
1996	14 334	17.69	0.54	14 872

	CO_2 [Gg]	CH_4 [Gg]	N_2O [Gg]	CO_2 equiv. [Gg]
1997	12 810	13.37	0.49	13 244
1998	12 778	12.90	0.48	13 199
1999	13 309	13.24	0.50	13 741
2000	12 164	12.49	0.47	12 571
2001	13 269	12.67	0.50	13 689
2002	13 269	12.67	0.50	13 689
2003	13 308	11.24	0.48	13 693
2004	12 799	10.69	0.48	13 171
2005	12 197	11.00	0.49	12 581
2006	11 719	9.98	0.46	12 071
2007	9 906	9.48	0.43	10 240
2008	10 565	9.72	0.45	10 910
2009	9 837	9.14	0.44	10 165
2010	10 133	10.14	0.47	10 493
2011	8 860	8.80	0.42	9 175
2012	8 233	9.53	0.44	8 570
Trend 1990-2012	-36.0%	-47.9%	-7.2%	-36.1%

[(1)] *Source: STATISTIK AUSTRIA*

Liquid fossil fuels are the main stationary source of CO_2 emissions from category *1.A.4* until 2010 with a quite constant share over time. Since 1990 solid fossil fuels became less important whereas the share of CO_2 emissions from natural gas combustion more than doubled.

Table A 44: Share of fuel types in total CO_2 emissions from Category 1.A.4 stationary sources.

	Liquid	Solid	Gaseous	Other
1990	57%	21%	20%	2.7%
1991	55%	21%	22%	2.0%
1992	53%	19%	26%	2.5%
1993	53%	16%	30%	1.4%
1994	54%	15%	29%	1.7%
1995	54%	13%	31%	1.4%
1996	58%	12%	29%	2.1%
1997	58%	10%	30%	2.1%
1998	58%	9%	32%	1.3%
1999	59%	8%	32%	1.1%
2000	57%	8%	33%	1.2%
2001	55%	7%	37%	0.5%
2002	54%	6%	34%	0.5%
2003	57%	5%	37%	0.5%
2004	54%	5%	41%	0.4%
2005	56%	4%	39%	0.3%
2006	55%	4%	41%	0.2%
2007	53%	3%	44%	0.2%
2008	55%	3%	42%	0.0%

	Liquid	Solid	Gaseous	Other
2009	52%	2%	46%	0.0%
2010	49%	2%	48%	0.1%
2011	48%	2%	49%	0.0%
2012	48%	2%	50%	0.0%

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_2O [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
1998	3 274	0.44	0.06	3 301
1999	3 751	0.73	0.07	3 787
2000	2 985	0.78	0.06	3 020
2001	3 900	0.51	0.07	3 932
2002	3 756	0.42	0.07	3 786
2003	4 437	0.48	0.08	4 471
2004	4 226	0.46	0.08	4 261
2005	3 423	0.26	0.06	3 449
2006	3 650	0.23	0.07	3 675
2007	2 772	0.22	0.05	2 794
2008	3 249	0.23	0.06	3 273
2009	2 830	0.20	0.06	2 852
2010	2 388	0.22	0.05	2 408
2011	1 951	0.19	0.04	1 968
2012	1 423	0.19	0.04	1 438
Trend 1990-2012	-44.6%	-14.2%	-13.8%	-44.4%

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_2O [Gg]	CO_2 equiv. [Gg]
1990	9 820	17.94	0.42	10 326
1991	10 919	19.42	0.46	11 471
1992	9 996	17.66	0.43	10 500
1993	9 862	17.36	0.43	10 360

	CO_2 [Gg]	CH_4 [Gg]	N_2O [Gg]	CO_2 equiv. [Gg]
1994	9 154	15.71	0.40	9 607
1995	9 714	16.39	0.42	10 189
1996	10 548	17.38	0.46	11 054
1997	8 973	12.10	0.41	9 354
1998	9 230	11.66	0.40	9 600
1999	9 265	11.72	0.40	9 636
2000	8 920	10.93	0.38	9 268
2001	9 111	11.35	0.40	9 474
2002	8 568	10.37	0.38	8 903
2003	8 633	10.04	0.38	8 961
2004	8 346	9.54	0.36	8 659
2005	8 626	10.11	0.39	8 960
2006	7 934	9.18	0.36	8 237
2007	7 023	8.70	0.34	7 311
2008	7 202	8.92	0.35	7 498
2009	6 925	8.38	0.34	7 206
2010	7 664	9.29	0.37	7 976
2011	6 850	8.07	0.33	7 123
2012	6 757	8.72	0.36	7 050
Trend 1990-2012	-31.2%	-51.4%	-14.9%	-31.7%

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_2O [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	0.80	0.02	298
1999	294	0.80	0.02	318
2000	259	0.78	0.02	283
2001	258	0.81	0.03	283
2002	217	0.72	0.03	240
2003	237	0.72	0.03	261
2004	227	0.70	0.03	252
2005	148	0.63	0.04	172
2006	136	0.57	0.04	158
2007	111	0.56	0.04	135
2008	114	0.58	0.04	139

	CO_2 [Gg]	CH_4 [Gg]	N_2O [Gg]	CO_2 equiv. [Gg]
2009	81	0.56	0.04	107
2010	80	0.63	0.05	109
2011	59	0.55	0.04	84
2012	52	0.62	0.05	82
Trend 1990-2012	-89.1%	340.8%	168.2%	-83.3%

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.

Table A 48: Activity data recalculations by sub categories with respect to previous submission [PJ absolut values].

	Fuel Consumption [PJ]								
	1990			2010			2011		
IPCC Category/ Fuel Group	Subm. 2013	Subm. 2014	Differ-ence	Subm. 2013	Subm. 2014	Differ-ence	Subm. 2013	Subm. 2014	Differ-ence
1.A FUEL COMBUSTION ACTIVITIES	**827.69**	**827.89**	**0.20**	**1 151.26**	**1 140.91**	**-10.35**	**1 104.06**	**1 096.95**	**-7.10**
1.A liquid	379.06	379.04	-0.01	456.12	450.59	-5.53	426.19	422.16	-4.03
1.A solid	139.89	139.89	-	93.01	92.66	-0.35	96.90	97.20	0.31
1.A gaseous	203.98	203.98	-	334.08	332.39	-1.69	315.40	315.05	-0.35
1.A biomass	95.77	95.99	0.22	232.21	233.57	1.36	225.50	227.41	1.91
1.A other	8.99	8.99	-	35.84	31.69	-4.14	40.07	35.13	-4.94
1.A.1 Energy Industries	**188.37**	**188.35**	**-0.01**	**275.19**	**267.56**	**-7.63**	**267.07**	**261.14**	**-5.93**
1.A.1 liquid	46.45	46.43	-0.01	43.08	39.02	-4.06	36.63	35.01	-1.62
1.A.1 solid	61.40	61.40	-	41.47	41.47	0.00	45.64	45.64	-
1.A.1 gaseous	76.48	76.48	-	113.31	111.03	-2.28	106.53	101.90	-4.64
1.A.1 biomass	1.63	1.63	-	60.46	58.97	-1.49	59.44	59.10	-0.35
1.A.1 other	2.41	2.41	-	16.88	17.07	0.19	18.83	19.50	0.67
1.A.1.a Public Electricity and Heat Production	**140.54**	**140.54**	**-**	**223.48**	**220.16**	**-3.31**	**214.80**	**212.57**	**-2.24**
1.A.1.a liquid	15.63	15.63	-	9.89	8.96	-0.93	4.27	4.85	0.58
1.A.1.a solid	61.40	61.40	-	41.47	41.47	0.00	45.64	45.64	-
1.A.1.a gaseous	59.46	59.46	-	94.78	93.69	-1.09	86.63	83.48	-3.14
1.A.1.a biomass	1.63	1.63	-	60.46	58.97	-1.49	59.44	59.10	-0.35
1.A.1.a other	2.41	2.41	-	16.88	17.07	0.19	18.83	19.50	0.67
1.A.1.b Petroleum refining	**38.63**	**38.62**	**-0.01**	**42.75**	**39.06**	**-3.69**	**41.42**	**39.16**	**-2.26**
1.A.1.b liquid	30.75	30.74	-0.01	33.19	30.06	-3.13	32.36	30.16	-2.20
1.A.1.b solid	NO	NO	-	NO	NO	-	NO	NO	-
1.A.1.b gaseous	7.88	7.88	-	9.56	9.00	-0.56	9.06	9.00	-0.07
1.A.1.b biomass	NO	NO	-	NO	NO	-	NO	NO	-
1.A.1.b other	NO	NO	-	NO	NO	-	NO	NO	-
1.A.1.c Manufacture of Solid fuels and Other Energy Industries	**9.20**	**9.20**	**-**	**8.97**	**8.34**	**-0.63**	**10.84**	**9.41**	**-1.43**
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	-	8.97	8.34	-0.63	10.84	9.41	-1.43
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 Manufacturing Industries and Construction	**200.81**	**200.81**	**-**	**291.93**	**297.22**	**5.30**	**289.68**	**297.29**	**7.60**
1.A.2 liquid	40.68	40.68	-	37.33	38.68	1.35	34.58	34.63	0.05
1.A.2 solid	50.28	50.28	-	48.93	48.59	-0.34	48.99	49.30	0.31

	Fuel Consumption [PJ]								
	1990			2010			2011		
IPCC Category/ Fuel Group	**Subm. 2013**	**Subm. 2014**	**Differ-ence**	**Subm. 2013**	**Subm. 2014**	**Differ-ence**	**Subm. 2013**	**Subm. 2014**	**Differ-ence**
1.A.2 gaseous	76.99	76.99	-	120.93	127.02	6.09	116.05	126.89	10.83
1.A.2 biomass	29.63	29.63	-	65.80	68.36	2.57	68.84	70.86	2.02
1.A.2 other	3.22	3.22	-	18.93	14.57	-4.37	21.22	15.61	-5.61
1.A.2.a Iron and Steel	**55.63**	**55.63**	**-**	**67.37**	**68.99**	**1.62**	**67.24**	**69.86**	**2.62**
1.A.2.a liquid	5.79	5.79	-	8.67	8.67	0.00	5.70	5.70	0.00
1.A.2.a solid	38.11	38.11	-	40.53	40.57	0.04	40.46	41.36	0.90
1.A.2.a gaseous	11.73	11.73	-	18.18	19.75	1.57	21.08	22.80	1.72
1.A.2.a biomass	NO	NO	-	0.00	0.00	0.00	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**	**-**	**4.19**	**4.09**	**-0.10**	**4.20**	**4.47**	**0.27**
1.A.2.b liquid	0.51	0.51	-	0.25	0.25	0.00	0.19	0.29	0.10
1.A.2.b solid	0.21	0.21	-	0.11	0.06	-0.05	0.12	0.06	-0.06
1.A.2.b gaseous	1.35	1.35	-	3.82	3.77	-0.04	3.88	4.11	0.23
1.A.2.b biomass	NO	NO	-	NO	NO	-	NO	NO	-
1.A.2.b other	NO	NO	-	NO	NO	-	NO	NO	-
1.A.2.c Chemi-cals	**16.09**	**16.09**	**-**	**22.90**	**27.63**	**4.73**	**23.33**	**32.45**	**9.12**
1.A.2.c liquid	1.06	1.06	-	1.35	1.89	0.54	1.23	1.65	0.42
1.A.2.c solid	1.10	1.10	-	0.81	0.81	-	0.72	0.72	-
1.A.2.c gaseous	9.36	9.36	-	13.18	15.48	2.30	13.83	20.60	6.78
1.A.2.c biomass	2.90	2.90	-	2.77	2.99	0.22	2.68	2.92	0.24
1.A.2.c other	1.67	1.67	-	4.79	6.46	1.67	4.87	6.55	1.68
1.A.2.d Pulp, Paper and Print	**54.15**	**54.15**	**-**	**73.80**	**77.06**	**3.26**	**71.46**	**71.52**	**0.06**
1.A.2.d liquid	10.94	10.94	-	0.91	0.92	0.01	0.62	0.70	0.08
1.A.2.d solid	4.12	4.12	-	3.55	3.55	-	3.94	3.94	-
1.A.2.d gaseous	17.01	17.01	-	31.85	35.12	3.27	29.37	29.37	-
1.A.2.d biomass	21.88	21.88	-	37.35	37.40	0.05	37.40	37.43	0.03
1.A.2.d other	0.19	0.19	-	0.14	0.08	-0.06	0.14	0.09	-0.05
1.A.2.e Food Processing, Beverages and Tobacco	**13.91**	**13.91**	**-**	**16.38**	**17.47**	**1.09**	**14.74**	**16.47**	**1.72**
1.A.2.e liquid	4.45	4.45	-	2.67	3.64	0.97	2.57	2.63	0.06
1.A.2.e solid	0.18	0.18	-	0.14	0.14	-	0.15	0.15	-
1.A.2.e gaseous	9.15	9.15	-	13.37	13.49	0.11	11.78	13.44	1.66
1.A.2.e biomass	0.13	0.13	-	0.19	0.19	0.00	0.24	0.25	0.00
1.A.2.e other	NO	NO	-	0.00	0.00	0.00	0.00	0.00	0.00
1.A.2.f Other	**58.96**	**58.96**	**-**	**107.29**	**101.99**	**-5.30**	**108.71**	**102.52**	**-6.19**
1.A.2.f liquid	17.94	17.94	-	23.48	23.31	-0.17	24.28	23.66	-0.62
1.A.2.f solid	6.56	6.56	-	3.79	3.46	-0.33	3.59	3.07	-0.53
1.A.2.f gaseous	28.38	28.38	-	40.54	39.41	-1.13	36.12	36.56	0.44
1.A.2.f biomass	4.73	4.73	-	25.49	27.79	2.30	28.51	30.27	1.75
1.A.2.f other	1.36	1.36	-	14.00	8.02	-5.98	16.22	8.97	-7.25
1.A.3 Transport	**186.67**	**186.67**	**-**	**321.65**	**321.46**	**-0.19**	**311.23**	**311.10**	**-0.13**
1.A.3 liquid	182.55	182.55	-	293.85	293.67	-0.17	282.20	281.95	-0.25
1.A.3 solid	0.07	0.07	-	0.00	0.00	-	0.00	0.00	-
1.A.3 gaseous	4.05	4.05	-	6.00	6.10	0.10	7.32	7.57	0.25
1.A.3 biomass	NO	NO	-	21.80	21.68	-0.12	21.71	21.58	-0.13

IPCC Category/ Fuel Group	1990 Subm. 2013	1990 Subm. 2014	1990 Difference	2010 Subm. 2013	2010 Subm. 2014	2010 Difference	2011 Subm. 2013	2011 Subm. 2014	2011 Difference
	Fuel Consumption [PJ]								
1.A.3 other	NO	NO	-	NO	NO	-	NO	NO	-
1.A.3.a Civil Aviation	**0.44**	**0.44**	**-**	**0.87**	**0.87**	**-**	**0.85**	**0.85**	**-**
1.A.3.a aviation gasoline	0.11	0.11	-	0.13	0.13	-	0.19	0.19	-
1.A.3.a jet kerosene	0.33	0.33	-	0.75	0.75	-	0.66	0.66	-
1.A.3.b Road Transportation	**179.60**	**179.60**	**-**	**312.68**	**312.64**	**-0.04**	**300.99**	**301.19**	**0.20**
1.A.3.b gasoline	106.76	106.76	-	70.50	70.82	0.31	67.86	68.21	0.35
1.A.3.b diesel oil	72.43	72.43	-	218.77	219.08	0.31	209.83	210.34	0.52
1.A.3.b LPG	0.41	0.41	-	1.56	0.84	-0.72	1.54	0.79	-0.75
1.A.3.b other liquid	NO	NO	-	NO	NO	-	NO	NO	-
1.A.3.b gaseous	NO	NO	-	0.21	0.38	0.16	0.22	0.40	0.18
1.A.3.b biomass	NO	NO	-	21.63	21.52	-0.11	21.53	21.44	-0.10
1.A.3.b other	NO	NO	-	NO	NO	-	NO	NO	-
1.A.3.c Railways	**2.38**	**2.38**	**-**	**2.16**	**2.06**	**-0.09**	**2.14**	**1.74**	**-0.40**
1.A.3.c solid	2.32	2.32	-	1.99	1.91	-0.08	1.97	1.60	-0.37
1.A.3.c liquid	0.07	0.07	-	0.00	0.00	-	0.00	0.00	-
1.A.3.c gaseous	NO	NO	-	NO	NO	-	NO	NO	-
1.A.3.c other	NO	NO	-	NO	NO	-	NO	NO	-
1.A.3.d Navigation	**0.19**	**0.19**	**-**	**0.16**	**0.16**	**0.00**	**0.16**	**0.16**	**0.00**
1.A.3.d residual oil	NO	NO	-	NO	NO	-	NO	NO	-
1.A.3.d gas/diesel oil	0.05	0.05	-	0.03	0.03	0.00	0.04	0.04	0.00
1.A.3.d gasoline	0.14	0.14	-	0.12	0.12	0.00	0.11	0.11	0.00
1.A.3.d other liquid	NO	NO	-	NO	NO	-	NO	NO	-
1.A.3.d solid	NO	NO	-	NO	NO	-	NO	NO	-
1.A.3.d gaseous	NO	NO	-	NO	NO	-	NO	NO	-
1.A.3.d other	NO	NO	-	NO	NO	-	NO	NO	-
1.A.3.e Other	**4.05**	**4.05**	**-**	**5.79**	**5.72**	**-0.07**	**7.10**	**7.17**	**0.07**
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	-	5.79	5.72	-0.07	7.10	7.17	0.07
1.A.3.e biomass	NO	NO	-	NO	NO	-	NO	NO	-
1.A.3.e other	NO	NO	-	NO	NO	-	NO	NO	-
1.A.4 Other Sectors	**251.36**	**251.58**	**0.22**	**261.85**	**254.03**	**-7.82**	**235.43**	**226.78**	**-8.65**
1.A.4 liquid	108.90	108.90	-	81.23	78.59	-2.64	72.13	69.93	-2.21
1.A.4 solid	28.14	28.14	-	2.61	2.60	-0.01	2.27	2.27	0.00
1.A.4 gaseous	46.46	46.46	-	93.84	88.24	-5.60	85.49	78.69	-6.80
1.A.4 biomass	64.51	64.73	0.22	84.15	84.55	0.40	75.51	75.87	0.36
1.A.4 other	3.36	3.36	-	0.02	0.06	0.03	0.02	0.02	-
1.A.4.a Commercial/Institutional	**37.80**	**37.80**	**-**	**51.25**	**44.10**	**-7.15**	**46.83**	**36.72**	**-10.11**
1.A.4.a liquid	18.69	18.69	-	10.58	8.32	-2.26	8.65	5.82	-2.82
1.A.4.a solid	0.95	0.95	-	0.20	0.20	0.00	0.18	0.18	0.00
1.A.4.a gaseous	12.75	12.75	-	36.50	31.56	-4.94	34.57	27.26	-7.31
1.A.4.a biomass	2.05	2.05	-	3.94	3.97	0.03	3.42	3.44	0.02
1.A.4.a other	3.36	3.36	-	0.02	0.06	0.03	0.02	0.02	-

	Fuel Consumption [PJ]								
	1990			2010			2011		
IPCC Category/ Fuel Group	**Subm. 2013**	**Subm. 2014**	**Differ-ence**	**Subm. 2013**	**Subm. 2014**	**Differ-ence**	**Subm. 2013**	**Subm. 2014**	**Differ-ence**
1.A.4.b Residen-tial	**192.70**	**192.92**	**0.22**	**189.26**	**189.07**	**-0.19**	**167.62**	**169.66**	**2.04**
1.A.4.b liquid	74.45	74.45	-	59.70	59.79	0.09	51.91	53.11	1.20
1.A.4.b solid	26.64	26.64	-	2.35	2.34	-0.01	2.04	2.04	0.00
1.A.4.b gaseous	33.34	33.34	-	56.69	56.05	-0.65	50.35	50.86	0.50
1.A.4.b biomass	58.27	58.49	0.22	70.51	70.88	0.37	63.31	63.65	0.34
1.A.4.b other	NO	NO	-	NO	NO	-	NO	NO	-
1.A.4.c Agricul-tu-re/Forestry/Fisheries	**20.86**	**20.86**	**-**	**21.33**	**20.86**	**-0.48**	**20.97**	**20.39**	**-0.58**
1.A.4.c liquid	15.76	15.76	-	10.95	10.48	-0.47	11.57	10.99	-0.58
1.A.4.c solid	0.55	0.55	-	0.05	0.05	-	0.04	0.04	-
1.A.4.c gaseous	0.37	0.37	-	0.64	0.64	-0.01	0.57	0.58	0.01
1.A.4.c biomass	4.19	4.19	-	9.70	9.69	0.00	8.78	8.78	0.00
1.A.4.c other	NO	NO	-	NO	NO	-	NO	NO	-
1.A.5 Other	**0.48**	**0.48**	**-**	**0.64**	**0.64**	**-**	**0.65**	**0.65**	**-**
1.A.5 liquid	0.48	0.48	-	0.64	0.64	-	0.64	0.64	-
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 Bun-kers	**12.26**	**12.26**	**-**	**28.19**	**28.19**	**-**	**29.82**	**29.82**	**-**
International Marine Bunkers	**0.52**	**0.52**	**-**	**0.68**	**0.68**	**0.00**	**0.59**	**0.59**	**0.00**

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 CO_2, CH_4 and N_2O. Sector specific considerations and emission factors are described in the related sub chapters of Chapter *3 Energy* of the NIR.

Activity data is taken from the national energy balance as described in the following sub chapters. Data of the national energy balance is presented in Annex 4.

The National Energy Balance

There are five different IEA questionnaires for each of: oil; natural gas; coal; renewable fuels; electricity and heat. Table A 49 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 2012) and their correspondence to IPCC categories.

IEA-Category and ISIC Codes[2]	Comments	SNAP	IPCC-Category
Production			Reference Approach: Production
Imports			Reference Approach: Import
Exports			Reference Approach: Export
Bunkers	No consumption [1]		
Stock Changes			Reference Approach: Stock Change
Refinery Fuel		0103	1.A.1.b Petroleum Refining
Transformation Sector, of which:			
Public Electricity plants	In the inventory plant specific data are considered.	0101 0102	1.A.1.a Public Electricity and Heat Production
Public CHP plants			
Public Heat plants			
Auto Producer Electricity plants	For autoproducers by sectors see table below.		
Auto Producer CHP plants			
Auto Producer Heat plants			
Coke Ovens	Transformation from *Coking Coal* to *Coke Oven Coke*.		
Blast furnaces	Coke Oven Coke.	030326	1.A.2.a Iron and Steel
Gas Works	Transformation of *Other Oil Products* to *Gas Works Gas*.		
Petrochemical Industry	No consumption [1]		
Patent Fuel Plants	No consumption [1]		
Not Elsewhere Specified	No consumption [1]		
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

IEA-Category and ISIC Codes[(2)]	Comments	SNAP	IPCC-Category
Inputs to oil refineries		0103	1.A.1.b Petroleum Refining
Coke Ovens	*Coke Oven Gas* and *Blast Furnace Gas*.	0301	1.A.2.a Iron and Steel
Blast furnaces	*Coke Oven Coke*.	030326	1.A.2.a Iron and Steel
Gas Works	*Natural Gas. Other liquid fuels*.	0105	1.A.1.c Manufacture of Solid fuels and Other Energy Industries
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 Road Rail Inland Waterways	Division to SNAP categories is performed by means of studies.	07 08 0201	1.A.2.f Manuf. Ind. and Constr. - Other 1.A.3 Transport 1.A.4.b Residential 1.A.4.c Agriculture/ Forestry/ Fisheries
Pipeline Transport	*Natural Gas*.	010506	1.A.3.e Transport-Other
Non Specified	*Other biofuels* and *Lubricants*.	0201	1.A.4.a Commercial/ Institutional
Total Industry, of which:			
Iron and Steel (ISIC 271, 2731)		0301 030301 030326	1.A.2.a Iron and Steel
Chemical incl.Petro-Chemical (ISIC 24)		0301	1.A.2.c Chemicals
Non ferrous Metals (ISIC 272, 2732)		0301	1.A.2.b Non-ferrous Metals
Non metallic Mineral Products (ISIC 26)		0301 030311 030317 030319	1.A.2.f Manuf. Ind. and Constr. - Other
Transportation Equipment (ISIC 34, 35)		0301	1.A.2.f Manuf. Ind. and Constr. - Other
Machinery (ISIC 28, 29, 30, 31, 32)		0301	1.A.2.f Manuf. Ind. and Constr. - Other
Mining and Quarrying (ISIC 13, 14)		0105	1.A.1.c Manufacture of Solid fuels and Other Energy Industries
Food, Beverages and Tobacco (ISIC 15, 16)		0301	1.A.2.e Food Processing, Beverages and Tobacco
Pulp, Paper and Printing (ISIC 21, 22)		0301	1.A.2.d Pulp, Paper and Print
Wood and Wood Products (ISIC 20)		0301	1.A.2.f Manuf. Ind. and Constr. - Other
Construction (ISIC 45)		0301	1.A.2.f Manuf. Ind. and Constr. - Other

IEA-Category and ISIC Codes[2]	Comments	SNAP	IPCC-Category
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 Revison 2 nomenclature.

Table A 50: Categories of the national energy balance (JQ 2013) and their correspondence to IPCC categories: Autoproducers by sector.

Auto Producers (Electricity + CHP + Heat), of which:			
Energy Sector, of which:			
Coal Mines	No consumption (1)		
Oil and Gas Extraction		0105	1.A.1.c Manufacture of Solid fuels and Other Energy Industries
Inputs to oil refineries		0103	1.A.1.b Petroleum Refining
Coke Ovens	No consumption (1)		
Gas Works	No consumption (1)		
Liquefaction Plants	No consumption (1)		
Not Elsewhere Specified	No consumption (1)		
Industrie, of which:			
Iron and Steel		030326	1.A.2.a Iron and Steel
Chemical (incl.Petro-Chemical)		0301	1.A.2.c Chemicals
Non ferrous Metals		0301	1.A.2.b Non-ferrous Metals
Non metallic Mineral Products		0301	1.A.2.f Manuf. Ind. and Constr. -Other
Transportation Equipment		0301	1.A.2.f Manuf. Ind. and Constr. -Other
Machinery		0301	1.A.2.f Manuf. Ind. and Constr. -Other
Mining and Quarrying		0301	1.A.1.c Manufacture of Solid fuels and Other Energy Industries
Food, Beverages and Tobacco		0301	1.A.2.e Food Processing, Beverages and Tobacco
Pulp, Paper and Printing		0301	1.A.2.d Pulp, Paper and Print
Wood and Wood Products		0301	1.A.2.f Manuf. Ind. and Constr. -Other

Auto Producers (Electricity + CHP + Heat), of which:			
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 51.

Table A 51: Fuel categories used for the inventory and correspondence to IPCC fuel categories.

Inventory Fuel Category		**IEA Fuel Category**		**IPCC Fuel Category (3)**
Code (1)	**Category**	**Category**	**Average Net Calorific Value(2)**	
102 A	Hard Coal	Bituminous Coal and Anthracite	27.33	Solid (coal)
104 A	Hard Coal Briquettes	Patent Fuel	31.00	Solid (coal)
105 A	Brown Coal	Lignite/Brown Coal	19.35	Solid (coal)
106 A	Brown Coal Briquettes	BKB/PB	19.31	Solid (coal)
107 A	Coke	Coke Oven Coke	29.00	Solid (coal)
113 A	Peat	Peat	8.80	Solid
304 A	Coke Oven Gas	Coke Oven Gas	19.89	Solid
305 A	Blast Furnace Gas	Blast Furnace Gas	3.81	Solid
110 A	Petrol Coke	Petrol Coke	35.20	Liquid
203 B	Light Fuel Oil Sulphur Content < 0,2 %	Residual Fuel Oil	40.36	Liquid (residual oil)
203 C	Medium Fuel Oil Sulphur Content < 0,4%			

Inventory Fuel Category		**IEA Fuel Category**		**IPCC Fuel Category** [3]
Code [1]	**Category**	**Category**	**Average Net Calorific Value**[2]	
203 D	Heavy Fuel Oil Sulphur Content >= 1%			
204 A	Gasoil	Heating and other Gasoil	42.81	Liquid (gas/diesel oil)
205 0	Diesel	Transport Diesel	42.08	Liquid (diesel oil; gas/diesel oil)
206 A	Petroleum	Other Kerosene	43.34	Liquid
206 B	Kerosene	Kerosene Type Jet Fuel	43.34	Liquid (jet kerosene)
207 A	Aviation Gasoline	Gasoline Type Jet Fuel	41.34	Liquid (aviation gasoline)
208 0	Motor Gasoline	Motor Gasoline	41.34	Liquid (gasoline)
224 A	Other Petroleum Products	Other Products	44.30	Liquid
303 A	Liquified Petroleum Gas (LPG)	LPG	46.12	Liquid
308 A	Refinery Gas	Refinery Gas	32.00	Liquid
301 A	Natural Gas	Natural Gas	36.26	Gaseous (natural gas)
114 B	Municipal Waste	Municipal Solid Waste Renewable	[4]10.87	Other Fuels
		Municipal Solid Waste Non Renewable	[4]10.77	Other Fuels
115 A	Industrial Waste	Industrial Wastes	12.57	Other Fuels
111 A	Fuel Wood	*Wood/Wood wastes/Other Solid Wastes, of which:* Wood	14.31	Biomass
112 A	Char Coal	Char coal	31.00	Biomass
116 A	Wood Wastes, Wood Chips, Pellets, Straw.	*Wood/Wood wastes/Other Solid Wastes, of which:* Other vegetal materials and waste (including straw, sawdust, wood chips)	9.12	Biomass
118 A	Sewage Sludge (dry substance)	*Wood/Wood wastes/Other Solid Wastes, of which:* Other vegetal materials and waste (including straw, sawdust, wood chips)	12.00	Biomass
215 A	Black Liquor	*Wood/Wood wastes/Other Solid Wastes, of which:* Black Liquor	[4]8.69	Biomass
309 A	Biogas	Biogas	[4]15.75	Biomass
309 B	Sewage Sludge Gas	Sewage Sludge Gas	[4]18.28	Biomass
310 A	Landfill Gas	Landfill Gas	[4]17.01	Biomass

(1) First three digits are based on CORINAIR / NAPFUE 94–Code

(2) Units: [MJ / kg] or [MJ / m^3 Gas] respectively, for the Year 2012 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.

Energy Consumption and CO_2 Emissions by Sectors and Fuel Types

The following tables show detailed data on fuel consumption and CO_2 emissions for each fuel type and each sector of *1.A Fuel Combustion* are provided for the period from 1990 to 2012. For information on completeness, in particular on CO_2 emissions included elsewhere, please refer to the documentation boxes of the CRF and to Chapter 3.2.1 subchapter *Completeness* of the NIR.

Table A 52: 2012 energy consumption and CO_2 emissions from category 1.A Fuel Combustion by fuel type and sector.

		Consumption (PJ)					CO_2 emissions (Tg)				
		1.A.1	1.A.2	1.A.3 + 1.A.5	1.A.4	1.A	1.A.1	1.A.2	1.A.3 + 1.A.5	1.A.4	1.A
		Energy Ind.	Industry	Transport	Other Sectors	Total	Energy Ind.	Industry	Transport	Other Sectors	Total
	Total Solid	**37.18**	**48.90**	**0.00**	**1.78**	**87.86**	**3.45**	**4.93**	**0.00**	**0.17**	**8.55**
102A	Hard Coal	37.18	5.97	0.00	0.11	43.25	3.45	0.54	0.00	0.01	4.00
104A	Hard Coal Briquettes				0.23	0.23				0.02	0.02
105A	Brown Coal		1.68		0.07	1.75		0.16		0.01	0.17
106A	Brown Coal Briquettes				0.42	0.42				0.04	0.04
107A	Coke		34.08		0.95	35.03		3.54		0.09	3.63
113A	Peat				0.00	0.00				0.00	0.00
304A	Coke Oven Gas		7.17			7.17		0.68			0.68
	Total Liquid	**34.39**	**33.58**	**281.40**	**64.78**	**414.15**	**2.59**	**2.56**	**21.00**	**4.83**	**31.02**
110A	Petrol Coke	2.48	1.54			4.02	0.25	0.14			0.39
203B	Light Fuel Oil	0.10	5.05		0.48	5.64	0.01	0.39		0.04	0.44
203C	Medium Fuel Oil	1.18				1.18	0.09				0.09
203D	Heavy Fuel Oil	7.61	7.17			14.78	0.61	0.56			1.17
204A	Gasoil	0.18	2.98		49.78	52.95	0.01	0.22		3.73	3.97
2050	Diesel	0.00	14.74	212.70	10.19	237.64	0.00	1.10	15.93	0.76	17.80
206A	Other Kerosene		0.01		0.17	0.18		0.00		0.01	0.01
206B	Jet Kerosene			1.27		1.27			0.05		0.09
207A	Aviation Gasoline			0.11		0.11			0.01		0.01
2080	Motor Gasoline		0.12	66.48	1.36	67.95		0.01	4.96	0.10	5.07
224A	Other Petroleum Products	8.03				8.03	0.63				0.63
303A	Liquified Petroleum Gas (LPG)	0.21	1.97	0.84	2.78	5.81	0.01	0.13	0.05	0.18	0.37
308A	Refinery Gas	14.59				14.59	0.98				0.98
301A	**Total Gaseous (Natural Gas)**	**90.17**	**126.39**	**7.53**	**74.01**	**298.10**	**5.00**	**7.00**	**0.42**	**4.10**	**16.51**
	Total Other Fuel	**20.62**	**13.03**		**0.02**	**33.68**	**1.29**	**0.93**		**0.00**	**2.22**
114B	Municipal Waste	15.56				15.56	0.76				0.76
115A	Industrial Waste	5.07	13.03		0.02	18.12	0.53	0.93		0.00	1.46
	Total Biomass(1)	**59.30**	**77.20**	**21.43**	**84.74**	**242.67**	**(8.44)**	**(1.52)**	**(8.68)**	**(0.00)**	**(25.18)**
111A	Fuel Wood	0.05	0.58		60.46	61.09	0.01	0.06		6.05	6.11
112A	Char coal				0.40	0.40				0.05	0.05
116A	Wood Wastes	50.55	42.74		22.58	115.87	5.56	4.70		2.48	12.75
118A	Sewage Sludge	2.15	0.61			2.75	0.24	0.07			0.30
215A	Black Liquor		30.12			30.12		3.31			3.31
250A	Liquid Biofuels		1.22	21.43	0.92	23.57		0.09	1.52	0.07	1.67

		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**
309A	Biogas	6.27	1.35		0.14	7.77	0.70	0.15		0.02	0.87
309B	Sewage Sludge Gas	0.17	0.58		0.17	0.93	0.02	0.07		0.02	0.10
310A	Landfill Gas	0.10			0.06	0.16	0.01			0.01	0.02
	Total[(1)]	**241.66**	**299.11**	**310.36**	**225.33**	**1 076.45**	**12.32**	**15.41**	**21.42**	**9.10**	**58.30**

Table A 53: 2011 energy consumption and CO_2 emissions from category 1.A Fuel Combustion by fuel type and sector.

		Consumption (PJ)					CO_2 emissions (Tg)				
		1.A.1	**1.A.2**	**1.A.3 + 1.A.5**	**1.A.4**	**1.A**	**1.A.1**	**1.A.2**	**1.A.3 + 1.A.5**	**1.A.4**	**1.A**
		Energy Ind.	**Industry**	**Transport**	**Other Sectors**	**Total**	**Energy Ind.**	**Industry**	**Transport**	**Other Sectors**	**Total**
	Total Solid	**45.64**	**49.30**	**0.00**	**2.27**	**97.20**	**4.25**	**4.97**	**0.00**	**0.21**	**9.44**
102A	Hard Coal	45.64	5.84	0.00	0.45	51.93	4.25	0.53	0.00	0.04	4.82
104A	Hard Coal Briquettes				0.01	0.01				0.00	0.00
105A	Brown Coal		1.81		0.08	1.89		0.18		0.01	0.19
106A	Brown Coal Briquettes				0.51	0.51				0.05	0.05
107A	Coke		34.71		1.21	35.92		3.61		0.11	3.72
113A	Peat				0.00	0.00				0.00	0.00
304A	Coke Oven Gas		6.94			6.94		0.66			0.66
	Total Liquid	**35.01**	**34.63**	**282.59**	**69.93**	**422.16**	**2.65**	**2.64**	**21.09**	**5.21**	**31.64**
110A	Petrol Coke	2.17	1.83			4.00	0.22	0.16			0.38
203B	Light Fuel Oil	0.09	5.20		1.58	6.88	0.01	0.41		0.12	0.53
203C	Medium Fuel Oil	0.97				0.97	0.08				0.08
203D	Heavy Fuel Oil	3.75	8.33		0.00	12.08	0.30	0.65		0.00	0.95
204A	Gasoil	0.15	2.93		52.47	55.55	0.01	0.22		3.94	4.17
2050	Diesel	0.00	14.19	212.00	10.95	237.15	0.00	1.06	15.88	0.82	17.77
206A	Other Kerosene		0.01		0.06	0.07		0.00		0.00	0.01
206B	Jet Kerosene			1.28		1.28			0.05		0.09
207A	Aviation Gasoline			0.19		0.19			0.01		0.01
2080	Motor Gasoline		0.12	68.33	1.37	69.82		0.01	5.09	0.10	5.21
224A	Other Petroleum Products	8.82				8.82	0.69				0.69
303A	Liquified Petroleum Gas (LPG)	1.19	2.01	0.79	3.50	7.49	0.08	0.13	0.05	0.22	0.48
308A	Refinery Gas	17.86				17.86	1.28				1.28
301A	**Total Gaseous (Natural Gas)**	**101.90**	**126.89**	**7.57**	**78.69**	**315.05**	**5.65**	**7.03**	**0.42**	**4.36**	**17.45**
	Total Other Fuel	**19.50**	**15.61**		**0.02**	**35.13**	**1.18**	**0.91**		**0.00**	**2.09**
114B	Municipal Waste	15.46				15.46	0.76				0.76
115A	Industrial Waste	4.04	15.61		0.02	19.67	0.42	0.91		0.00	1.33
	Total Biomass[(1)]	**59.10**	**70.86**	**21.58**	**75.87**	**227.41**	**(7.74)**	**(1.53)**	**(7.75)**	**(0.00)**	**(23.53)**
111A	Fuel Wood	0.04	1.05		55.51	56.60	0.00	0.10		5.55	5.66
112A	Char Coal				0.34	0.34				0.04	0.04
116A	Wood Wastes	51.57	37.71		18.61	107.89	5.67	4.15		2.05	11.87
118A	Sewage Sludge	2.00	0.64			2.64	0.22	0.07			0.29
215A	Black Liquor		28.91			28.91		3.18			3.18
250A	Liquid Biofuels		1.19	21.58	1.00	23.77		0.08	1.53	0.07	1.68
309A	Biogas	5.05	0.86		0.13	6.04	0.57	0.10		0.02	0.68
309B	Sewage Sludge Gas	0.33	0.50		0.21	1.04	0.04	0.06		0.02	0.12
310A	Landfill Gas	0.10			0.07	0.18	0.01			0.01	0.02
	Total[(1)]	**261.14**	**297.29**	**311.75**	**226.78**	**1 096.95**	**13.72**	**15.55**	**21.51**	**9.78**	**60.62**

Table A 54: 2010 energy consumption and CO_2 emissions from category 1.A Fuel Combustion by fuel type and sector.

		Consumption (PJ)					CO_2 emissions (Tg)				
		1.A.1	**1.A.2**	**1.A.3 + 1.A.5**	**1.A.4**	**1.A**	**1.A.1**	**1.A.2**	**1.A.3 + 1.A.5**	**1.A.4**	**1.A**
		Energy Ind.	**Industry**	**Transport**	**Other Sectors**	**Total**	**Energy Ind.**	**Industry**	**Transport**	**Other Sectors**	**Total**
	Total Solid	**41.47**	**48.59**	**0.00**	**2.60**	**92.66**	**3.87**	**4.91**	**0.00**	**0.24**	**9.02**
102A	Hard Coal	41.47	6.13	0.00	0.16	47.76	3.87	0.56	0.00	0.01	4.45
104A	Hard Coal Briquettes				0.40	0.40				0.04	0.04
105A	Brown Coal		1.70		0.09	1.79		0.16		0.01	0.17
106A	Brown Coal Briquettes				0.57	0.57				0.06	0.06
107A	Coke		34.38		1.37	35.75		3.58		0.13	3.70
113A	Peat				0.00	0.00				0.00	0.00
304A	Coke Oven Gas		6.38			6.38		0.60			0.60
	Total Liquid	**39.02**	**38.68**	**294.31**	**78.59**	**450.59**	**2.93**	**2.94**	**21.85**	**5.86**	**33.62**
110A	Petrol Coke	2.16	1.28			3.44	0.22	0.12			0.34
203B	Light Fuel Oil	0.17	4.91		3.87	8.95	0.01	0.38		0.30	0.69
203C	Medium Fuel Oil	1.54				1.54	0.12				0.12
203D	Heavy Fuel Oil	7.37	11.82			19.19	0.58	0.92			1.50
204A	Gasoil	0.12	3.22		59.58	62.92	0.01	0.24		4.47	4.72
2050	Diesel	0.00	14.26	221.05	10.21	245.52	0.00	1.06	16.45	0.76	18.27
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	70.93	1.38	72.43		0.01	5.29	0.10	5.40
224A	Other Petroleum Products	7.96				7.96	0.62				0.62
303A	Liquified Petroleum Gas (LPG)	1.30	3.08	0.84	3.48	8.71	0.08	0.20	0.05	0.22	0.56
308A	Refinery Gas	18.39				18.39	1.28				1.28
301A	**Total Gaseous (Natural Gas)**	**111.03**	**127.02**	**6.10**	**88.24**	**332.39**	**6.15**	**7.03**	**0.34**	**4.89**	**18.41**
	Total Other Fuel	**17.07**	**14.57**		**0.06**	**31.69**	**1.00**	**0.89**		**0.01**	**1.90**
114B	Municipal Waste	14.11				14.11	0.69				0.69
115A	Industrial Waste	2.96	14.57		0.06	17.58	0.31	0.89		0.01	1.21
	Total Biomass(1)	**58.97**	**68.36**	**21.69**	**84.55**	**233.57**	**(7.46)**	**(1.54)**	**(8.64)**	**(0.00)**	**(24.14)**
111A	Fuel Wood	0.05	1.20		62.59	63.85	0.01	0.12		6.26	6.38
112A	Char Coal				0.37	0.37				0.04	0.04
116A	Wood Wastes	52.97	35.86		20.23	109.07	5.83	3.94		2.23	12.00
118A	Sewage Sludge	0.71	0.69			1.40	0.08	0.08			0.15
215A	Black Liquor		28.53			28.53		3.14			3.14
250A	Liquid Biofuels		1.15	21.69	0.90	23.73		0.08	1.54	0.06	1.68
309A	Biogas	4.78	0.42		0.11	5.31	0.54	0.05		0.01	0.59
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)	**267.56**	**297.22**	**322.10**	**254.03**	**1 140.91**	**13.95**	**15.77**	**22.19**	**10.99**	**62.95**

Table A 55: 2009 energy consumption and CO_2 emissions from category 1.A Fuel Combustion by fuel type and sector.

		Consumption (PJ)					CO_2 emissions (Tg)				
		1.A.1	1.A.2	1.A.3 + 1.A.5	1.A.4	1.A	1.A.1	1.A.2	1.A.3.+ 1.A.5	1.A.4	1.A
		Energy Ind.	Industry	Transport	Other Sectors	Total	Energy Ind.	Industry	Transport	Other Sectors	Total
	Total Solid	**32.44**	**43.16**	**0.01**	**2.34**	**77.95**	**3.02**	**4.34**	**0.00**	**0.22**	**7.58**
102A	Hard Coal	32.44	7.45	0.01	0.06	39.95	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		1.72		0.08	1.80		0.17		0.01	0.17
106A	Brown Coal Briquettes		0.00		0.52	0.52		0.00		0.05	0.05
107A	Coke		28.84		1.22	30.06		3.00		0.11	3.11
113A	Peat				0.00	0.00				0.00	0.00
304A	Coke Oven Gas		5.14			5.14		0.49			0.49
	Total Liquid	**38.98**	**34.50**	**283.69**	**80.21**	**437.38**	**3.20**	**2.62**	**21.09**	**5.98**	**32.93**
110A	Petrol Coke	2.30	0.89			3.19	0.23	0.08			0.32
203B	Light Fuel Oil	0.14	5.00		4.03	9.17	0.01	0.39		0.31	0.71
203C	Medium Fuel Oil	1.68				1.68	0.13				0.13
203D	Heavy Fuel Oil	7.54	8.81			16.35	0.59	0.69			1.28
204A	Gasoil	0.20	3.06		60.58	63.83	0.01	0.23		4.54	4.79
2050	Diesel	0.01	14.77	209.52	10.39	234.69	0.00	1.10	15.59	0.77	17.46
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	71.68	1.37	73.17		0.01	5.37	0.10	5.49
224A	Other Petroleum Products	7.99				7.99	0.62				0.62
303A	Liquified Petroleum Gas (LPG)	3.93	1.83	0.97	3.77	10.50	0.25	0.12	0.06	0.24	0.67
308A	Refinery Gas	15.20				15.20	1.35				1.35
301A	**Total Gaseous (Natural Gas)**	**97.44**	**116.13**	**7.84**	**81.49**	**302.89**	**5.40**	**6.43**	**0.43**	**4.51**	**16.78**
	Total Other Fuel	**16.60**	**15.23**		**0.02**	**31.85**	**0.98**	**0.84**		**0.00**	**1.82**
114B	Municipal Waste	13.54				13.54	0.66				0.66
115A	Industrial Waste	3.05	15.23		0.02	18.30	0.32	0.84		0.00	1.16
	Total Biomass[(1)]	**48.72**	**63.63**	**22.01**	**75.66**	**210.02**	**(6.94)**	**(1.56)**	**(7.73)**	**(0.00)**	**(21.59)**
111A	Fuel Wood	0.05	1.30		55.98	57.33	0.00	0.13		5.60	5.73
112A	Char Coal				0.34	0.34				0.04	0.04
116A	Wood Wastes	42.61	32.73		18.09	93.43	4.69	3.60		1.99	10.28
118A	Sewage Sludge	0.67	0.52			1.20	0.07	0.06			0.13
215A	Black Liquor		26.83			26.83		2.95			2.95
250A	Liquid Biofuels		1.29	22.01	0.98	24.29		0.09	1.56	0.07	1.72
309A	Biogas	4.80	0.53		0.11	5.44	0.54	0.06		0.01	0.61
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)]	**234.17**	**272.65**	**313.55**	**239.72**	**1 060.09**	**12.60**	**14.23**	**21.52**	**10.71**	**59.11**

Table A 56: 2008 energy consumption and CO_2 emissions from category 1.A Fuel Combustion by fuel type and sector.

		Consumption (PJ)					CO_2 emissions (Tg)				
		1.A.1	1.A.2	1.A.3 + 1.A.5	1.A.4	1.A	1.A.1	1.A.2	1.A.3 + 1.A.5	1.A.4	1.A
		Energy Ind.	Industry	Transport	Other Sectors	Total	Energy Ind.	Industry	Transport	Other Sectors	Total
	Total Solid	**47.87**	**53.79**	**0.00**	**3.58**	**105.24**	**4.44**	**5.40**	**0.00**	**0.34**	**10.18**
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		35.75		1.74	37.49		3.72		0.16	3.88
113A	Peat				0.00	0.00				0.00	0.00
304A	Coke Oven Gas		7.48			7.48		0.71			0.71
	Total Liquid	**43.69**	**39.81**	**294.62**	**90.74**	**468.86**	**3.00**	**3.03**	**21.74**	**6.76**	**34.57**
110A	Petrol Coke	2.25	1.16			3.41	0.23	0.11			0.33
203B	Light Fuel Oil	0.15	4.97		5.20	10.32	0.01	0.39		0.40	0.80
203C	Medium Fuel Oil	1.81				1.81	0.14				0.14
203D	Heavy Fuel Oil	6.83	13.47			20.30	0.54	1.05			1.59
204A	Gasoil	0.19	3.00		68.24	71.43	0.01	0.22		5.12	5.36
2050	Diesel	0.05	15.38	218.46	11.43	245.33	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	73.59	1.49	75.22		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	17.99				17.99	0.98				0.98
301A	**Total Gaseous (Natural Gas)**	**98.68**	**118.83**	**10.45**	**79.93**	**307.89**	**5.47**	**6.58**	**0.58**	**4.43**	**17.05**
	Total Other Fuel	**12.92**	**15.28**		**0.02**	**28.23**	**0.72**	**0.92**		**0.00**	**1.64**
114B	Municipal Waste	11.25				11.25	0.55				0.55
115A	Industrial Waste	1.67	15.28		0.02	16.98	0.17	0.92		0.00	1.09
	Total Biomass(1)	**45.46**	**62.04**	**17.60**	**76.56**	**201.66**	**(6.77)**	**(1.25)**	**(7.81)**	**(0.00)**	**(20.84)**
111A	Fuel Wood	0.03	1.75		57.92	59.70	0.00	0.17		5.79	5.97
112A	Char Coal				0.40	0.40				0.05	0.05
116A	Wood Wastes	38.67	30.09		17.08	85.83	4.25	3.31		1.88	9.44
118A	Sewage Sludge	0.75	0.43			1.18	0.08	0.05			0.13
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	0.56		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)	**248.63**	**289.74**	**322.68**	**250.83**	**1 111.88**	**13.63**	**15.93**	**22.32**	**11.52**	**63.45**

(1) CO_2 emissions of Biomass are not included in Total.

Table A 57: 2007 energy consumption and CO_2 emissions from category 1.A Fuel Combustion by fuel type and sector.

		Consumption (PJ)					CO_2 emissions (Tg)				
		1.A.1	1.A.2	1.A.3 + 1.A.5	1.A.4	1.A	1.A.1	1.A.2	1.A.3 + 1.A.5	1.A.4	1.A
		Energy Ind.	**Industry**	**Transport**	**Other Sectors**	**Total**	**Energy Ind.**	**Industry**	**Transport**	**Other Sectors**	**Total**
	Total Solid	**54.46**	**53.72**	**0.01**	**3.57**	**111.76**	**5.07**	**5.41**	**0.00**	**0.33**	**10.81**
102A	Hard Coal	54.46	9.57	0.01	0.75	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		36.32		1.72	38.04		3.78		0.16	3.94
113A	Peat				0.00	0.00				0.00	0.00
304A	Coke Oven Gas		5.82			5.82		0.55			0.55
	Total Liquid	**46.81**	**41.12**	**313.46**	**83.01**	**484.41**	**3.12**	**3.14**	**23.12**	**6.18**	**35.60**
110A	Petrol Coke	2.42	1.23			3.65	0.24	0.12			0.36
203B	Light Fuel Oil	0.21	5.89		6.55	12.66	0.02	0.46		0.50	0.98
203C	Medium Fuel Oil	1.88				1.88	0.15				0.15
203D	Heavy Fuel Oil	6.87	14.47			21.34	0.54	1.13			1.67
204A	Gasoil	0.18	3.68		58.79	62.66	0.01	0.28		4.41	4.70
2050	Diesel	0.01	14.03	228.85	11.40	254.29	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	82.05	1.52	83.70		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	19.15				19.15	0.94				0.94
301A	**Total Gaseous (Natural Gas)**	**88.90**	**116.09**	**8.17**	**78.29**	**291.44**	**4.92**	**6.43**	**0.45**	**4.34**	**16.14**
	Total Other Fuel	**12.76**	**11.85**		**0.15**	**24.75**	**0.73**	**0.69**		**0.02**	**1.43**
114B	Municipal Waste	10.92				10.92	0.53				0.53
115A	Industrial Waste	1.84	11.85		0.15	13.83	0.19	0.69		0.02	0.90
	Total Biomass[(1)]	**38.12**	**60.99**	**14.13**	**73.51**	**186.76**	**(6.66)**	**(1.00)**	**(7.50)**	**(0.00)**	**(19.37)**
111A	Fuel Wood	0.02	1.72		56.09	57.82	0.00	0.17		5.61	5.78
112A	Char Coal				0.37	0.37				0.04	0.04
116A	Wood Wastes	32.07	29.90		16.03	78.01	3.53	3.29		1.76	8.58
118A	Sewage Sludge	0.77	0.08			0.85	0.08	0.01			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)]	**241.05**	**283.78**	**335.77**	**238.53**	**1 099.12**	**13.84**	**15.66**	**23.57**	**10.86**	**63.98**

[(1)] CO_2 emissions of Biomass are not included in Total.

Table A 58: 2006 energy consumption and CO_2 emissions from category 1.A Fuel Combustion by fuel type and sector.

		Consumption (PJ)					CO_2 emissions (Tg)				
		1.A.1	**1.A.2**	**1.A.3 + 1.A.5**	**1.A.4**	**1.A**	**1.A.1**	**1.A.2**	**1.A.3 + 1.A.5**	**1.A.4**	**1.A**
		Energy Ind.	**Industry**	**Transport**	**Other Sectors**	**Total**	**Energy Ind.**	**Industry**	**Transport**	**Other Sectors**	**Total**
	Total Solid	**60.20**	**55.83**	**0.01**	**4.64**	**120.68**	**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		36.38		2.14	38.53		3.78		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	**48.01**	**41.43**	**311.08**	**99.74**	**500.25**	**3.34**	**3.16**	**22.92**	**7.43**	**36.91**
110A	Petrol Coke	2.13	1.30			3.43	0.22	0.12			0.34
203B	Light Fuel Oil	0.23	7.13		12.05	19.41	0.02	0.56		0.93	1.50
203C	Medium Fuel Oil	2.30				2.30	0.18				0.18
203D	Heavy Fuel Oil	9.96	13.34			23.29	0.79	1.04			1.83
204A	Gasoil	0.19	4.58		69.32	74.09	0.01	0.34		5.20	5.56
2050	Diesel	0.02	13.02	224.44	11.38	248.87	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	84.07	1.52	85.72		0.01	6.15	0.11	6.27
224A	Other Petroleum Products	13.22				13.22	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	17.92				17.92	0.96				0.96
301A	**Total Gaseous (Natural Gas)**	**97.09**	**115.09**	**8.53**	**86.20**	**306.92**	**5.38**	**6.37**	**0.47**	**4.78**	**17.00**
	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**	**73.36**	**169.45**	**(5.90)**	**(0.84)**	**(7.46)**	**(0.00)**	**(17.55)**
111A	Fuel Wood	0.02	1.04		58.38	59.44	0.00	0.10		5.84	5.94
112A	Char Coal				0.40	0.40				0.05	0.05
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)	**248.57**	**278.58**	**331.42**	**264.21**	**1 122.78**	**15.08**	**15.88**	**23.40**	**12.67**	**67.07**

(1) CO_2 emissions of Biomass are not included in Total.

Table A 59: 2005 energy consumption and CO_2 emissions from category 1.A Fuel Combustion by fuel type and sector.

		Consumption (PJ)					CO2 emissions (Tg)				
		1.A.1	1.A.2	1.A.3 + 1.A.5	1.A.4	1.A	1.A.1	1.A.2	1.A.3 + 1.A.5	1.A.4	1.A
		Energy Ind.	Industry	Trans-port	Other Sectors	Total	Energy Ind.	Industry	Trans-port	Other Sectors	Total
	Total Solid	**61.63**	**55.87**	**0.01**	**4.98**	**122.49**	**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		34.86		2.31	37.17		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	**46.33**	**40.35**	**329.72**	**105.63**	**522.04**	**3.42**	**3.10**	**24.31**	**7.87**	**38.74**
110A	Petrol Coke	2.12	2.05			4.17	0.21	0.19			0.41
203B	Light Fuel Oil	0.17	7.14		9.23	16.53	0.01	0.56		0.71	1.28
203C	Medium Fuel Oil	2.29	0.00			2.29	0.18	0.00			0.18
203D	Heavy Fuel Oil	12.41	13.72			26.13	0.98	1.07			2.05
204A	Gasoil	0.19	4.94		77.61	82.74	0.01	0.37		5.82	6.21
2050	Diesel	0.02	10.86	241.08	11.79	263.74	0.00	0.80	17.78	0.87	19.45
206A	Other Kerosene		0.02		0.13	0.15		0.00		0.01	0.01
206B	Jet Kerosene			1.37		1.37			0.06		0.10
207A	Aviation Gasoline			0.12		0.12			0.01		0.01
2080	Motor Gasoline		0.11	86.18	1.48	87.77		0.01	6.41	0.11	6.52
224A	Other Petroleum Pro-ducts	11.02				11.02	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	14.21				14.21	0.91				0.91
301A	**Total Gaseous (Natu-ral Gas)**	**115.19**	**121.54**	**6.55**	**86.66**	**329.95**	**6.38**	**6.73**	**0.36**	**4.80**	**18.27**
	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)	**23.48**	**53.68**	**3.35**	**76.93**	**157.43**	**(5.89)**	**(0.24)**	**(7.84)**	**(0.00)**	**(16.56)**
111A	Fuel Wood	0.05	1.14		61.74	62.93	0.01	0.11		6.17	6.29
112A	Char Coal				0.37	0.37				0.04	0.04
116A	Wood Wastes	19.28	24.44		14.27	57.99	2.12	2.69		1.57	6.38
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)	**256.85**	**283.57**	**339.62**	**274.61**	**1 154.65**	**16.22**	**16.16**	**24.68**	**13.18**	**70.28**

(1) CO_2 emissions of Biomass are not included in Total.

Table A 60: 2004 energy consumption and CO_2 emissions from category 1.A Fuel Combustion by fuel type and sector.

		Consumption (PJ)					CO2 emissions (Tg)				
		1.A.1	**1.A.2**	**1.A.3 + 1.A.5**	**1.A.4**	**1.A**	**1.A.1**	**1.A.2**	**1.A.3 + 1.A.5**	**1.A.4**	**1.A**
		Energy Ind.	**Industry**	**Trans-port**	**Other Sectors**	**Total**	**Energy Ind.**	**Industry**	**Trans-port**	**Other Sectors**	**Total**
	Total Solid	**69.07**	**50.04**	**0.01**	**6.46**	**125.58**	**6.67**	**5.03**	**0.00**	**0.61**	**12.32**
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	2.39		0.47	12.23	1.03	0.23		0.05	1.31
106A	Brown Coal Briquettes		0.00		1.13	1.13		0.00		0.11	0.11
107A	Coke		31.86		3.11	34.97		3.31		0.29	3.60
113A	Peat				0.00	0.00				0.00	0.00
304A	Coke Oven Gas		8.29			8.29		0.78			0.78
	Total Liquid	**43.37**	**36.57**	**325.96**	**105.13**	**511.03**	**3.68**	**2.85**	**24.01**	**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	7.90	234.64	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		0.12	88.93	1.51	90.55		0.01	6.60	0.11	6.72
224A	Other Petroleum Pro-ducts	12.77				12.77	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	13.46				13.46	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**	**0.83**		**0.05**	**1.48**
114B	Municipal Waste	8.39				8.39	0.41				0.41
115A	Industrial Waste	1.70	13.95		0.52	16.17	0.18	0.83		0.05	1.07
	Total Biomass(1)	**15.84**	**41.55**		**67.19**	**124.58**	**(4.56)**		**(6.85)**		**(13.15)**
111A	Fuel Wood	0.05	1.56		53.78	55.39	0.00	0.16		5.38	5.54
112A	Char Coal				0.43	0.43				0.05	0.05
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)	**235.57**	**257.79**	**332.70**	**273.86**	**1 099.91**	**16.32**	**15.13**	**24.38**	**13.74**	**69.62**

(1) CO_2 emissions of Biomass are not included in Total.

Table A 61: 2003 energy consumption and CO_2 emissions from category 1.A Fuel Combustion by fuel type and sector.

		Consumption (PJ)					CO2 emissions (Tg)				
		1.A.1	1.A.2	1.A.3 + 1.A.5	1.A.4	1.A	1.A.1	1.A.2	1.A.3 + 1.A.5	1.A.4	1.A
		Energy Ind.	Industry	Trans-port	Other Sectors	Total	Energy Ind.	Industry	Trans-port	Other Sectors	Total
	Total Solid	**70.88**	**50.38**	**0.02**	**7.07**	**128.35**	**6.92**	**5.08**	**0.00**	**0.67**	**12.66**
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	2.77		0.57	17.04	1.51	0.27		0.06	1.84
106A	Brown Coal Briquettes		0.00		1.38	1.38		0.00		0.13	0.13
107A	Coke		32.85		3.29	36.14		3.42		0.30	3.72
113A	Peat				0.00	0.00				0.00	0.00
304A	Coke Oven Gas		7.62			7.62		0.72			0.72
	Total Liquid	**43.71**	**32.70**	**318.92**	**114.65**	**509.98**	**3.43**	**2.53**	**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	7.18	224.97	10.93	243.27	0.01	0.53	16.57	0.81	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 Pro-ducts	12.22				12.22	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	12.53				12.53	0.95				0.95
301A	**Total Gaseous (Natu-ral 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**	**0.78**		**0.07**	**1.34**
114B	Municipal Waste	5.88				5.88	0.29				0.29
115A	Industrial Waste	1.98	10.90		0.65	13.52	0.21	0.78		0.07	1.05
	Total Biomass(1)	**14.01**	**40.84**		**68.39**	**123.23**	**(4.48)**		**(6.97)**		**(12.99)**
111A	Fuel Wood		1.42		55.87	57.28		0.14		5.59	5.73
112A	Char Coal				0.40	0.40				0.05	0.05
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)	**234.81**	**249.43**	**325.64**	**279.61**	**1 089.48**	**16.29**	**14.73**	**23.86**	**14.23**	**69.15**

(1) CO_2 emissions of Biomass are not included in Total.

Table A 62: 2002 energy consumption and CO_2 emissions from category 1.A Fuel Combustion by fuel type and sector.

		Consumption (PJ)					CO2 emissions (Tg)				
		1.A.1	**1.A.2**	**1.A.3 + 1.A.5**	**1.A.4**	**1.A**	**1.A.1**	**1.A.2**	**1.A.3 + 1.A.5**	**1.A.4**	**1.A**
		Energy Ind.	**Industry**	**Trans-port**	**Other Sectors**	**Total**	**Energy Ind.**	**Industry**	**Trans-port**	**Other Sectors**	**Total**
	Total Solid	**56.13**	**48.89**	**0.02**	**7.89**	**112.92**	**5.51**	**4.92**	**0.00**	**0.74**	**11.17**
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	2.43		0.59	16.26	1.46	0.24		0.06	1.76
106A	Brown Coal Briquettes		0.00		1.26	1.26		0.00		0.12	0.12
107A	Coke		31.12		4.11	35.23		3.24		0.38	3.61
113A	Peat				0.00	0.00				0.00	0.00
304A	Coke Oven Gas		6.99			6.99		0.66			0.66
	Total Liquid	**38.60**	**29.44**	**295.06**	**109.04**	**472.13**	**3.02**	**2.28**	**21.73**	**8.15**	**35.22**
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	6.74	203.28	11.39	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	89.40	1.51	91.01		0.01	6.63	0.11	6.75
224A	Other Petroleum Pro-ducts	11.20				11.20	0.87				0.87
303A	Liquified Petroleum Gas (LPG)	0.13	1.90	0.98	4.83	7.84	0.01	0.12	0.06	0.31	0.50
308A	Refinery Gas	14.13				14.13	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**	**0.64**		**0.06**	**1.13**
114B	Municipal Waste	5.03				5.03	0.25				0.25
115A	Industrial Waste	1.74	9.39		0.62	11.74	0.18	0.64		0.06	0.88
	Total Biomass(1)	**13.07**	**37.77**		**68.23**	**119.06**	**(4.14)**		**(6.93)**		**(12.51)**
111A	Fuel Wood		1.42		57.63	59.05		0.14		5.76	5.91
112A	Char Coal				0.34	0.34				0.04	0.04
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)	**196.00**	**238.43**	**300.08**	**267.65**	**1 002.16**	**13.47**	**14.09**	**22.01**	**13.49**	**63.10**

(1) CO_2 emissions of Biomass are not included in Total.

Table A 63: 2001 energy consumption and CO_2 emissions from category 1.A Fuel Combustion by fuel type and sector.

		Consumption (PJ)					CO2 emissions (Tg)				
		1.A.1	1.A.2	1.A.3 + 1.A.5	1.A.4	1.A	1.A.1	1.A.2	1.A.3 + 1.A.5	1.A.4	1.A
		Energy Ind.	Industry	Trans-port	Other Sectors	Total	Energy Ind.	Industry	Trans-port	Other Sectors	Total
	Total Solid	**59.77**	**43.98**	**0.02**	**9.95**	**113.72**	**5.87**	**4.44**	**0.00**	**0.94**	**11.25**
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	1.87		0.71	17.20	1.60	0.18		0.08	1.86
106A	Brown Coal Briquettes		0.00		2.09	2.09		0.00		0.20	0.20
107A	Coke		29.37		5.05	34.42		3.05		0.46	3.52
113A	Peat				0.00	0.00				0.00	0.00
304A	Coke Oven Gas		3.38			3.38		0.32			0.32
	Total Liquid	**47.50**	**36.56**	**266.33**	**110.87**	**461.27**	**3.38**	**2.79**	**19.61**	**8.30**	**34.13**
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	181.14	11.47	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	83.11	1.50	84.71		0.01	6.16	0.11	6.28
224A	Other Petroleum Pro-ducts	9.90				9.90	0.77				0.77
303A	Liquified Petroleum Gas (LPG)		2.19	0.72	3.66	6.58		0.14	0.05	0.23	0.42
308A	Refinery Gas	15.08				15.08	0.78				0.78
301A	**Total Gaseous (Natu-ral 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**	**0.55**		**0.07**	**0.94**
114B	Municipal Waste	4.65				4.65	0.23				0.23
115A	Industrial Waste	0.94	8.28		0.63	9.84	0.10	0.55		0.07	0.71
	Total Biomass(1)	**11.08**	**45.17**		**72.67**	**128.92**	**(4.96)**		**(7.38)**		**(13.55)**
111A	Fuel Wood		1.15		61.98	63.13		0.11		6.20	6.31
112A	Char Coal				0.34	0.34				0.04	0.04
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)	**200.55**	**241.83**	**275.32**	**282.86**	**1 000.56**	**13.83**	**13.75**	**20.11**	**14.22**	**61.95**

(1) CO_2 emissions of Biomass are not included in Total.

Table A 64: 2000 energy consumption and CO_2 emissions from category 1.A Fuel Combustion by fuel type and sector.

		Consumption (PJ)					CO2 emissions (Tg)				
		1.A.1	1.A.2	1.A.3 + 1.A.5	1.A.4	1.A	1.A.1	1.A.2	1.A.3 + 1.A.5	1.A.4	1.A
		Energy Ind.	Industry	Trans-port	Other Sectors	Total	Energy Ind.	Industry	Trans-port	Other Sectors	Total
	Total Solid	**49.16**	**46.36**	**0.03**	**10.34**	**105.89**	**4.82**	**4.69**	**0.00**	**0.97**	**10.49**
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	1.90		0.64	14.34	1.29	0.18		0.07	1.55
106A	Brown Coal Briquettes		0.00		2.06	2.06		0.00		0.20	0.20
107A	Coke		32.04		5.35	37.38		3.33		0.49	3.82
113A	Peat				0.00	0.00				0.00	0.00
304A	Coke Oven Gas		2.12			2.12		0.20			0.20
	Total Liquid	**43.08**	**34.17**	**248.22**	**105.84**	**431.31**	**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	7.38	163.61	11.13	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 Pro-ducts	9.74				9.74	0.76				0.76
303A	Liquified Petroleum Gas (LPG)	0.94	2.54	0.67	3.70	7.85	0.06	0.16	0.04	0.24	0.50
308A	Refinery Gas	14.35				14.35	0.74				0.74
301A	**Total Gaseous (Natu-ral 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**	**0.45**		**0.14**	**0.82**
114B	Municipal Waste	4.64				4.64	0.23				0.23
115A	Industrial Waste		6.25		1.38	7.63		0.45		0.14	0.59
	Total Biomass(1)	**8.05**	**40.83**		**69.99**	**118.87**	**(4.48)**		**(7.11)**		**(12.48)**
111A	Fuel Wood		0.95		59.22	60.17		0.10		5.92	6.02
112A	Char Coal				0.31	0.31				0.03	0.03
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)	**179.66**	**238.62**	**254.34**	**260.82**	**933.44**	**12.22**	**13.89**	**18.62**	**13.09**	**57.87**

(1) CO_2 emissions of Biomass are not included in Total.

Table A 65: 1999 energy consumption and CO_2 emissions from category 1.A Fuel Combustion by fuel type and sector.

		Consumption (PJ)					**CO2 emissions (Tg)**				
		1.A.1	**1.A.2**	**1.A.3 + 1.A.5**	**1.A.4**	**1.A**	**1.A.1**	**1.A.2**	**1.A.3 + 1.A.5**	**1.A.4**	**1.A**
		Energy Ind.	**Industry**	**Trans-port**	**Other Sectors**	**Total**	**Energy Ind.**	**Industry**	**Trans-port**	**Other Sectors**	**Total**
	Total Solid	**37.89**	**43.34**	**0.03**	**11.37**	**92.62**	**3.79**	**4.38**	**0.00**	**1.07**	**9.24**
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	1.33		0.62	15.62	1.50	0.13		0.07	1.70
106A	Brown Coal Briquettes		0.00		2.05	2.05		0.00		0.20	0.20
107A	Coke		29.81		5.86	35.67		3.10		0.54	3.64
113A	Peat				0.00	0.00				0.00	0.00
304A	Coke Oven Gas		3.19			3.19		0.30			0.30
	Total Liquid	**49.33**	**33.59**	**236.08**	**116.98**	**435.98**	**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	6.35	148.43	11.46	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	14.39				14.39	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	0.59
	Total Biomass(1)	**6.47**	**45.81**		**73.82**	**126.10**	**(5.02)**		**(7.48)**		**(13.21)**
111A	Fuel Wood		1.87		64.10	65.97		0.19		6.41	6.60
112A	Char Coal				0.25	0.25				0.03	0.03
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)	**186.55**	**233.07**	**243.95**	**280.92**	**944.48**	**12.53**	**13.22**	**17.83**	**14.26**	**57.87**

(1) CO_2 emissions of Biomass are not included in Total.

Table A 66: 1998 energy consumption and CO_2 emissions from category 1.A Fuel Combustion by fuel type and sector.

		Consumption (PJ)					CO2 emissions (Tg)				
		1.A.1	1.A.2	1.A.3 + 1.A.5	1.A.4	1.A	1.A.1	1.A.2	1.A.3 + 1.A.5	1.A.4	1.A
		Energy Ind.	Industry	Trans-port	Other Sectors	Total	Energy Ind.	Industry	Trans-port	Other Sectors	Total
	Total Solid	**35.81**	**42.49**	**0.03**	**12.01**	**90.34**	**3.50**	**4.28**	**0.00**	**1.13**	**8.90**
102A	Hard Coal	28.48	11.94	0.03	3.06	43.51	2.69	1.12	0.00	0.28	4.10
104A	Hard Coal Briquettes				0.12	0.12				0.01	0.01
105A	Brown Coal	7.33	0.66		0.57	8.57	0.81	0.06		0.06	0.93
106A	Brown Coal Briquettes		0.00		1.99	1.99		0.00		0.19	0.19
107A	Coke		27.93		6.26	34.20		2.91		0.58	3.48
113A	Peat				0.00	0.00				0.00	0.00
304A	Coke Oven Gas		1.94			1.94		0.18			0.18
	Total Liquid	**60.99**	**45.05**	**243.95**	**111.72**	**461.71**	**4.38**	**3.46**	**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	6.60	149.89	11.34	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 Pro-ducts	11.08				11.08	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 (Natu-ral 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**		**71.06**	**110.84**	**(3.63)**		**(7.17)**		**(11.55)**
111A	Fuel Wood		0.15		64.52	64.67		0.02		6.45	6.47
112A	Char Coal				0.28	0.28				0.03	0.03
116A	Wood Wastes	5.91	9.38		5.59	20.88	0.65	1.03		0.61	2.30
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)	**196.60**	**231.87**	**250.33**	**269.75**	**948.54**	**13.00**	**13.99**	**18.35**	**13.73**	**59.11**

(1) CO_2 emissions of Biomass are not included in Total.

Table A 67: 1997 energy consumption and CO_2 emissions from category 1.A Fuel Combustion by fuel type and sector.

		Consumption (PJ)					CO2 emissions (Tg)				
		1.A.1	1.A.2	1.A.3 + 1.A.5	1.A.4	1.A	1.A.1	1.A.2	1.A.3 + 1.A.5	1.A.4	1.A
		Energy Ind.	Industry	Trans-port	Other Sectors	Total	Energy Ind.	Industry	Trans-port	Other Sectors	Total
	Total Solid	**50.96**	**50.20**	**0.03**	**13.78**	**114.97**	**5.00**	**5.02**	**0.00**	**1.29**	**11.32**
102A	Hard Coal	39.25	12.17	0.03	3.36	54.82	3.71	1.14	0.00	0.31	5.17
104A	Hard Coal Briquettes				0.22	0.22				0.02	0.02
105A	Brown Coal	11.70	0.69		0.64	13.03	1.29	0.07		0.07	1.42
106A	Brown Coal Briquettes		0.00		2.55	2.56		0.00		0.25	0.25
107A	Coke		29.29		7.01	36.29		3.05		0.64	3.69
113A	Peat				0.00	0.00				0.00	0.00
304A	Coke Oven Gas		8.05			8.05		0.76			0.76
	Total Liquid	**57.32**	**47.52**	**217.04**	**111.32**	**433.19**	**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	5.62	127.25	11.54	144.71	0.02	0.41	9.39	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	11.61				11.61	0.91				0.91
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**		**72.50**	**112.95**	**(3.77)**		**(7.31)**		**(11.76)**
111A	Fuel Wood		0.27		66.93	67.21		0.03		6.69	6.72
112A	Char Coal				0.28	0.28				0.03	0.03
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)	**201.48**	**247.06**	**221.27**	**270.14**	**939.95**	**13.87**	**15.24**	**16.25**	**13.77**	**59.18**

(1) *CO_2 emissions of Biomass are not included in Total.*

Table A 68: 1996 energy consumption and CO_2 emissions from category 1.A Fuel Combustion by fuel type and sector.

		Consumption (PJ)					CO2 emissions (Tg)				
		1.A.1	**1.A.2**	**1.A.3 + 1.A.5**	**1.A.4**	**1.A**	**1.A.1**	**1.A.2**	**1.A.3 + 1.A.5**	**1.A.4**	**1.A**
		Energy Ind.	**Industry**	**Trans-port**	**Other Sectors**	**Total**	**Energy Ind.**	**Industry**	**Trans-port**	**Other Sectors**	**Total**
	Total Solid	**47.52**	**43.99**	**0.06**	**17.65**	**109.23**	**4.70**	**4.40**	**0.01**	**1.66**	**10.76**
102A	Hard Coal	33.51	9.72	0.06	4.30	47.60	3.17	0.91	0.01	0.40	4.49
104A	Hard Coal Briquettes										
105A	Brown Coal	14.01	1.12		0.92	16.05	1.52	0.11		0.10	1.73
106A	Brown Coal Briquettes		0.26		2.96	3.22		0.02		0.29	0.31
107A	Coke		25.65		9.46	35.11		2.67		0.87	3.54
113A	Peat				0.00	0.00				0.00	0.00
304A	Coke Oven Gas		7.25			7.25		0.69			0.69
	Total Liquid	**52.92**	**38.63**	**230.22**	**122.72**	**444.49**	**3.73**	**2.95**	**16.99**	**9.21**	**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	5.99	135.54	11.02	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 Pro-ducts	11.02				11.02	0.86				0.86
303A	Liquified 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 (Natu-ral Gas)**	**92.83**	**104.97**	**4.22**	**73.93**	**275.94**	**5.14**	**5.82**	**0.23**	**4.10**	**15.29**
	Total Other Fuel	**4.77**	**6.35**		**2.90**	**14.01**	**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**		**76.79**	**117.46**	**(3.79)**		**(7.72)**		**(12.19)**
111A	Fuel Wood		0.78		72.50	73.29		0.08		7.25	7.33
112A	Char Coal				0.28	0.28				0.03	0.03
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)	**204.16**	**228.48**	**234.49**	**294.00**	**961.13**	**13.80**	**13.70**	**17.23**	**15.26**	**60.04**

[(1)] CO_2 emissions of Biomass are not included in Total.

Table A 69: 1995 energy consumption and CO_2 emissions from category 1.A Fuel Combustion by fuel type and sector.

		Consumption (PJ)					CO2 emissions (Tg)				
		1.A.1	1.A.2	1.A.3 + 1.A.5	1.A.4	1.A	1.A.1	1.A.2	1.A.3 + 1.A.5	1.A.4	1.A
		Energy Ind.	Industry	Trans-port	Other Sectors	Total	Energy Ind.	Industry	Trans-port	Other Sectors	Total
	Total Solid	**45.49**	**44.37**	**0.06**	**18.57**	**108.50**	**4.53**	**4.46**	**0.01**	**1.75**	**10.74**
102A	Hard Coal	29.91	7.44	0.06	4.09	41.50	2.82	0.70	0.01	0.38	3.91
104A	Hard Coal Briquettes										
105A	Brown Coal	15.58	2.29		1.14	19.00	1.71	0.22		0.12	2.05
106A	Brown Coal Briquettes		0.28		3.05	3.32		0.03		0.30	0.32
107A	Coke		27.66		10.30	37.96		2.88		0.95	3.82
113A	Peat				0.00	0.00				0.00	0.00
304A	Coke Oven Gas		6.70			6.70		0.63			0.63
	Total Liquid	**51.96**	**39.73**	**209.02**	**107.67**	**408.39**	**3.73**	**3.05**	**15.44**	**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	4.84	107.17	10.65	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		0.01	7.44	0.11	7.56
224A	Other Petroleum Pro-ducts	8.89			0.01	8.90	0.69			0.00	0.69
303A	Liquified 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 (Natu-ral Gas)**	**80.70**	**99.58**	**4.09**	**74.46**	**258.83**	**4.47**	**5.52**	**0.23**	**4.13**	**14.34**
	Total Other Fuel	**3.91**	**5.27**		**1.74**	**10.92**	**0.19**	**0.47**		**0.18**	**0.84**
114B	Municipal Waste	3.91				3.91	0.19				0.19
115A	Industrial Waste		5.27		1.74	7.01		0.47		0.18	0.65
	Total Biomass(1)	**4.02**	**35.89**		**70.32**	**110.23**	**(3.94)**		**(7.07)**		**(11.45)**
111A	Fuel Wood		1.08		66.28	67.35		0.11		6.63	6.74
112A	Char Coal				0.28	0.28				0.03	0.03
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)	**186.08**	**224.84**	**213.17**	**272.76**	**896.86**	**12.92**	**13.49**	**15.68**	**14.11**	**56.23**

(1) CO_2 emissions of Biomass are not included in Total.

Table A 70: 1994 energy consumption and CO_2 emissions from category 1.A Fuel Combustion by fuel type and sector.

		Consumption (PJ)					CO2 emissions (Tg)				
		1.A.1	1.A.2	1.A.3 + 1.A.5	1.A.4	1.A	1.A.1	1.A.2	1.A.3 + 1.A.5	1.A.4	1.A
		Energy Ind.	Industry	Trans-port	Other Sectors	Total	Energy Ind.	Industry	Trans-port	Other Sectors	Total
	Total Solid	**32.97**	**42.30**	**0.06**	**19.73**	**95.06**	**3.28**	**4.24**	**0.01**	**1.86**	**9.38**
102A	Hard Coal	22.73	6.39	0.06	4.04	33.22	2.17	0.60	0.01	0.38	3.15
104A	Hard Coal Briquettes										
105A	Brown Coal	10.05	2.20		1.28	13.53	1.09	0.21		0.14	1.44
106A	Brown Coal Briquettes	0.19	0.47		3.20	3.86	0.02	0.05		0.31	0.38
107A	Coke		24.94		11.20	36.14		2.59		1.03	3.62
113A	Peat				0.00	0.00				0.00	0.00
304A	Coke Oven Gas		8.31			8.31		0.79			0.79
	Total Liquid	**59.10**	**42.01**	**205.30**	**99.38**	**405.79**	**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	4.53	99.86	11.05	115.65	0.02	0.34	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 Pro-ducts	10.58			0.02	10.61	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 (Natu-ral 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**		**64.92**	**103.42**	**(3.85)**		**(6.53)**		**(10.75)**
111A	Fuel Wood		0.91		61.49	62.39		0.09		6.15	6.24
112A	Char Coal				0.22	0.22				0.02	0.02
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)	**172.72**	**220.65**	**209.13**	**248.96**	**851.46**	**11.76**	**13.24**	**15.39**	**12.98**	**53.41**

(1) CO_2 emissions of Biomass are not included in Total.

Table A 71: 1993 energy consumption and CO_2 emissions from category 1.A Fuel Combustion by fuel type and sector.

		Consumption (PJ)					CO2 emissions (Tg)				
		1.A.1	1.A.2	1.A.3 + 1.A.5	1.A.4	1.A	1.A.1	1.A.2	1.A.3 + 1.A.5	1.A.4	1.A
		Energy Ind.	Industry	Trans-port	Other Sectors	Total	Energy Ind.	Industry	Trans-port	Other Sectors	Total
	Total Solid	**30.81**	**43.32**	**0.06**	**22.10**	**96.29**	**3.09**	**4.32**	**0.01**	**2.08**	**9.49**
102A	Hard Coal	19.93	8.35	0.06	4.23	32.58	1.92	0.79	0.01	0.39	3.10
104A	Hard Coal Briquettes										
105A	Brown Coal	10.64	2.48		1.54	14.66	1.15	0.24		0.17	1.55
106A	Brown Coal Briquettes	0.23	0.34		3.61	4.18	0.02	0.03		0.35	0.41
107A	Coke		23.38		12.71	36.09		2.43		1.17	3.60
113A	Peat				0.00	0.00				0.00	0.00
304A	Coke Oven Gas		8.77			8.77		0.83			0.83
	Total Liquid	**59.10**	**43.00**	**204.50**	**107.07**	**413.67**	**4.24**	**3.32**	**15.12**	**8.02**	**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	95.33	11.00	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	9.89	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**		**70.16**	**107.41**	**(3.75)**		**(7.06)**		**(11.15)**
111A	Fuel Wood		0.80		66.38	67.18		0.08		6.64	6.72
112A	Char Coal				0.28	0.28				0.03	0.03
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**	**272.87**	**851.93**	**11.47**	**12.25**	**15.34**	**14.26**	**53.35**

(1) CO_2 emissions of Biomass are not included in Total.

Table A 72: 1992 energy consumption and CO_2 emissions from category 1.A Fuel Combustion by fuel type and sector.

		Consumption (PJ)					CO2 emissions (Tg)				
		1.A.1	**1.A.2**	**1.A.3 + 1.A.5**	**1.A.4**	**1.A**	**1.A.1**	**1.A.2**	**1.A.3 + 1.A.5**	**1.A.4**	**1.A**
		Energy Ind.	**Industry**	**Trans-port**	**Other Sectors**	**Total**	**Energy Ind.**	**Industry**	**Trans-port**	**Other Sectors**	**Total**
	Total Solid	**39.96**	**41.61**	**0.07**	**26.69**	**108.34**	**4.01**	**4.14**	**0.01**	**2.51**	**10.67**
102A	Hard Coal	27.97	10.19	0.07	3.35	41.58	2.73	0.96	0.01	0.31	4.01
104A	Hard Coal Briquettes										
105A	Brown Coal	11.74	2.27		1.89	15.91	1.25	0.22		0.20	1.67
106A	Brown Coal Briquettes	0.26	0.39		4.23	4.87	0.03	0.04		0.41	0.47
107A	Coke		21.60		17.22	38.82		2.25		1.58	3.83
113A	Peat				0.00	0.00				0.00	0.00
304A	Coke Oven Gas		7.16			7.16		0.68			0.68
	Total Liquid	**48.39**	**36.66**	**202.49**	**107.63**	**395.17**	**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	88.92	10.93	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 Pro-ducts	7.36			0.00	7.36	0.57			0.00	0.57
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	0.85				0.85
301A	**Total Gaseous (Natu-ral 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**		**68.05**	**102.14**	**(3.41)**		**(6.83)**		**(10.58)**
111A	Fuel Wood		0.71		65.28	65.98		0.07		6.53	6.60
112A	Char Coal				0.25	0.25				0.03	0.03
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)	**162.29**	**196.39**	**206.53**	**269.06**	**834.26**	**11.31**	**11.95**	**15.21**	**14.44**	**52.95**

(1) CO_2 emissions of Biomass are not included in Total.

Table A 73: 1991 energy consumption and CO_2 emissions from category 1.A Fuel Combustion by fuel type and sector.

		Consumption (PJ)					CO2 emissions (Tg)				
		1.A.1	1.A.2	1.A.3 + 1.A.5	1.A.4	1.A	1.A.1	1.A.2	1.A.3 + 1.A.5	1.A.4	1.A
		Energy Ind.	Industry	Trans-port	Other Sectors	Total	Energy Ind.	Industry	Trans-port	Other Sectors	Total
	Total Solid	**67.34**	**47.60**	**0.06**	**31.15**	**146.16**	**6.82**	**4.76**	**0.01**	**2.93**	**14.52**
102A	Hard Coal	41.79	8.24	0.06	5.51	55.60	4.13	0.77	0.01	0.51	5.42
104A	Hard Coal Briquettes										
105A	Brown Coal	24.92	2.89		2.38	30.19	2.62	0.28		0.26	3.16
106A	Brown Coal Briquettes	0.63	0.62		4.90	6.15	0.06	0.06		0.47	0.60
107A	Coke		27.00		18.36	45.35		2.81		1.69	4.50
113A	Peat				0.00	0.00				0.00	0.00
304A	Coke Oven Gas		8.86			8.86		0.84			0.84
	Total Liquid	**48.52**	**46.18**	**202.79**	**114.11**	**411.61**	**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	84.13	10.84	98.82	0.00	0.29	6.22	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**		**71.90**	**104.67**	**(3.31)**		**(7.22)**		**(10.81)**
111A	Fuel Wood		0.74		69.23	69.96		0.07		6.92	7.00
112A	Char Coal				0.25	0.25				0.03	0.03
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**	**206.92**	**275.69**	**888.05**	**14.62**	**13.07**	**15.23**	**14.88**	**57.85**

[(1)] *CO_2 emissions of Biomass are not included in Total.*

Table A 74: 1990 energy consumption and CO_2 emissions from category 1.A Fuel Combustion by fuel type and sector.

		Consumption (PJ)					CO2 emissions (Tg)				
		1.A.1	1.A.2	1.A.3 + 1.A.5	1.A.4	1.A	1.A.1	1.A.2	1.A.3 + 1.A.5	1.A.4	1.A
		Energy Ind.	Industry	Trans-port	Other Sectors	Total	Energy Ind.	Industry	Trans-port	Other Sectors	Total
	Total Solid	**61.40**	**50.28**	**0.07**	**28.14**	**139.89**	**6.25**	**5.02**	**0.01**	**2.65**	**13.92**
102A	Hard Coal	38.44	7.17	0.07	5.29	50.97	3.85	0.67	0.01	0.49	5.03
104A	Hard Coal Briquettes										
105A	Brown Coal	22.73	2.19		2.36	27.28	2.37	0.21		0.26	2.84
106A	Brown Coal Briquettes	0.23	1.24		4.45	5.91	0.02	0.12		0.43	0.57
107A	Coke		27.19		16.04	43.22		2.83		1.48	4.30
113A	Peat				0.00	0.00				0.00	0.00
304A	Coke Oven Gas		12.51			12.51		1.18			1.18
	Total Liquid	**46.43**	**40.68**	**183.03**	**108.90**	**379.04**	**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	74.83	10.82	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	6.91	0.02		0.87	7.81	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**		**64.73**	**95.99**	**(3.25)**		**(6.50)**		**(9.93)**
111A	Fuel Wood		0.66		62.46	63.12		0.07		6.25	6.31
112A	Char Coal				0.22	0.22				0.02	0.02
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)	**188.35**	**200.81**	**187.15**	**251.58**	**827.89**	**13.79**	**12.69**	**13.77**	**13.79**	**54.07**

(1) CO_2 emissions of Biomass are not included in Total.

ANNEX 3: CO_2 REFERENCE APPROACH

In this annex the results, methodology and detailed data for the CO_2 reference approach are presented.

Methodology

The default methodology according to IPCC Worksheet 1-1 was used.

Emission factors

Carbon emission factors

For estimation of emissions that arise from combustion of fossil fuels the default carbon emission factors described in chapter 1.4.1.1 of the IPCC Reference Manual have been used (IPCC Workbook 1.6 table 1-2) except for natural gas and coal, where country specific values have been used.The selected values are presented in Table A 79.

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 79.

Activity data

Production, Imports, Exports, Stock Change

Activity data are taken from the national energy balance (IEA JQ 2013) (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.
- Coal Tar is included in Coking Coal
- 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:

Carbon stored in steel [Mg] = raw steel production [Mg] 0.0015 + electric steel [Mg] * 0.01*

which leads to an average fraction of carbon stored of 0.007 of total inland coke consumption.

In the Sectoral Approach the release of stored carbon as emissions is considered as quoted in the NIR, chapter *3.4 Feedstock*.

Recalculations

Activity data

Imports, Exports and Production are updated according to the new version of the energy balance (IEA JQ 2013). Changes of activity data are based on energy balance recalculations as described in Annex 2.

Recalculations

In the actual submission the share of biofuels in blended diesel and gasoline is considered in the carbon emission factors from the year 2005 on. This leads to a significant lower difference between the Sectoral and the Reference Approach for liquid fuels. In the previous submission the difference for e.g. the year 2010 was +3.5% which is improved to -0.6 %. In the previous submission the difference due the use of biofuel blended fuels was quantified to explain the difference which is obsolete now.

Coal tar is now included together with coking coal. However, this does not significantly improve the difference between the reference and sectoral approach.

Results of the Reference Approach

Table A 75 to Table A 79 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 75 presents the calculation results for each fuel type of the Reference Approach for selected years.

Table A 75: Actual CO_2 emissions (Gg CO_2) for selected years.

Fuel Type	1990	2000	2006	2007	2008	2009	2010	2011	2012
Crude Oil	24 536.32	25 435.31	26 285.28	26 225.30	27 005.81	25 726.99	23 975.22	25 335.03	25 760.60
Orimulsion	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Natural Gas Liquids	108.79	284.26	234.33	487.74	213.99	346.68	358.95	517.66	326.31
Gasoline	-217.42	490.55	1 173.85	781.97	442.04	300.44	841.43	410.82	279.62
Jet Kerosene	-843.3	-1 571.3	-1 509.2	-1 746.2	-1 344.9	-860.3	-1 366.2	-1 795.7	-1 800.7
Other Kerosene	-43.17	15.02	7.16	5.67	4.60	4.24	3.58	3.16	8.76
Shale Oil	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Gas / Diesel Oil	1 780.57	7 083.44	12 061.32	12 374.94	10 764.89	9 928.24	11 976.52	9 301.75	9 837.25
Residuel Fuel Oil	1 014.96	1 131.92	571.08	389.18	142.50	-619.80	227.32	-469.60	-442.02
LPG	246.20	393.77	380.09	316.89	213.36	260.11	293.20	176.66	169.73
Ethane	IE	IE	IE	IE	IE	IE	IE	IE	IE
Naphtha	-1 059.56	-1 428.81	-2 093.80	-2 217.97	-2 120.75	-2 217.97	-2 236.76	-2 094.61	-2 623.98
Bitumen	-897.96	-1 194.18	-1 368.91	-1 448.63	-1 590.51	-1 494.21	-1 028.61	-1 350.40	-1 294.60
Lubricants	168.96	-172.37	-243.57	-256.95	-298.40	-223.56	-191.54	-112.12	84.19
Petroleum Coke	-18.83	18.35	112.68	87.06	84.07	83.74	144.36	40.09	170.66
Refinery Feedstocks	2 986.77	1 518.67	1 450.13	797.49	1 259.30	1 417.65	981.53	1 619.75	259.77
OtherOil	274.45	-139.96	-175.82	-245.72	-63.25	-440.86	-420.89	-129.61	-119.12
Liquid Fossil Totals	**28 036.73**	**31 864.69**	**36 884.61**	**35 550.77**	**34 712.75**	**32 211.34**	**33 558.09**	**31 452.92**	**30 616.42**
Anthracite	40.45	6.74	244.03	516.37	6.74	1.35	4.04	0.00	26.96
Coking Coal	6 994.08	5 363.89	5 374.18	5 460.29	4 697.04	4 296.18	4 636.97	4 506.24	4 556.00
Other Bit. Coal	4 712.74	4 809.32	5 899.88	5 661.59	5 683.49	3 836.88	4 772.58	5 185.96	4 250.81
Sub- Bit. Coal	0.00	79.42	173.98	185.11	165.45	151.05	141.89	146.96	153.45
Lignite	2 729.15	1 318.72	752.69	27.66	16.10	51.25	58.12	56.05	28.36
Oil Shale	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Peat	0.46	0.46	0.46	0.43	0.43	0.43	0.46	0.46	0.46
BKB & Patent Fuel	548.08	197.22	87.09	84.16	159.09	79.99	76.02	48.20	50.73
Coke Oven / Gas Coke	2 014.15	3 146.61	4 223.27	3 986.14	4 011.94	2 554.94	3 581.57	3 836.84	3 701.70
Solid Fuel Totals	**17 039.09**	**14 922.38**	**16 755.57**	**15 921.75**	**14 740.28**	**10 972.06**	**13 271.65**	**13 780.70**	**12 768.48**
Gaseous Fossil	**12 145.84**	**15 272.75**	**17 769.40**	**16 757.27**	**17 708.20**	**17 327.51**	**19 053.24**	**18 058.78**	**17 197.96**
TOTAL	**57 221.66**	**62 059.83**	**71 409.58**	**68 229.80**	**67 161.23**	**60 510.91**	**65 882.98**	**63 292.39**	**60 582.86**
Biomass Total	**9 196.63**	**11 392.45**	**14 810.10**	**16 302.50**	**17 419.40**	**17 764.06**	**20 229.29**	**19 648.06**	**21 223.63**
Solid Biomass	9 196.63	11 254.05	14 084.42	15 603.11	16 643.56	17 064.55	19 529.57	18 879.62	20 280.72
Liquid Biomass	IE	IE	IE	IE	IE	IE	IE	IE	IE
Gas Biomass	0.00	138.40	725.67	699.38	775.84	699.51	699.71	768.44	942.91

Table A 76 presents the apparent fuel consumption for each fuel type of the Reference Approach.

Table A 76: Apparent Consumption (TJ).

Fuel Type	1990	2000	2006	2007	2008	2009	2010	2011	2012
Crude Oil	337 966	350 349	362 056	361 230	371 981	354 366	330 237	348 967	354 829
Orimulsion	0	0	0	0	0	0	0	0	0
Natural Gas Liquids	1 743	4 553	3 753	7 812	3 427	5 553	5 749	8 291	5 226
Gasoline	-3 169	7 150	17 161	11 551	6 776	4 643	13 057	6 378	4 355
Jet Kerosene	-11 914	-22 198	-21 321	-24 669	-19 000	-12 154	-19 301	-25 368	-25 440
Other Kerosene	-607	211	101	80	65	60	50	44	166
Shale Oil	0	0	0	0	0	0	0	0	0
Gas/Diesel Oil	24 283	96 602	172 251	177 341	155 491	145 859	175 387	136 422	143 879
Residuel Fuel Oil	13 251	14 778	7 456	5 081	1 860	-8 092	2 968	-6 131	-5 771
LPG	3 943	6 307	6 088	5 075	3 417	4 166	4 696	2 829	2 718
Ethane	IE	IE	IE	IE	IE	IE	IE	IE	IE
Naphtha	90	0	-4 906	-3 106	-4 906	-4 996	-4 816	-5 221	-8 327
Bitumen	11 244	10 634	12 836	5 087	2 745	3 660	6 993	3 683	2 868
Lubricants	5 938	-115	-1 712	-1 973	-2 588	-1 840	-1 264	-98	2 398
Petroleum Coke	2 889	2 068	2 478	2 347	2 982	1 689	3 607	1 035	2 782
Refinery Feedstocks	41 140	20 918	19 974	10 985	17 346	19 527	13 520	22 311	3 578
OtherOil	3 780	-1 208	1 774	-1 645	1 243	-2 824	-1 225	33	588
Liquid Fossil Totals	**430 578**	**490 049**	**577 989**	**555 196**	**540 839**	**509 616**	**529 658**	**493 176**	**483 851**
Anthracite	448	84	2 548	5 376	84	28	56	0	280
Coking Coal	67 923	53 164	53 931	54 857	54 166	48 918	53 500	52 123	52 607
Other Bit. Coal	50 568	51 604	63 239	60 829	61 273	41 300	51 254	55 848	45 936
Sub- Bit. Coal	0	844	1 848	1 966	1 757	1 604	1 507	1 561	1 630
Lignite	27 294	13 188	7 429	285	166	532	601	567	290
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	2 127	939	908	1 716	863	820	520	567
Coke Oven / Gas Coke	19 304	30 110	40 163	38 034	37 775	24 156	33 835	36 180	34 954
Solid Fuel Totals	**171 453**	**151 126**	**170 102**	**162 259**	**156 942**	**117 406**	**141 578**	**146 803**	**136 267**
Gaseous Fossil	**219 239**	**275 681**	**320 747**	**302 478**	**319 643**	**312 771**	**343 921**	**325 971**	**310 433**
TOTAL	**821 270**	**916 857**	**1 068 838**	**1 019 933**	**1 017 423**	**939 793**	**1 015 157**	**965 950**	**930 550**
Biomass Total	**95 324**	**117 925**	**152 673**	**168 172**	**179 661**	**183 321**	**208 873**	**202 770**	**218 900**
Solid Biomass	95 324	116 650	145 987	161 728	172 513	176 876	202 427	195 690	210 212
Liquid Biomass	IE	IE	IE	IE	IE	IE	IE	IE	IE
Gas Biomass	0	1 275	6 686	6 444	7 148	6 445	6 447	7 080	8 687

Table A 77 presents the carbon stored for each fuel type of the Reference Approach.

Table A 77: Carbon Stored (Gg C)

Fuel Type	1990	2000	2006	2007	2008	2009	2010	2011	2012
Crude Oil	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Orimulsion	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Natural Gas Liquids	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Gasoline	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Jet Kerosene	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Other Kerosene	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.85
Shale Oil	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Gas / Diesel Oil	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Residuel Fuel Oil	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
LPG	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Ethane	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Naphtha	293.69	393.61	478.68	548.90	486.11	511.09	519.87	472.61	556.32
Bitumen	494.74	562.92	659.51	510.98	498.54	492.15	437.20	453.03	419.73
Lubricants	72.21	45.19	32.86	31.32	30.45	24.79	27.48	28.93	24.76
Petroleum Coke	84.65	51.81	37.10	40.57	58.84	23.37	59.43	17.43	29.48
Refinery Feedstocks	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
OtherOil	0.00	14.40	83.91	34.78	42.29	64.98	91.45	36.36	44.58
Liquid Fossil Totals	**945.30**	**1 067.93**	**1 292.06**	**1 166.55**	**1 116.23**	**1 116.38**	**1 135.43**	**1 008.36**	**1 075.72**
Anthracite	0.75	0.38	0.38	0.38	0.38	0.38	0.38	0.00	0.00
Coking Coal	39.55	61.69	81.85	77.75	76.23	48.86	68.48	73.15	70.74
Other Bit. Coal	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Sub- Bit. Coal	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Lignite	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Oil Shale	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Peat	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
BKB & Patent Fuel	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.50
Coke Oven/ Gas Coke	4.79	6.09	7.15	6.98	6.67	5.50	6.29	5.99	6.11
Solid Fuel Totals	**45.09**	**68.16**	**89.37**	**85.11**	**83.27**	**54.74**	**75.15**	**79.14**	**77.35**
Gaseous Fossil	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**
TOTAL	**990.38**	**1 136.09**	**1 381.43**	**1 251.66**	**1 199.50**	**1 171.12**	**1 210.58**	**1 087.50**	**1 153.07**
Biomass Total	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**
Solid Biomass	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Liquid Biomass	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Gas Biomass	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

Table A 78 presents international bunker fuels for the relevant fuel types of the Reference Approach.

Table A 78: International Bunkers [Gg fuel].

Fuel Type	1990	2000	2006	2007	2008	2009	2010	2011	2012
Jet Kerosene	281	538	650	690	692	601	650	688	657
Diesel	1	1	2	2	1	1	1	1	1

Table A 79 presents conversion factors, carbon emission factors and the fraction of carbon oxidised for all fuel types of the Reference Approach. Country specific values are provided only were relevant.

Table A 79: 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 2012	Default value	Country specific value 2012	
Crude Oil	42.75	42.50	20.00	-	0.99
Orimulsion	-	-	-	-	-
Natural Gas Liquids	45.22	42.50	17.20	-	0.99
Gasoline	44.80	41.34	18.90	17.69	0.99
Jet Kerosene	44.59	43.34	19.50	-	0.99
Other Kerosene	44.75	43.34	19.60	-	0.99
Shale Oil	-	-	-	-	-
Gas / Diesel Oil	43.33	42.08	20.20	18.84	0.99
Residuel Fuel Oil	40.19	40.36	21.10	-	0.99
LPG	47.31	46.12	17.20	-	0.99
Ethane	-	-	-	-	-
Naphtha	45.01	-	20.00	-	0.99
Bitumen	40.19	44.30	22.00	-	0.99
Lubricants	40.19	41.81	20.00	-	0.99
Petroleum Coke	31.00	35.20	27.50	-	0.99
Refinery Feedstocks	42.50	42.57	20.00	-	0.99
OtherOil	40.19	44.30	20.00	-	0.99
Anthracite	28.00		26.80	-	0.98
Coking Coal	28.00	29.07	25.80	25.45	0.98
Other Bit. Coal	28.00	27.33	25.80	25.75	0.98
Sub- Bit. Coal	22.20	21.73	26.20	-	0.98
Lignite	10.90	19.35	27.60	27.19	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 Coke	28.20	29.00	29.50	29.65	0.98
Natural Gas	-	-	15.30	15.19	1.00
Solid Biomass	-	-	29.90	-	0.88
Liquid Biomass	-	-	-	-	-
Gas Biomass	-	-	29.90	-	0.99

Table A 80 presents selected country specific conversion factors. From 2007 on the conversion factor of lignite is higher because indigenous production and use of lignite with a comparable low calorific value (high water content) has been suspended.

Table A 80: Country specific conversion factors for selected fuels [TJ/Gg]

Fuel Type	1990	2000	2006	2007	2008	2009	2010	2011	2012
Other Bit. Coal	28.00	27.99	28.07	27.92	28.46	28.08	27.00	27.36	27.33
Lignite	10.90	9.82	10.94	21.93	20.76	17.17	17.18	17.72	19.35
Coke	28.50	28.67	29.00	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 2013.

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 81: National Energy Balance 1990-2012 Coking Coal [1000 tons].

101A Coking Coal	1990	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012
Indigenous Production	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Total Imports (Balance)	2 376	1 738	1 861	1 864	1 858	1 789	2 063	1 806	1 859	1 931	1 661	1 907	1 742	1 786
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	139	30	34	40	115	-164	86	41	-68	32	-69	43	12
Gross Inland Deliveries (Obs.)	2 337	1 878	1 892	1 898	1 898	1 905	1 899	1 891	1 900	1 863	1 693	1 838	1 785	1 799
Statistical Difference	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Total Transformation Sector	2 337	1 878	1 892	1 898	1 898	1 905	1 899	1 891	1 900	1 863	1 693	1 838	1 785	1 799
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	1 878	1 892	1 898	1 898	1 905	1 899	1 891	1 900	1 863	1 693	1 838	1 785	1 799
Blast Furnaces (Transformation)	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Patent Fuel Plants	0	0	0	0	0	0	0	0	0	0	0	0	0	0
BKB (Transformation)	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Non Specified (Transformation)	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Total Energy Sector	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Coal Mines	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Patent Fuel Plants	0	0	0	0	0	0	0	0	0	0	0	0	0	1
Coke Ovens (Energy)	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Blast Furnaces (Energy)	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Gas Works (Energy)	0	0	0	0	0	0	0	0	0	0	0	0	0	0
BKB (Transformation)	0	0	0	0	0	0	0	0	0	0	0	0	0	1
Petroleum refineries	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Power Plants	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Non Specified (Energy)	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Distribution Losses	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Final Consumption	0	0	0	0	0	0	0	0	0	0	0	0	0	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

101A Coking Coal	1990	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012
Wood and Wood Products	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Construction	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Textiles and Leather	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Non Specified (Industry)	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Total Other Sectors	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Commerce - Public Services	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Residential	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Agriculture	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Non Specified (Others)	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Total Non-Energy Use	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Table A 82: National Energy Balance 1990–2012 Bituminous Coal & Anthracite [1000 tons].

102A Bitominous Coal & Anthracite (hard coal)	1990	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012
Indigenous Production	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Total Imports (Balance)	1 233	1 672	1 862	2 167	2 101	2 659	2 272	2 316	2 569	2 132	1 451	1 727	1 642	1 851
Total Exports (Balance)	0	0	0	0	0	21	3	0	1	2	0	1	1	2
International Marine Bunkers	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Stock Change (National Territory)	589	176	178	-225	310	-212	-119	29	-191	26	21	174	402	-158
Gross Inland Deliveries (Obs.)	1 822	1 848	2 040	1 942	2 411	2 426	2 150	2 345	2 377	2 156	1 471	1 899	2 043	1 691
Statistical Difference	0	0	0	0	0	0	0	0	4	0	0	0	0	0
Total Transformation Sector	1 421	1 422	1 673	1 617	2 129	2 147	1 885	2 001	1 978	1 735	1 199	1 576	1 709	1 399
Public Electricity	964	1 203	1 476	1 373	1 936	1 939	1 694	1 799	1 801	1 540	1 020	1 396	1 524	1 225
Public Combined Heat and Power	409	161	150	194	149	161	148	145	140	157	140	144	148	140
Public Heat Plants	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Auto Producers of Electricity	0	10	10	8	9	7	7	7	7	7	0	0	0	0
Auto Producers for CHP	48	48	37	42	35	40	36	50	29	31	40	36	36	34
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	33	2	0	0	0	0	0	0	10	6	7	8	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	0	0	1
Coke Ovens (Energy)	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Blast Furnaces (Energy)	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Gas Works (Energy)	0	0	0	0	0	0	0	0	0	0	0	0	0	0
BKB (Transformation)	0	0	0	0	0	0	0	0	0	0	0	0	0	1
Petroleum refineries	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Power Plants	0	33	2	0	0	0	0	0	0	10	6	7	8	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	392	363	323	280	277	264	343	310	228	156	179	176	171
Total Transport	3	1	1	1	1	0	0	0	0	0	0	0	0	0
Rail	3	1	1	1	1	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

102A Bitominous Coal & Anthracite (hard coal)	1990	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012
Total Industry	208	313	288	254	215	217	212	296	283	220	153	173	160	167
Iron and Steel	0	0	0	0	0	0	3	5	6	1	0	2	0	1
Chemical (incl.Petro-Chemical)	7	57	68	66	67	61	35	29	22	19	18	20	19	18
Non ferrous Metals	0	0	0	0	0	0	0	0	0	0	1	0	0	0
Non metallic Mineral Products	199	170	151	98	74	72	86	140	156	140	97	56	39	42
Transportation Equipment	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Machinery	0	0	0	0	0	0	0	1	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	1	1	1	0	0	0
Pulp, Paper and Printing	2	86	69	90	74	83	87	121	97	60	37	94	101	106
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	78	74	69	64	60	52	46	27	8	2	6	16	4
Commerce - Public Services	11	8	7	13	15	12	9	6	3	0	0	0	0	0
Residential	177	69	67	56	49	47	42	40	23	7	2	5	16	4
Agriculture	1	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	2	1	1	2	2	1	1	1	85	183	110	137	151	115

Table A 83: National Energy Balance 1990-2012. Patent Fuel [1000 tons].

104A Patent Fuel (hard coal briquettes)	1990	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012
Indigenous Production	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Total Imports (Balance)	0	4	1	1	2	1	1	1	9	75	18	13	0	7
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	-25	0	0	0	0
Gross Inland Deliveries (Obs.)	0	4	1	1	2	1	1	1	9	49	18	13	0	7
Statistical Difference	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Total Transformation Sector	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Public Electricity	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Public Combined Heat and Power	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Public Heat Plants	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Auto Producers of Electricity	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Auto Producers for CHP	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Auto Producer Heat Plants	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Gas Works (Transformation)	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Coke Ovens (Transformation)	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Blast Furnaces (Transformation)	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Patent Fuel Plants	0	0	0	0	0	0	0	0	0	0	0	0	0	0
BKB (Transformation)	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Non Specified (Transformation)	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Total Energy Sector	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Coal Mines	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Patent Fuel Plants	0	0	0	0	0	0	0	0	0	0	0	0	0	1
Coke Ovens (Energy)	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Blast Furnaces (Energy)	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Gas Works (Energy)	0	0	0	0	0	0	0	0	0	0	0	0	0	0
BKB (Transformation)	0	0	0	0	0	0	0	0	0	0	0	0	0	1
Petroleum refineries	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Power Plants	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Non Specified (Energy)	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Distribution Losses	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Final Consumption	0	4	1	1	2	1	1	1	9	49	18	13	0	8
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	24	3	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	24	3	0	0	0
Wood and Wood Products	0	0	0	0	0	0	0	0	0	0	0	0	0	0

104A Patent Fuel (hard coal briquettes)	1990	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012
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	4	1	1	2	1	1	1	9	25	15	13	0	8
Commerce - Public Services	0	1	0	0	0	0	0	0	0	0	0	0	0	0
Residential	0	3	0	1	2	1	1	1	9	25	15	13	0	7
Agriculture	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Non Specified (Others)	0	0	0	0	0	0	0	0	0	0	0	0	0	1
Total Non-Energy Use	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Table A 84: National Energy Balance 1990-2012. Lignite and Brown Coal [1000 tons].

105A Lignite and brown coal	1990	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012
Indigenous Production	2 448	1 249	1 206	1 412	1 152	235	0	0	0	0	0	0	0	0
Total Imports (Balance)	36	54	73	59	70	88	112	140	119	132	111	112	112	90
Total Exports (Balance)	3	0	0	0	0	0	0	0	0	5	3	8	6	0
International Marine Bunkers	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Stock Change (National Territory)	23	78	351	90	431	891	1 163	616	-24	-38	-3	0	0	0
Gross Inland Deliveries (Obs.)	2 503	1 381	1 630	1 561	1 653	1 215	1 274	757	95	89	105	104	107	90
Statistical Difference	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Total Transformation Sector	2 133	1 230	1 477	1 384	1 471	1 035	1 136	657	0	0	0	0	0	0
Public Electricity	1 182	1 168	1 413	1 317	1 399	972	1 068	624	0	0	0	0	0	0
Public Combined Heat and Power	881	26	38	42	46	36	48	32	0	0	0	0	0	0
Public Heat Plants	16	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	54	35	26	25	27	27	20	1	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	6	2	0	1	0	0	0	0	0	0	0	0	0	0
Coal Mines	3	0	0	0	0	0	0	0	0	0	0	0	0	0
Patent Fuel Plants	0	0	0	0	0	0	0	0	0	0	0	0	0	1
Coke Ovens (Energy)	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Blast Furnaces (Energy)	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Gas Works (Energy)	0	0	0	0	0	0	0	0	0	0	0	0	0	0
BKB (Transformation)	0	0	0	0	0	0	0	0	0	0	0	0	0	1
Petroleum refineries	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Power Plants	3	2	0	1	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	364	149	153	176	182	180	138	99	95	89	105	104	107	90
Total Transport	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Rail	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Inland Waterways	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Non Specified (Transport)	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Total Industry	147	105	106	138	148	148	126	88	92	85	100	99	102	87
Iron and Steel	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Chemical (incl.Petro-Chemical)	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Non ferrous Metals	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Non metallic Mineral Products	11	39	44	59	72	68	70	84	87	85	100	99	102	87
Transportation Equipment	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Machinery	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Mining and Quarrying	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Food, Beverages and Tobacco	2	0	0	0	0	0	0	0	0	0	0	0	0	0
Pulp, Paper and Printing	132	66	62	80	76	79	56	4	4	0	0	0	0	0
Wood and Wood Products	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Construction	2	0	0	0	0	0	0	0	0	0	0	0	0	0

105A Lignite and brown coal	1990	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012
Textiles and Leather	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Non Specified (Industry)	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Total Other Sectors	217	43	47	37	34	32	13	11	4	3	5	5	5	4
Commerce - Public Services	9	3	3	2	2	2	1	1	0	0	0	0	0	0
Residential	208	41	44	36	32	31	12	11	4	3	4	5	4	3
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 85: National Energy Balance 1990–2012. Brown Coal Briquettes [1000 tons].

106A BKB-PB	1990	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012
Indigenous Production	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Total Imports (Balance)	295	95	108	65	72	59	53	57	40	38	44	37	20	23
Total Exports (Balance)	0	0	0	0	0	1	2	1	1	0	2	0	1	1
International Marine Bunkers	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Stock Change (National Territory)	12	11	0	0	0	0	0	-9	-2	2	-15	-7	7	0
Gross Inland Deliveries (Obs.)	306	107	108	65	72	58	51	48	38	40	27	30	27	22
Statistical Difference	0	0	0	0	0	0	0	0	0	0	0	0	0	-1
Total Transformation Sector	12	0	0	0	0	0	0	0	0	0	0	0	0	0
Public Electricity	7	0	0	0	0	0	0	0	0	0	0	0	0	0
Public Combined Heat and Power	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Public Heat Plants	5	0	0	0	0	0	0	0	0	0	0	0	0	0
Auto Producers of Electricity	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Auto Producers for CHP	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Auto Producer Heat Plants	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Gas Works (Transformation)	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Coke Ovens (Transformation)	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Blast Furnaces (Transformation)	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Patent Fuel Plants	0	0	0	0	0	0	0	0	0	0	0	0	0	0
BKB (Transformation)	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Non Specified (Transformation)	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Total Energy Sector	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Coal Mines	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Patent Fuel Plants	0	0	0	0	0	0	0	0	0	0	0	0	0	1
Coke Ovens (Energy)	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Blast Furnaces (Energy)	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Gas Works (Energy)	0	0	0	0	0	0	0	0	0	0	0	0	0	0
BKB (Transformation)	0	0	0	0	0	0	0	0	0	0	0	0	0	1
Petroleum refineries	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Power Plants	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Non Specified (Energy)	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Distribution Losses	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Final Consumption	295	107	108	65	72	58	51	48	38	40	27	30	27	22
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	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

106A BKB-PB	1990	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012
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	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	230	107	108	65	72	58	51	48	38	40	27	30	27	22
Commerce - Public Services	8	34	41	14	30	18	13	12	10	10	7	8	7	6
Residential	214	70	65	49	40	39	36	34	27	28	19	21	19	16
Agriculture	8	3	3	2	2	2	2	2	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	1

Table A 86: National Energy Balance 1990-2012. Coke Oven Coke [1000 tons].

107A Coke Oven Coke	1990	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012
Indigenous Production	1 725	1 385	1 394	1 395	1 395	1 400	1 388	1 398	1 424	1 410	1 281	1 391	1 316	1 308
Total Imports (Balance)	815	981	1 091	1 073	1 173	1 266	1 402	1 282	1 438	1 420	813	1 252	1 324	1 191
Total Exports (Balance)	1	1	1	2	3	42	4	3	5	0	0	3	0	0
International Marine Bunkers	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Stock Change (National Territory)	-136	71	-164	124	-84	-181	-53	106	-121	-117	20	-83	-76	14
Gross Inland Deliveries (Obs.)	2 402	2 435	2 320	2 589	2 481	2 443	2 733	2 783	2 736	2 712	2 114	2 557	2 563	2 513
Statistical Difference	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Total Transformation Sector	623	909	899	1 049	1 019	1 059	1 035	1 154	1 183	1 237	897	1 181	1 239	1 181
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	909	899	1 049	1 019	1 059	1 035	1 154	1 183	1 237	897	1 181	1 239	1 181
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	53	52	58	55	50	65	62	61	57	47	54	51	52
Coal Mines	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Patent Fuel Plants	0	0	0	0	0	0	0	0	0	0	0	0	0	1
Coke Ovens (Energy)	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Blast Furnaces (Energy)	107	53	52	58	55	50	65	62	61	57	47	54	51	52
Gas Works (Energy)	0	0	0	0	0	0	0	0	0	0	0	0	0	0
BKB (Transformation)	0	0	0	0	0	0	0	0	0	0	0	0	0	1
Petroleum refineries	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Power Plants	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Non Specified (Energy)	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Distribution Losses	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Final Consumption	853	436	344	365	348	351	367	372	321	313	255	277	279	265
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	247	165	219	231	241	287	298	261	253	213	230	237	232
Iron and Steel	235	207	143	193	202	216	235	273	239	232	202	221	227	222
Chemical (incl.Petro-Chemical)	14	15	12	11	14	10	9	0	0	0	0	0	0	0
Non ferrous Metals	7	6	3	6	5	6	4	4	5	5	5	4	4	4
Non metallic Mineral Products	23	10	2	5	4	5	32	16	13	14	2	0	1	0
Transportation Equipment	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Machinery	5	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	5	7	4	5	5	4	6	4	4	3	5	5	5	6
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

107A Coke Oven Coke	1990	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012
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	190	179	146	117	110	80	74	59	60	42	47	42	33
Commerce - Public Services	13	6	7	7	6	5	4	3	2	1	1	2	1	1
Residential	537	180	169	136	109	104	74	70	56	57	40	45	39	31
Agriculture	12	4	4	3	2	2	1	1	1	1	1	1	1	1
Non Specified (Others)	0	0	0	0	0	0	0	0	0	0	0	0	0	1
Total Non-Energy Use	820	1 037	1 025	1 117	1 059	984	1 266	1 196	1 172	1 105	914	1 046	995	1 015

Table A 87: National Energy Balance 1990-2012. Peat [1000 tons].

113A Peat	1990	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012
Indigenous Production	1	1	1	1	1	1	1	1	1	1	1	1	1	1
Total Imports (Balance)	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Total Exports (Balance)	0	0	0	0	0	0	0	0	0	0	0	0	0	0
International Marine Bunkers	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Stock Change (National Territory)	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Gross Inland Deliveries (Obs.)	1	1	1	1	1	1	1	1	1	1	1	1	1	1
Statistical Difference	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Total Transformation Sector	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Public Electricity	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Public Combined Heat and Power	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Public Heat Plants	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Auto Producers of Electricity	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Auto Producers for CHP	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Auto Producer Heat Plants	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Gas Works (Transformation)	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Coke Ovens (Transformation)	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Blast Furnaces (Transformation)	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Patent Fuel Plants	0	0	0	0	0	0	0	0	0	0	0	0	0	0
BKB (Transformation)	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Non Specified (Transformation)	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Total Energy Sector	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Coal Mines	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Patent Fuel Plants	0	0	0	0	0	0	0	0	0	0	0	0	0	1
Coke Ovens (Energy)	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Blast Furnaces (Energy)	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Gas Works (Energy)	0	0	0	0	0	0	0	0	0	0	0	0	0	0
BKB (Transformation)	0	0	0	0	0	0	0	0	0	0	0	0	0	1
Petroleum refineries	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Power Plants	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Non Specified (Energy)	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Distribution Losses	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Final Consumption	1	1	1	1	1	1	1	1	1	1	1	1	1	1
Total Transport	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Rail	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Inland Waterways	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Non Specified (Transport)	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Total Industry	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Iron and Steel	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Chemical (incl.Petro-Chemical)	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Non ferrous Metals	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Non metallic Mineral Products	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Transportation Equipment	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Machinery	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Mining and Quarrying	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Food, Beverages and Tobacco	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Pulp, Paper and Printing	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Wood and Wood Products	0	0	0	0	0	0	0	0	0	0	0	0	0	0

113A Peat	1990	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012
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 88: National Energy Balance 1990-2012. Coke Oven Gas [TJ].

304A Coke Oven Gas	1990	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012
Indigenous Production	13 117	10 466	9 776	9 579	10 722	10 911	8 884	8 713	8 571	8 913	9 072	10 233	10 647	10 606
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	10 466	9 776	9 579	10 722	10 911	8 884	8 713	8 571	8 913	9 072	10 233	10 647	10 606
Statistical Difference	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Total Transformation Sector	3 385	3 592	3 816	3 187	1 748	2 436	2 099	1 907	1 856	2 007	2 393	2 274	2 199	2 282
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	3 256	3 531	2 778	1 356	2 266	1 914	1 783	1 702	1 809	2 135	2 003	1 914	1 974
Auto Producers for CHP	3 385	286	285	409	393	170	185	124	153	198	259	271	285	308
Auto Producer Heat Plants	0	50	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	4 136	3 300	3 083	3 020	4 187	4 326	3 754	3 682	3 682	3 734	3 755	3 734	3 810	4 033
Coal Mines	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Patent Fuel Plants	0	0	0	0	0	0	0	0	0	0	0	0	0	1
Coke Ovens (Energy)	1 072	856	799	783	708	595	282	235	-307	-104	1 943	1 219	802	771
Blast Furnaces (Energy)	3 064	2 444	2 283	2 237	3 479	3 730	3 472	3 447	3 989	3 838	1 812	2 514	3 008	3 262
Gas Works (Energy)	0	0	0	0	0	0	0	0	0	0	0	0	0	0
BKB (Transformation)	0	0	0	0	0	0	0	0	0	0	0	0	0	1
Petroleum refineries	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Power Plants	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Non Specified (Energy)	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Distribution Losses	0	0	0	1 023	1 171	1 204	760	656	605	419	719	1 096	1 508	2 009
Final Consumption	5 596	3 574	2 878	2 348	3 616	2 946	2 271	2 469	2 429	2 753	2 205	3 129	3 130	2 282
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	3 574	2 878	2 348	3 616	2 946	2 271	2 469	2 429	2 753	2 205	3 129	3 130	2 282
Iron and Steel	5 596	3 574	2 878	2 348	3 616	2 946	2 271	2 469	2 429	2 753	2 205	3 129	3 130	2 282
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

304A Coke Oven Gas	1990	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012
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 89: National Energy Balance 1990–2012. Blast Furnace Gas [TJ].

305A Blast Furnace Gas	1990	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012
Indigenous Production	17 094	25 385	25 098	29 309	28 463	29 577	28 902	32 217	33 031	34 556	25 055	32 977	34 593	32 972
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	25 385	25 098	29 309	28 463	29 577	28 902	32 217	33 031	34 556	25 055	32 977	34 593	32 972
Statistical Difference	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Total Transformation Sector	4 822	6 014	7 811	9 181	9 088	11 128	12 095	12 431	13 751	11 941	10 294	14 468	14 980	14 233
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	5 011	7 340	8 395	8 241	10 633	11 292	11 846	13 151	10 887	9 330	13 502	13 724	12 898
Auto Producers for CHP	4 822	1 003	471	786	847	494	802	585	600	1 054	964	966	1 255	1 335
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	15 254	15 077	17 304	17 025	16 175	16 290	18 137	18 200	19 524	13 606	16 857	18 066	17 463
Coal Mines	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Patent Fuel Plants	0	0	0	0	0	0	0	0	0	0	0	0	0	1
Coke Ovens (Energy)	2 391	3 675	3 609	4 251	4 161	4 282	3 647	5 367	4 123	4 420	3 360	4 029	5 012	5 032
Blast Furnaces (Energy)	7 291	11 579	11 468	13 053	12 864	11 894	12 643	12 770	14 077	15 103	10 246	12 829	13 054	12 431
Gas Works (Energy)	0	0	0	0	0	0	0	0	0	0	0	0	0	0
BKB (Transformation)	0	0	0	0	0	0	0	0	0	0	0	0	0	1
Petroleum refineries	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Power Plants	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Non Specified (Energy)	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Distribution Losses	0	0	0	1 111	653	967	517	1 649	1 080	352	0	0	0	0
Final Consumption	2 590	4 117	2 210	1 713	1 696	1 307	0	0	0	2 740	1 155	1 652	1 547	1 275
Total Transport	0	0	0	0	0	0	0	0	0	0	0	0	0	0

305A Blast Furnace Gas	1990	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012
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	4 117	2 210	1 713	1 696	1 307	0	0	0	2 740	1 155	1 652	1 547	1 275
Iron and Steel	2 590	4 117	2 210	1 713	1 696	1 307	0	0	0	2 740	1 155	1 652	1 547	1 275
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 90: National Energy Balance 1990-2012. Crude Oil [1000 tons].

201A Crude Oil	1990	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012
Indigenous Production	1 149	971	957	957	1 113	971	855	863	800	906	910	933	742	840
Refinery Losses	9 031	122	210	72	28	91	94	92	34	97	48	104	105	106
Refinery Intake (Calculated)	7 952	8 240	8 799	8 947	8 819	8 442	8 743	8 472	8 496	8 710	8 286	7 719	8 170	8 349
Refinery Intake (Observed)	7 952	8 240	8 799	8 947	8 819	8 442	8 778	8 513	8 496	8 710	8 286	7 719	8 170	8 349
Refinery Fuel	0	0	0	1	0	0	0	0	0	0	0	0	0	0
Total Imports (Balance)	6 797	7 315	7 940	8 118	7 819	7 562	7 833	7 699	7 591	7 864	7 424	6 765	7 293	7 472
Total Exports (Balance)	0	61	63	0	0	0	0	0	0	0	0	0	0	0
Stock Change (National Territory)	6	16	-36	-128	-114	-91	55	-90	105	-61	-48	20	135	37
Statistical Difference	0	0	0	0	0	0	-35	-41	0	0	0	0	0	0

Table A 91: National Energy Balance 1990-2012. Natural Gas Liquids [1000 tons].

302A Natural Gas Liquids	1990	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012
Indigenous Production	41	101	55	53	92	90	78	88	134	80	130	134	81	79
Refinery Losses	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Refinery Intake (Calculated)	41	107	55	53	92	90	43	47	184	80	130	134	194	123
Refinery Intake (Observed)	41	107	55	53	92	90	43	47	184	80	130	134	194	123
Refinery Fuel	0	0	0	0	0	0	35	41	0	0	0	0	0	0
Total Imports (Balance)	0	6	0	0	0	0	0	0	50	0	0	0	113	44

Total Exports (Balance)	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
Statistical Difference	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Table A 92: National Energy Balance 1990-2012. Refinery Feedstocks [1000 tons].

217A Refinery Feedstocks	**1990**	**2000**	**2001**	**2002**	**2003**	**2004**	**2005**	**2006**	**2007**	**2008**	**2009**	**2010**	**2011**	**2012**
Refinery Losses	0	0	0	0	0	0	-7	-6	-5	-4	-3	-2	-1	0
Refinery Intake (Calculated)	1 069	540	616	440	152	339	526	470	348	406	461	317	505	395
Refinery Intake (Observed)	1 069	540	616	440	152	339	526	470	348	406	461	317	505	395
Refinery Fuel	0	1	56	37	5	45	0	0	0	0	0	0	20	0
Total Imports (Balance)	1 009	627	534	593	374	223	265	497	305	358	481	358	458	143
Total Exports (Balance)	0	125	37	22	72	12	8	0	15	18	2	2	11	0
Stock Change (National Territory)	-26	-10	125	-146	-198	108	72	-27	-31	63	-18	-40	78	-59

Table A 93: National Energy Balance 1990-2012. Residual Fuel Oil [1000 tons].

203X; Residual Fuel Oil	1990	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012
Refinery Gross Output	1 913	979	1 047	1 012	978	1 030	1 045	915	844	738	989	815	822	983
Refinery Fuel	81	37	7	7	25	6	24	4	5	4	38	6	3	155
Total Imports (Balance)	602	262	317	241	328	306	182	199	183	184	109	174	86	59
Total Exports (Balance)	185	152	228	146	55	55	72	58	37	148	296	244	266	217
International Marine Bunkers	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Stock Change (National Territory)	-93	246	352	-17	8	-99	-8	40	-23	8	-10	142	29	15
Gross Inland Deliveries (Obs.)	2 156	1 298	1 481	1 083	1 234	1 176	1 068	1 092	872	779	584	709	477	365
Statistical Difference	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Total Transformation Sector	608	380	472	261	353	366	350	313	219	215	200	226	119	67
Public Electricity	28	109	113	34	114	97	84	95	75	68	42	32	19	2
Public Combined Heat and Power	253	162	189	168	195	194	174	156	96	93	104	143	70	29
Public Heat Plants	99	87	152	45	28	63	81	52	42	49	46	42	27	33
Auto Producers of Electricity	0	5	8	5	6	3	3	3	0	1	0	2	0	1
Auto Producers for CHP	227	15	9	8	8	9	9	7	5	4	8	5	3	2
Auto Producer Heat Plants	1	1	1	1	2	0	0	0	0	0	0	2	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	231	256	154	159	203	234	227	274	224	120	203	133	112
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	231	256	154	159	203	234	227	274	224	120	203	133	112
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	687	753	668	722	607	484	552	379	340	297	280	225	186
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	277	247	215	246	250	263	259	222	215	199	186	186	174
Iron and Steel	19	21	13	8	6	10	15	16	6	28	7	8	8	8
Chemical (incl.Petro-Chemical)	23	11	10	9	11	15	13	11	13	14	26	30	26	26
Non ferrous Metals	4	9	7	7	7	7	6	6	5	5	4	5	6	6
Non metallic Mineral Products	115	51	37	35	39	42	45	46	49	49	47	39	32	27
Transportation Equipment	13	4	5	3	4	4	5	4	4	3	2	2	2	2
Machinery	29	30	27	25	31	32	32	31	24	22	23	23	29	27
Mining and Quarrying	6	12	13	11	13	12	12	11	7	3	4	4	5	5
Food, Beverages and Tobacco	78	38	37	33	42	47	42	42	37	34	33	31	32	34

203X; Residual Fuel Oil	1990	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012
Pulp, Paper and Printing	126	41	43	36	42	30	39	36	31	24	24	18	14	9
Wood and Wood Products	15	9	4	12	13	13	13	12	9	3	4	6	6	6
Construction	32	16	11	10	14	14	16	21	16	14	10	4	10	9
Textiles and Leather	27	12	16	11	9	9	11	9	7	6	6	7	6	5
Non Specified (Industry)	30	23	24	13	15	16	15	15	12	10	9	9	10	10
Total Other Sectors	914	410	506	453	476	357	221	293	157	125	98	94	39	12
Commerce - Public Services	316	117	217	210	198	93	81	165	68	34	48	56	23	3
Residential	471	232	229	193	220	210	111	101	71	72	40	30	13	7
Agriculture	127	60	60	50	57	55	29	26	18	19	10	8	3	2
Non Specified (Others)	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Total Non-Energy Use	116	231	256	154	159	203	234	227	274	224	120	203	133	112

Table A 94: National Energy Balance 1990-2012. Heating and Oher Gas Oil [1000 tons].

204A Heating and Other Gas Oil	1990	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012
Refinery Gross Output	1 239	1 062	1 301	1 062	1 103	928	997	1 004	612	991	835	761	738	688
Refinery Fuel	0	0	0	0	0	0	0	0	0	0	0	0	0	1
Total Imports (Balance)	0	533	626	734	860	805	926	850	743	813	706	673	614	634
Total Exports (Balance)	0	1	3	0	0	17	20	36	10	34	33	14	34	51
International Marine Bunkers	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Stock Change (National Territory)	5	125	-93	-41	-63	75	30	-87	123	-100	-19	12	-22	64
Gross Inland Deliveries (Obs.)	1 244	1 719	1 831	1 755	1 899	1 791	1 933	1 731	1 467	1 669	1 490	1 467	1 296	1 236
Statistical Difference	0	0	0	0	0	0	0	0	0	0	0	0	0	200
Total Transformation Sector	0	0	18	0	4	2	5	6	5	6	6	4	5	5
Public Electricity	0	0	15	0	0	0	1	1	1	1	1	0	1	1
Public Combined Heat and Power	0	0	3	0	1	0	3	1	2	2	1	1	1	1
Public Heat Plants	0	0	0	0	3	2	1	2	1	1	2	1	1	1
Auto Producers of Electricity	0	0	0	0	0	0	0	1	1	1	1	1	1	1
Auto Producers for CHP	0	0	0	0	0	0	0	0	0	0	0	0	1	0
Auto Producer Heat Plants	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Gas Works (Transformation)	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Coke Ovens (Transformation)	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Blast Furnaces (Transformation)	0	0	0	0	0	0	0	0	0	0	0	0	0	0
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	1 719	1 813	1 755	1 895	1 789	1 929	1 725	1 462	1 663	1 484	1 463	1 290	1 231
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

204A Heating and Other Gas Oil	1990	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012
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	38	111	64	93	113	115	107	86	70	71	75	69	70
Iron and Steel	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Chemical (incl.Petro-Chemical)	0	2	6	4	3	2	2	1	1	1	1	1	1	2
Non ferrous Metals	0	2	5	3	1	1	1	1	1	0	0	0	0	0
Non metallic Mineral Products	0	2	5	2	4	5	6	6	6	7	6	6	5	5
Transportation Equipment	0	0	0	0	1	1	1	1	1	1	1	1	1	1
Machinery	0	5	16	9	11	12	13	13	10	7	8	9	8	8
Mining and Quarrying	0	1	4	3	3	3	4	4	3	2	1	1	1	1
Food, Beverages and Tobacco	0	10	32	19	25	29	29	27	24	22	24	26	24	23
Pulp, Paper and Printing	0	1	2	1	1	2	2	2	1	1	1	1	1	1
Wood and Wood Products	0	1	3	2	4	6	7	7	5	1	1	1	1	2
Construction	0	10	30	17	32	44	41	34	26	23	22	23	21	21
Textiles and Leather	0	1	4	2	3	3	4	4	3	2	2	2	2	2
Non Specified (Industry)	0	2	5	3	5	5	6	7	5	3	3	3	3	3
Total Other Sectors	1 243	1 682	1 702	1 690	1 802	1 675	1 813	1 618	1 376	1 593	1 412	1 388	1 221	1 161
Commerce - Public Services	26	264	302	308	437	358	326	292	229	411	272	107	75	23
Residential	1 216	1 416	1 399	1 381	1 364	1 316	1 486	1 325	1 146	1 181	1 140	1 279	1 146	1 137
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 95: National Energy Balance 1990-2012. Diesel [1000 tons].

2050 Diesel	1990	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012
Refinery Gross Output	1 531	2 662	2 658	2 922	2 746	2 601	2 931	2 780	2 976	3 108	3 164	2 741	3 367	3 275
Refinery Fuel	0	0	0	0	4	0	0	0	0	1	0	0	0	0
Total Imports (Balance)	576	2 075	2 433	2 728	3 491	4 078	4 129	4 054	4 273	4 099	3 653	4 282	3 647	3 814
Total Exports (Balance)	3	415	415	520	539	563	889	584	945	1 040	805	858	865	961
International Marine Bunkers	12	18	19	21	17	20	20	18	19	17	15	18	16	16
Stock Change (National Territory)	-7	-59	-8	49	-9	-179	91	-145	-8	-76	-59	46	-96	-81
Gross Inland Deliveries (Obs.)	2 084	4 263	4 668	5 180	5 685	5 936	6 263	6 106	6 297	6 090	5 953	6 210	6 053	6 047
Statistical Difference	13	0	0	0	0	0	0	0	0	0	0	0	0	0
Total Transformation Sector	0	1	1	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

2050 Diesel	1990	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012
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	2 084	4 244	4 649	5 158	5 668	5 915	6 242	6 088	6 278	6 073	5 938	6 192	6 037	6 031
Total Transport	1 753	3 812	4 226	4 739	5 157	5 297	5 639	5 489	5 672	5 453	5 337	5 615	5 449	5 443
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	1 697	3 769	4 183	4 697	5 112	5 251	5 586	5 433	5 616	5 397	5 284	5 562	5 404	5 396
Rail	54	42	42	41	44	44	52	54	54	54	52	52	44	46
Inland Waterways	1	1	1	1	1	2	2	2	2	1	1	1	1	1
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	172	162	157	248	354	338	337	343	358	340	316	328	329
Iron and Steel	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Chemical (incl.Petro-Chemical)	1	1	1	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	1	1	1	0	1	1	1	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	3	3	4	4	5	4	4	4	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	1	1	1	1	1	1	1	1	0	0	1	1	0
Wood and Wood Products	0	1	1	1	1	1	1	1	2	1	1	1	1	1
Construction	77	165	155	151	241	346	331	329	334	350	333	308	320	321
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	260	261	262	263	265	265	263	263	262	261	261	260	259
Commerce - Public Services	9	19	21	23	24	26	28	27	28	27	26	27	27	27
Residential	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Agriculture	241	241	240	240	239	238	237	236	236	235	235	234	233	233
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 1990–2012. Other Kerosene [1000 tons].

206A Other Kerosene	1990	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012
Refinery Gross Output	31	1	1	1	1	1	1	1	1	3	3	3	0	16
Refinery Fuel	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Total Imports (Balance)	14	5	0	3	4	3	3	2	2	2	2	1	1	6
Total Exports (Balance)	21	0	0	0	0	0	0	0	0	0	0	0	0	2
International Marine Bunkers	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Stock Change (National Territory)	-7	0	0	0	0	0	0	0	0	0	0	0	0	0
Gross Inland Deliveries (Obs.)	18	6	1	4	5	4	3	4	3	5	4	4	2	4
Statistical Difference	0	0	0	0	0	0	0	0	0	0	0	0	0	0

206A Other Kerosene	1990	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012
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	2	2	2	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	2	2	2	0	0
Final Consumption	18	6	1	4	5	4	3	4	3	2	2	2	2	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	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

206A Other Kerosene	1990	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012
Total Other Sectors	18	6	1	4	4	4	3	3	3	2	2	1	1	4
Commerce - Public Services	18	6	1	4	4	4	3	3	3	2	2	1	1	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	1

Table A 97: National Energy Balance 1990-2012. Kerosene Type Jet Fuel [1000 tons].

206B Kerosene Type Jet Fuel	1990	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012
Refinery Gross Output	291	544	513	484	446	455	592	526	604	472	313	476	615	616
Refinery Fuel	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Total Imports (Balance)	13	35	37	38	47	132	85	190	159	252	228	193	113	92
Total Exports (Balance)	5	5	1	1	5	4	2	1	1	2	0	0	7	24
International Marine Bunkers	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Stock Change (National Territory)	0	-4	4	-3	4	-4	-22	-32	-38	3	92	12	-3	2
Gross Inland Deliveries (Obs.)	299	569	553	519	491	578	653	683	724	725	633	681	717	687
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	569	553	519	491	578	653	683	724	725	633	681	717	687
Total Transport	299	569	553	519	491	578	653	683	724	725	633	681	717	687
International Civil Aviation	281	538	524	489	461	547	622	650	690	692	601	650	688	657
Domestic Air Transport	18	32	30	30	30	31	32	33	34	33	32	31	29	29
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

206B Kerosene Type Jet Fuel	1990	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012
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 98: National Energy Balance 1990-2012. Gasoline Type Jet Fuel [1000 tons].

207A Gasoline Type Jet Fuel	1990	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012
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	3	4	4	5	7	6	7	5	7	4	4	6	3
Total Exports (Balance)	0	1	1	2	3	3	3	3	3	4	2	2	1	1
International Marine Bunkers	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Stock Change (National Territory)	2	0	-1	0	1	-1	0	-1	0	0	1	0	-1	1
Gross Inland Deliveries (Obs.)	3	2	2	2	3	2	3	3	3	3	3	3	4	3
Statistical Difference	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Total Transformation Sector	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Public Electricity	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Public Combined Heat and Power	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Public Heat Plants	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Auto Producers of Electricity	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Auto Producers for CHP	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Auto Producer Heat Plants	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Gas Works (Transformation)	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Coke Ovens (Transformation)	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Blast Furnaces (Transformation)	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Petrochemical Industry	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Patent Fuel Plants	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Non Specified (Transformation)	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Total Energy Sector	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Coal Mines	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Oil and Gas Extraction	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Coke Ovens (Energy)	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Blast Furnaces (Energy)	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Gas Works (Energy)	0	0	0	0	0	0	0	0	0	0	0	0	0	0

207A Gasoline Type Jet Fuel	1990	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012
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	2	2	2	3	2	3	3	3	3	3	3	4	3
Total Transport	3	2	2	2	3	2	3	3	3	3	3	3	4	3
International Civil Aviation	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Domestic Air Transport	3	2	2	2	3	2	3	3	3	3	3	3	4	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 99: National Energy Balance 1990-2012. Motor Gasoline [1000 tons].

2080 Motor Gasoline	1990	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012
Refinery Gross Output	2 631	1 815	1 922	1 927	1 799	1 756	1 798	1 615	1 704	1 684	1 739	1 519	1 614	1 635
Refinery Fuel	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Total Imports (Balance)	259	670	603	706	879	1 043	1 090	959	883	712	719	796	719	841
Total Exports (Balance)	281	472	582	496	474	614	767	562	646	653	575	598	569	777
International Marine Bunkers	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Stock Change (National Territory)	-55	-32	51	7	-9	-50	-44	-4	28	95	-37	108	-3	39
Gross Inland Deliveries (Obs.)	2 545	1 981	1 994	2 143	2 195	2 135	2 077	2 009	1 968	1 838	1 846	1 825	1 761	1 739
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

2080 Motor Gasoline	1990	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012
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	1 981	1 994	2 143	2 195	2 135	2 077	2 009	1 968	1 838	1 846	1 825	1 761	1 739
Total Transport	2 545	1 981	1 994	2 143	2 195	2 135	2 077	2 009	1 968	1 838	1 846	1 825	1 761	1 739
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	2 542	1 978	1 991	2 140	2 192	2 132	2 074	2 006	1 966	1 835	1 843	1 822	1 758	1 736
Rail	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Inland Waterways	3	3	3	3	3	3	3	3	3	3	3	3	3	3
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 100: National Energy Balance 1990-2012. Lubricants [1000 tons].

219A Lubricants	1990	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012
Refinery Gross Output	31	111	117	100	123	108	111	120	122	135	103	96	72	2
Refinery Fuel	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Total Imports (Balance)	177	57	51	47	44	43	53	53	52	54	45	45	47	102
Total Exports (Balance)	32	58	65	62	80	70	85	91	102	117	91	71	50	46
International Marine Bunkers	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Stock Change (National Territory)	-2	-1	5	2	4	-6	1	-3	2	1	2	-5	1	1
Gross Inland Deliveries (Obs.)	174	108	108	86	92	75	80	79	75	73	59	66	69	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	12	12	9	10	8	9	9	8	8	6	7	7	6
Coal Mines	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Oil and Gas Extraction	1	1	1	0	1	0	0	0	0	0	0	0	0	0
Coke Ovens (Energy)	6	4	4	3	3	2	3	3	2	2	2	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	6	6	5	6	4	5	5	4	4	4	4	4	4
Distribution Losses	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Final Consumption	155	96	96	77	82	67	71	70	67	65	53	59	62	53
Total Transport	71	44	44	36	38	31	32	32	30	29	24	27	28	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	43	43	35	37	30	32	31	30	29	24	26	28	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	1	1	0	0	0	0	0	0	0	0	0
Total Industry	81	50	50	40	42	35	38	37	35	34	28	31	32	28
Iron and Steel	15	9	9	7	7	7	7	7	7	6	5	6	6	5
Chemical (incl.Petro-Chemical)	7	4	4	3	4	3	3	3	3	3	2	3	3	2
Non ferrous Metals	2	2	2	1	1	1	1	1	1	1	1	1	1	1
Non metallic Mineral Products	11	7	7	5	6	5	5	5	5	4	4	4	4	4
Transportation Equipment	2	1	1	1	1	1	1	1	1	1	1	1	1	1
Machinery	3	2	4	3	3	3	3	3	3	3	2	2	3	2
Mining and Quarrying	3	2	2	2	2	1	1	1	1	1	1	1	1	1
Food, Beverages and Tobacco	11	7	7	5	6	5	5	5	5	5	4	4	4	4

219A Lubricants	1990	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012
Pulp, Paper and Printing	9	5	5	4	5	4	4	4	4	4	3	3	3	3
Wood and Wood Products	3	2	2	1	1	1	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	3	3	2	2	2	2	2	2	2	2	2	2	2
Non Specified (Industry)	9	6	4	3	3	2	3	3	2	2	2	2	2	2
Total Other Sectors	3	2	2	2	2	1	2	2	1	1	1	1	1	1
Commerce - Public Services	3	2	2	1	1	1	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	108	108	86	92	75	80	79	75	73	59	66	69	59

Table A 101: National Energy Balance 1990-2012. White Spirit [1000 tons].

220A White Spirit	1990	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012
Refinery Gross Output	0	0	0	0	0	0	0	0	0	0	64	70	65	0
Refinery Fuel	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Total Imports (Balance)	11	7	7	9	11	10	11	13	12	12	13	12	14	15
Total Exports (Balance)	0	0	0	1	0	0	0	0	0	0	70	65	69	0
International Marine Bunkers	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Stock Change (National Territory)	0	1	0	0	0	-1	0	0	0	0	5	-6	3	0
Gross Inland Deliveries (Obs.)	11	7	7	8	10	9	12	12	12	11	12	12	13	15
Statistical Difference	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Total Transformation Sector	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Public Electricity	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Public Combined Heat and Power	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Public Heat Plants	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Auto Producers of Electricity	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Auto Producers for CHP	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Auto Producer Heat Plants	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Gas Works (Transformation)	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Coke Ovens (Transformation)	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Blast Furnaces (Transformation)	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Petrochemical Industry	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Patent Fuel Plants	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Non Specified (Transformation)	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Total Energy Sector	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Coal Mines	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Oil and Gas Extraction	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Coke Ovens (Energy)	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Blast Furnaces (Energy)	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Gas Works (Energy)	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Power Plants	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Non Specified (Energy)	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Distribution Losses	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Final Consumption	11	7	7	8	10	9	12	12	12	11	12	12	13	15
Total Transport	9	0	0	1	2	1	4	5	2	3	4	4	6	7
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	0	0	1	2	1	4	5	2	3	4	4	6	7

220A White Spirit	1990	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012
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	2	7	7	7	8	8	7	8	9	8	7	8	8	8
Iron and Steel	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Chemical (incl.Petro-Chemical)	0	4	5	5	6	4	4	4	4	4	3	3	3	3
Non ferrous Metals	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Non metallic Mineral Products	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Transportation Equipment	1	1	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	1	2	2	2	3	3	3	5	4	4	5	4	5
Textiles and Leather	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Non Specified (Industry)	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Total Other Sectors	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Commerce - Public Services	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Residential	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Agriculture	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Non Specified (Others)	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Total Non-Energy Use	11	4	5	5	6	4	4	4	4	4	3	3	3	3

Table A 102: National Energy Balance 1990-2012. Bitumen [1000 tons].

222A Bitumen	1990	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012
Refinery Gross Output	269	343	402	416	398	433	466	392	411	444	420	292	376	366
Refinery Fuel	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Total Imports (Balance)	292	292	296	248	296	295	335	415	268	272	281	346	291	270
Total Exports (Balance)	1	45	78	62	82	81	147	122	151	215	198	182	209	205
International Marine Bunkers	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Stock Change (National Territory)	-23	-3	-1	-1	1	-2	-3	1	-2	5	-1	-4	1	0
Gross Inland Deliveries (Obs.)	538	587	618	601	613	646	651	685	526	505	502	451	458	431
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

222A Bitumen	1990	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012
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	587	618	601	613	646	651	685	526	505	502	451	458	431
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	587	618	601	613	646	651	685	526	505	502	451	458	431
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	587	618	601	613	646	651	685	526	505	502	451	458	431
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	587	618	601	613	646	651	685	526	505	502	451	458	431

Table A 103: National Energy Balance 1990-2012. Other Oil Products [1000 tons].

224A Other Oil Products	1990	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012
Refinery Gross Output	448	763	826	873	878	885	718	1 035	1 095	978	983	991	867	1 069
Refinery Fuel	114	127	64	97	109	99	99	122	115	106	9	9	5	0
Total Imports (Balance)	126	111	42	43	43	95	97	78	51	54	50	60	44	5
Total Exports (Balance)	4	139	162	168	149	163	111	180	157	161	260	171	154	195
International Marine Bunkers	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Stock Change (National Territory)	-41	-6	17	1	-13	21	-6	22	-13	14	88	35	46	4
Gross Inland Deliveries (Obs.)	416	601	659	652	651	738	599	833	862	779	851	905	798	888
Statistical Difference	0	0	0	0	0	0	0	0	0	0	0	0	0	-5
Total Transformation Sector	73	96	162	157	169	197	155	180	181	154	170	172	191	181

224A Other Oil Products	1990	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012
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	59	29	0	78	105	69	63	59	73	79	37	57	0
Auto Producers for CHP	50	37	133	157	91	92	86	117	122	81	91	135	134	181
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	393	601	659	652	651	738	599	833	862	779	851	905	798	888
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	393	601	659	652	651	738	599	833	862	779	851	905	798	888
Iron and Steel	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Chemical (incl.Petro-Chemical)	393	601	659	652	651	738	599	833	862	779	851	905	751	888
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	47	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	393	601	659	652	651	738	599	833	862	779	851	905	751	888

Table A 104: National Energy Balance 1990-2012. LPG [1000 tons].

303A LPG	1990	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012
Refinery Gross Output	47	34	0	23	87	57	143	91	113	138	137	87	101	67
Refinery Fuel	8	20	0	2	39	3	85	44	66	60	85	28	26	4
Total Imports (Balance)	97	159	140	155	137	132	133	155	129	112	99	114	91	81
Total Exports (Balance)	14	17	4	7	9	17	20	21	21	37	8	11	29	22
International Marine Bunkers	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Stock Change (National Territory)	2	-5	6	-2	-1	5	0	-2	3	-1	0	-1	0	0
Gross Inland Deliveries (Obs.)	125	150	143	168	176	174	172	179	158	152	143	161	137	121
Statistical Difference	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Total Transformation Sector	1	0	0	1	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	1	0	0	0	0	0	0	0	0	0	0
Public Heat Plants	1	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	124	150	143	168	176	174	171	179	158	151	143	161	137	121
Total Transport	9	15	16	21	25	21	21	22	21	22	21	18	17	18
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	15	16	21	25	21	21	22	21	22	21	18	17	18
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	55	48	41	40	29	33	42	36	36	40	67	44	43
Iron and Steel	4	1	0	0	0	0	0	0	0	0	0	0	0	0
Chemical (incl.Petro-Chemical)	0	0	0	0	0	0	1	1	1	1	0	0	0	0
Non ferrous Metals	8	4	4	4	5	4	4	4	4	2	1	1	1	1
Non metallic Mineral Products	12	15	14	10	11	2	3	5	6	8	8	9	8	9
Transportation Equipment	1	1	1	1	3	3	2	2	3	2	1	1	1	1
Machinery	11	14	13	13	10	9	10	12	10	9	10	12	10	10
Mining and Quarrying	1	1	1	1	1	1	1	1	1	1	1	1	1	1
Food, Beverages and Tobacco	3	4	5	3	3	4	5	6	4	3	6	27	7	6

303A LPG	1990	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012
Pulp, Paper and Printing	1	2	1	2	1	1	1	1	0	0	0	1	1	0
Wood and Wood Products	0	1	1	1	1	0	0	0	0	0	2	2	2	2
Construction	23	13	6	5	5	5	6	9	7	10	10	9	10	10
Textiles and Leather	0	0	0	0	0	0	0	1	0	0	0	0	0	0
Non Specified (Industry)	0	0	1	1	1	0	0	0	0	0	0	1	1	1
Total Other Sectors	50	80	80	105	112	124	117	116	101	93	82	76	76	60
Commerce - Public Services	32	24	33	63	75	88	74	73	46	37	39	29	34	29
Residential	16	51	43	39	34	34	40	39	51	52	40	43	39	29
Agriculture	2	5	4	3	3	3	3	3	4	4	3	4	3	2
Non Specified (Others)	0	0	0	0	0	0	0	0	0	0	0	0	0	1
Total Non-Energy Use	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Table A 105: National Energy Balance 1990-2012. Refinery Gas [1000 tons].

308A Refinery Gas	1990	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012
Refinery Gross Output	373	312	328	306	273	293	309	390	417	383	324	392	381	311
Refinery Fuel	373	310	327	306	271	291	308	388	415	381	321	388	378	308
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.)	0	2	1	2	2	2	2	2	2	2	2	4	2	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	0	2	1	2	2	2	2	2	2	2	2	4	2	3
Total Transport	0	0	0	0	0	0	0	0	0	0	0	0	0	0
International Civil Aviation	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Domestic Air Transport	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Road	0	0	0	0	0	0	0	0	0	0	0	0	0	0

308A Refinery Gas	1990	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012
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	2	1	2	2	2	2	2	2	2	2	4	2	3
Iron and Steel	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Chemical (incl.Petro-Chemical)	0	2	1	2	2	2	2	2	2	2	2	4	2	3
Non ferrous Metals	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Non metallic Mineral Products	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Transportation Equipment	0	0	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 106: National Energy Balance 1990-2012. Natural Gas [PJ NCV].

	1990	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012
Indigenous Production	46.4	64.8	62.2	67.5	75.1	71.1	58.8	65.5	66.5	55.1	60.2	62.2	61.0	65.5
Total Imports (Balance)	187.9	222.8	225.6	234.8	292.7	305.7	336.2	368.7	341.6	347.8	398.0	431.0	464.5	487.0
Total Exports (Balance)	0.0	0.6	14.7	24.7	40.8	48.8	36.7	89.2	94.8	68.1	130.0	175.0	128.1	219.1
Stock Change (National Territory)	-15.1	-11.3	19.1	14.0	-7.1	-2.4	-16.6	-24.3	-10.9	-15.2	-15.4	25.7	-71.5	-22.9
Gross Inland Deliveries (Obs.)	219.2	275.7	292.2	291.7	319.9	325.7	341.6	320.7	302.5	319.6	312.8	343.9	326.0	310.4
Statistical Difference	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Transformation Sector	74.7	83.3	80.7	86.9	99.5	97.2	114.2	96.4	90.9	99.9	101.8	114.9	102.0	92.0
Public Electricity	28.1	25.4	28.3	22.1	37.4	34.9	46.2	31.9	24.1	33.0	36.6	34.4	30.1	14.1
Public Combined Heat and Power	23.8	27.7	29.2	37.1	35.5	36.0	38.9	37.6	38.4	36.5	39.3	49.7	43.7	48.2
Public Heat Plants	7.6	9.2	5.8	9.5	7.9	6.5	9.0	8.7	8.9	11.3	8.4	10.1	10.2	10.6
Auto Producers of Electricity	9.6	12.0	7.0	5.6	6.9	9.0	8.9	6.2	7.0	6.7	6.4	8.2	5.6	9.1
Auto Producers for CHP	5.7	8.6	10.3	12.5	11.3	10.5	10.6	11.7	12.1	11.5	10.4	11.9	12.3	9.7
Auto Producer Heat Plants	0.0	0.4	0.2	0.0	0.5	0.4	0.6	0.3	0.5	0.9	0.8	0.5	0.1	0.2
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	11.6	12.4	11.6	16.3	18.4	17.6	16.9	14.7	15.4	9.9	13.7	14.2	15.2
Coal Mines	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Oil and Gas Extraction	6.6	5.2	5.6	5.8	10.2	13.4	12.1	11.2	9.5	9.0	8.7	7.9	8.3	8.6
Inputs to Oil Refineries	6.8	6.4	6.8	5.8	6.1	5.0	5.5	5.7	5.2	6.4	1.1	5.8	5.9	6.7
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	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1
Final Consumption	113.5	167.5	189.1	182.8	192.3	197.4	196.5	194.0	184.8	191.4	186.7	199.5	195.8	189.9
Total Transport	4.1	6.1	9.0	5.0	6.7	6.7	6.5	8.5	8.1	10.4	7.8	6.0	7.5	7.4
Road	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.1	0.2	0.3	0.3	0.3
Pipeline Transport	4.1	6.1	9.0	5.0	6.7	6.7	6.5	8.5	8.1	10.3	7.6	5.7	7.2	7.1
Non Specified (Transport)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Industry	69.0	88.4	91.6	95.9	96.8	96.2	103.3	99.3	98.4	101.5	98.1	105.7	109.8	108.6
Iron and Steel	10.5	13.6	14.0	13.9	14.1	16.1	17.0	16.6	15.6	14.7	14.8	15.9	20.2	21.3
Chemical (incl.Petro-Chemical)	7.7	14.4	13.8	13.5	13.7	12.8	16.5	13.4	13.8	15.7	13.5	13.8	14.1	14.1
Non ferrous Metals	1.4	2.3	2.6	2.7	2.8	3.0	3.1	3.2	3.8	3.9	3.6	3.8	4.1	3.9
Non metallic Mineral Products	10.1	11.6	12.0	13.6	14.0	14.8	15.7	13.7	13.8	13.6	12.7	13.5	14.0	13.1
Transportation Equipment	1.5	1.3	1.5	1.2	1.7	2.3	2.2	2.3	2.1	1.7	1.5	1.9	1.9	2.0
Machinery	4.3	4.8	5.1	4.8	5.4	5.8	6.6	7.0	6.9	6.9	7.8	8.8	8.8	8.8
Mining and Quarrying	2.6	2.3	2.6	2.8	2.6	2.7	1.6	2.8	2.9	3.0	1.6	2.0	2.2	2.0
Food, Beverages and Tobacco	8.9	11.4	11.0	15.1	11.6	11.0	11.5	11.4	10.9	11.3	11.3	12.4	12.3	12.8
Pulp, Paper and Printing	12.9	19.5	21.0	20.5	23.5	20.9	20.5	20.2	20.1	21.7	22.6	25.1	24.2	22.7
Wood and Wood Products	1.7	1.7	1.9	1.9	2.1	1.8	3.3	2.9	2.9	3.4	3.0	2.9	2.6	2.5
Construction	0.7	1.4	1.8	1.8	1.6	1.4	1.6	2.0	1.7	1.6	1.8	1.8	1.8	1.8

Textiles and Leather	3.5	2.9	2.9	2.6	2.2	2.0	2.1	2.0	2.1	2.0	1.8	1.8	1.7	1.7
Non Specified (Industry)	3.1	1.2	1.3	1.4	1.5	1.7	1.6	1.7	1.8	1.8	1.8	2.0	2.0	1.9
Total Other Sectors	40.4	73.0	88.6	81.9	88.8	94.5	86.7	86.2	78.2	79.5	80.9	87.8	78.6	73.9
Commerce - Public Services	6.7	25.0	34.9	31.7	35.8	42.8	32.3	33.9	29.2	29.8	29.4	31.1	27.2	21.9
Residential	33.3	47.5	53.1	49.7	52.5	51.2	53.8	51.7	48.4	49.1	50.9	56.0	50.9	51.5
Agriculture	0.4	0.5	0.6	0.6	0.6	0.6	0.6	0.6	0.5	0.6	0.6	0.6	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	13.3	9.9	10.3	11.6	12.5	13.2	13.4	12.0	12.9	14.3	15.8	13.9	13.2

Renewable Fuels

Table A 107: National Energy Balance 1990-2012. Fuel Wood [PJ].

111A Fuel Wood	**1990**	**2000**	**2001**	**2002**	**2003**	**2004**	**2005**	**2006**	**2007**	**2008**	**2009**	**2010**	**2011**	**2012**
Indigenous Production	61.40	58.63	61.58	57.40	55.78	53.50	60.35	56.03	55.13	56.86	51.16	57.04	46.89	52.52
Total Imports (Balance)	2.30	1.80	1.80	2.10	2.53	3.31	3.51	4.19	3.36	3.44	7.26	7.87	10.63	9.41
Total Exports (Balance)	0.04	0.18	0.18	0.38	0.93	1.32	0.84	0.69	0.57	0.50	0.99	0.97	0.83	0.74
Stock Change (National Territory)	-0.55	0.00	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	60.25	63.21	59.13	57.38	55.49	63.01	59.53	57.91	59.80	57.44	63.94	56.69	61.20
Statistical Difference	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Total Transformation Sector	0.00	0.08	0.08	0.07	0.09	0.15	0.14	0.12	0.11	0.13	0.15	0.14	0.13	0.16
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	0.05	0.05	0.02	0.02	0.03	0.05	0.05	0.04	0.05
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	60.17	63.13	59.05	57.28	55.34	62.88	59.42	57.80	59.67	57.28	63.79	56.56	61.04
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	0.95	1.15	1.42	1.42	1.56	1.14	1.04	1.72	1.75	1.30	1.20	1.05	0.58
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	0.01	0.01	0.07	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	0.05	0.00	0.00	0.00	0.01	0.01	0.02	0.02	0.01	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

111A Fuel Wood	1990	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012
Machinery	0.05	0.03	0.03	0.03	0.05	0.07	0.06	0.06	0.04	0.02	0.08	0.10	0.07	0.08
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	0.02	0.02	0.02	0.05	0.07	0.05	0.04	0.03	0.03	0.04	0.05	0.05	0.05
Pulp, Paper and Printing	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.67	0.55	0.50	0.00
Wood and Wood Products	0.23	0.71	0.86	1.15	0.86	0.78	0.37	0.32	1.16	1.35	0.21	0.37	0.32	0.34
Construction	0.00	0.11	0.13	0.13	0.20	0.25	0.27	0.29	0.28	0.27	0.18	0.09	0.08	0.08
Textiles and Leather	0.02	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.01	0.01
Non Specified (Industry)	0.19	0.08	0.10	0.09	0.24	0.37	0.36	0.31	0.18	0.06	0.05	0.02	0.02	0.02
Total Other Sectors	62.45	59.22	61.98	57.63	55.87	53.78	61.74	58.38	56.09	57.92	55.98	62.59	55.51	60.46
Commerce - Public Services	1.33	0.34	0.49	0.48	0.48	0.53	0.59	0.64	0.70	0.75	0.74	0.83	0.72	0.77
Residential	57.50	55.38	57.84	53.76	52.11	50.09	57.52	54.31	52.11	53.78	51.97	58.10	51.54	56.15
Agriculture	3.63	3.49	3.65	3.39	3.28	3.16	3.63	3.42	3.28	3.39	3.28	3.66	3.25	3.54
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 1990-2012. Wood Waste [PJ].

116A Wood waste; Other	1990	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012
Indigenous Production	14.61	20.25	36.43	42.14	38.41	47.70	52.04	65.11	56.68	76.95	88.47	87.24	106.59	109.12
Total Imports (Balance)	2.14	2.49	3.14	4.09	4.47	4.24	7.48	7.36	17.51	14.98	11.79	11.87	12.86	13.47
Total Exports (Balance)	2.08	2.62	6.51	7.98	6.86	10.41	16.91	13.84	12.41	13.17	13.32	9.72	12.98	12.28
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	-5.28
Gross Inland Deliveries (Obs.)	14.67	20.12	33.06	38.26	36.03	41.53	42.60	58.63	61.78	78.75	86.93	89.39	106.47	105.02
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	3.19	10.12	12.50	14.33	15.36	16.52	18.15	23.95	29.13	39.76	46.51	49.24	61.73	62.49
Public Electricity	0.00	0.00	0.01	1.36	1.15	1.36	1.93	2.86	5.67	7.86	7.76	10.07	9.46	10.33
Public Combined Heat and Power	0.00	0.00	0.35	0.74	1.07	1.45	2.96	7.35	8.47	12.56	17.44	16.97	21.47	20.81
Public Heat Plants	1.63	3.98	7.59	8.87	10.75	10.90	9.94	9.80	10.52	12.43	14.21	15.76	23.86	22.62
Auto Producers of Electricity	0.00	0.19	1.51	1.32	1.00	0.86	1.27	1.32	1.10	2.76	2.95	2.78	3.01	4.78
Auto Producers for CHP	1.56	5.95	2.96	1.83	1.26	1.76	1.96	2.60	3.36	4.16	4.15	3.66	3.85	3.88
Auto Producer Heat Plants	0.00	0.00	0.08	0.21	0.13	0.19	0.09	0.02	0.00	0.00	0.00	0.00	0.08	0.07
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	20.56	23.93	20.67	25.00	24.45	34.69	32.65	38.99	40.42	40.15	44.74	42.53
Total Transport	0.08	0.23	0.61	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	9.43	6.89	11.62	14.02	10.72	13.19	12.02	20.54	19.35	23.39	24.59	22.62	24.86	24.14
Iron and Steel	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.00	0.00	0.00
Chemical (incl.Petro-Chemical)	2.90	1.72	2.52	1.07	0.97	1.35	1.13	1.46	1.37	1.91	1.72	1.30	1.84	1.82
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	0.01	0.07	0.07	2.12	2.49	2.71	3.67	2.94	2.78	5.72
Transportation Equipment	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.02	0.02	0.03	0.01	0.01	0.02
Machinery	0.00	0.00	0.05	0.14	0.15	0.24	0.32	0.24	0.22	0.33	0.50	0.82	1.12	1.14
Mining and Quarrying	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.00	0.01	0.00	0.00	0.02	0.03	0.03
Food, Beverages and Tobacco	0.01	0.01	0.21	0.24	0.23	0.16	0.08	0.07	0.40	0.43	0.22	0.29	0.39	0.38

116A Wood waste; Other	1990	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012
Pulp, Paper and Printing	3.66	3.90	1.95	5.91	3.11	4.08	3.05	7.52	5.42	5.73	5.17	3.62	3.66	2.63
Wood and Wood Products	2.76	1.16	6.00	5.52	5.24	5.99	5.78	8.16	8.03	9.76	11.36	11.23	12.22	9.89
Construction	0.04	0.03	0.36	0.41	0.40	0.56	0.80	0.48	0.45	1.50	0.76	0.93	1.13	1.05
Textiles and Leather	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.00	0.01	0.01	0.00	0.02	0.03	0.02
Non Specified (Industry)	0.07	0.07	0.52	0.73	0.62	0.73	0.78	0.47	0.92	0.98	1.15	1.44	1.64	1.45
Total Other Sectors	1.98	2.87	8.33	9.90	9.95	11.82	12.43	14.15	13.30	15.61	15.83	17.53	19.88	18.39
Commerce - Public Services	0.64	0.60	2.27	2.23	2.20	2.65	3.02	2.73	2.43	2.33	1.95	1.86	2.33	2.09
Residential	0.77	1.40	4.50	5.73	5.78	6.79	6.54	7.93	7.56	9.29	9.68	11.01	12.30	11.65
Agriculture	0.57	0.87	1.57	1.95	1.97	2.38	2.87	3.48	3.31	4.00	4.20	4.67	5.25	4.65
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 1990-2012. Black Liquor [PJ].

215A Black Liquor	1990	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012
Indigenous Production	17.80	24.06	23.24	22.72	22.92	24.24	24.38	24.68	25.07	25.78	24.93	28.08	28.51	30.39
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	24.06	23.24	22.72	22.92	24.24	24.38	24.68	25.07	25.78	24.93	28.08	28.51	30.39
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	7.62	7.46	8.10	7.81	7.83	8.78	7.30	6.32	7.24	7.41	7.26	8.04	9.81
Public Electricity	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
Public Combined Heat and Power	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
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	2.00	1.23	2.34	2.36	1.99	2.42	0.79	0.35	0.66	0.40	0.42	0.42	1.91
Auto Producers for CHP	2.64	5.62	6.21	5.76	5.45	5.84	6.36	6.51	5.96	6.58	7.01	6.85	7.62	7.90
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	16.44	15.78	14.62	15.11	16.41	15.61	17.38	18.75	18.54	17.52	20.82	20.48	20.57
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	16.44	15.78	14.62	15.11	16.41	15.61	17.38	18.75	18.54	17.52	20.82	20.48	20.57
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

215A Black Liquor	1990	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012
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	16.44	15.78	14.62	15.11	16.41	15.61	17.38	18.75	18.54	17.52	20.82	20.48	20.57
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 1990-2012. Biogas [TJ].

309A Biogas	1990	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012
Indigenous Production	0.00	0.36	0.29	0.35	0.51	0.48	3.48	5.85	5.34	6.03	5.44	5.31	6.04	7.77
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	0.36	0.29	0.35	0.51	0.48	3.48	5.85	5.34	6.03	5.44	5.31	6.04	7.77
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	0.22	0.20	0.19	0.38	0.28	2.98	5.54	4.96	5.60	5.02	4.98	5.29	6.48
Public Electricity	0.00	0.00	0.00	0.00	0.17	0.08	2.46	4.69	4.25	4.83	4.45	4.37	4.65	5.91
Public Combined Heat and Power	0.00	0.00	0.00	0.00	0.02	0.09	0.20	0.28	0.31	0.29	0.28	0.33	0.33	0.28
Public Heat Plants	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.10	0.14	0.25	0.07	0.08	0.07	0.08
Auto Producers of Electricity	0.00	0.12	0.08	0.11	0.13	0.04	0.14	0.36	0.12	0.11	0.09	0.06	0.07	0.05
Auto Producers for CHP	0.00	0.10	0.11	0.09	0.06	0.07	0.18	0.10	0.14	0.13	0.13	0.13	0.18	0.16
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	0.15	0.10	0.16	0.13	0.21	0.50	0.31	0.38	0.43	0.42	0.33	0.75	1.28
Total Transport	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Rail	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Inland Waterways	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Non Specified (Transport)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Total Industry	0.00	0.15	0.10	0.16	0.13	0.21	0.50	0.31	0.38	0.42	0.40	0.30	0.70	1.21
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	0.02
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	0.01
Non ferrous Metals	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Non metallic Mineral Products	0.00	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
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

309A Biogas	1990	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012
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	0.29	0.28
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	0.02	0.03	0.08	0.10	0.13	0.17	0.21	0.23	0.08	0.14	0.57
Pulp, Paper and Printing	0.00	0.12	0.10	0.14	0.11	0.12	0.25	0.10	0.08	0.08	0.15	0.20	0.19	0.28
Wood and Wood Products	0.00	0.03	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	0.15	0.09	0.13	0.12	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	0.01	0.01	0.01	0.03	0.01
Total Other Sectors	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.02	0.03	0.05	0.07
Commerce - Public Services	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.02	0.03	0.04
Residential	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.01	0.03	0.03
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 1990-2012. Sewage Sludge Gas [PJ].

309B Sewage sludge gas	1990	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012
Indigenous Production	0.00	0.47	0.36	0.21	0.25	0.23	1.04	0.63	0.90	0.92	0.80	0.93	0.86	0.76
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	0.47	0.36	0.21	0.25	0.23	1.04	0.63	0.90	0.92	0.80	0.93	0.86	0.76
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	0.11	0.07	0.04	0.07	0.08	0.75	0.36	0.58	0.68	0.54	0.59	0.54	0.40
Public Electricity	0.00	0.08	0.04	0.04	0.03	0.04	0.65	0.25	0.47	0.56	0.46	0.28	0.28	0.17
Public Combined Heat and Power	0.00	0.00	0.00	0.00	0.00	0.00	0.04	0.04	0.04	0.04	0.04	0.04	0.05	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	0.03	0.03	0.00	0.01	0.01	0.01	0.03	0.02	0.01	0.01	0.22	0.15	0.13
Auto Producers for CHP	0.00	0.00	0.00	0.00	0.02	0.02	0.05	0.05	0.05	0.06	0.03	0.05	0.06	0.10
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	0.36	0.30	0.17	0.19	0.15	0.29	0.27	0.33	0.24	0.26	0.34	0.32	0.36
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	0.36	0.30	0.17	0.19	0.15	0.29	0.27	0.33	0.24	0.26	0.34	0.32	0.36
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	0.36	0.30	0.17	0.19	0.15	0.29	0.27	0.33	0.24	0.26	0.34	0.32	0.36
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

309B Sewage sludge gas	1990	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012
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 1990-2012. Landfill Gas [PJ].

310A Landfill Gas	1990	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012
Indigenous Production	0.00	0.44	0.48	0.36	0.33	0.49	0.23	0.20	0.20	0.20	0.21	0.21	0.18	0.16
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	0.44	0.48	0.36	0.33	0.49	0.23	0.20	0.20	0.20	0.21	0.21	0.18	0.16
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	0.44	0.48	0.36	0.33	0.49	0.23	0.20	0.20	0.20	0.21	0.21	0.18	0.16
Public Electricity	0.00	0.01	0.07	0.06	0.07	0.05	0.04	0.04	0.05	0.05	0.08	0.14	0.10	0.10
Public Combined Heat and Power	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Public Heat Plants	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Auto Producers of Electricity	0.00	0.43	0.41	0.30	0.27	0.43	0.19	0.17	0.15	0.15	0.12	0.07	0.07	0.06
Auto Producers for CHP	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
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

310A Landfill Gas	1990	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012
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 113: National Energy Balance 1990-2012. Municipal Solid Waste [PJ].

114B Municipal Solid Waste	1990	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012
Indigenous Production	2.41	4.64	4.65	5.03	5.88	8.39	8.88	11.44	10.92	11.25	13.54	14.11	15.46	15.56
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	4.64	4.65	5.03	5.88	8.39	8.88	11.44	10.92	11.25	13.54	14.11	15.46	15.56
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	2.41	4.64	4.65	5.03	5.88	8.39	8.88	11.44	10.92	11.25	13.54	14.11	15.46	15.56
Public Electricity	0.00	0.72	0.67	0.69	1.58	2.91	2.19	2.39	2.60	2.24	2.95	2.82	3.77	4.25
Public Combined Heat and Power	1.72	2.23	2.20	2.37	2.50	3.38	3.14	3.15	2.94	3.52	4.72	5.09	3.17	2.44
Public Heat Plants	0.69	1.69	1.78	1.96	1.81	1.89	1.97	1.88	1.95	2.05	1.86	1.87	2.04	2.25
Auto Producers of Electricity	0.00	0.00	0.00	0.00	0.00	0.07	1.46	3.90	3.33	3.33	3.91	4.22	3.38	3.45
Auto Producers for CHP	0.00	0.00	0.00	0.00	0.00	0.14	0.10	0.11	0.10	0.10	0.11	0.11	3.10	3.16
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

114B Municipal Solid Waste	1990	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012
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 114: National Energy Balance 1990-2012. Industrial Waste [PJ].

115A Industrial Waste	1990	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012
Indigenous Production	6.58	7.63	9.84	11.74	13.52	16.17	14.09	14.87	15.48	20.61	18.90	18.89	20.46	19.03
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	7.63	9.84	11.74	13.52	16.17	14.09	14.87	15.48	20.61	18.90	18.89	20.46	19.03
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	1.45	1.58	2.67	2.82	3.06	2.50	2.80	3.13	3.42	4.56	5.07	6.11	7.15
Public Electricity	0.00	0.00	0.06	1.04	1.16	0.95	0.62	0.69	0.51	0.42	0.51	0.51	1.21	1.33
Public Combined Heat and Power	0.00	0.00	0.88	0.70	0.82	0.75	0.72	0.79	0.92	0.82	0.74	0.92	0.79	1.60
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	0.08	0.04
Auto Producers of Electricity	0.00	0.44	0.10	0.14	0.14	0.26	0.25	0.30	0.70	0.75	1.43	1.83	1.86	1.85
Auto Producers for CHP	2.54	1.02	0.54	0.79	0.70	1.10	0.91	1.02	1.00	1.43	1.88	1.81	1.57	1.82
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	0.60	0.52
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	6.17	8.26	9.07	10.71	13.11	11.59	12.07	12.35	17.19	14.34	13.82	14.35	11.88
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

115A Industrial Waste	1990	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012
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	5.61	7.64	8.45	10.06	12.59	11.19	11.80	12.20	17.17	14.32	13.77	14.33	11.86
Iron and Steel	0.00	0.00	0.00	0.00	0.00	0.00	0.22	0.82	1.64	3.64	0.60	1.31	0.78	0.91
Chemical (incl.Petro-Chemical)	1.57	1.64	2.23	3.28	5.09	6.06	6.99	6.42	3.71	5.78	4.61	5.09	5.42	4.80
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	3.56	4.55	4.56	4.15	5.34	3.47	4.14	5.76	6.46	8.12	6.55	7.10	5.25
Transportation Equipment	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Machinery	0.00	0.00	0.00	0.00	0.01	0.01	0.03	0.01	0.06	0.04	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	0.11	0.09	0.16	0.17	0.04	0.04	0.13	0.04	0.08	0.09	0.11	0.08
Wood and Wood Products	0.04	0.37	0.69	0.46	0.58	0.94	0.36	0.29	0.63	1.05	0.89	0.69	0.89	0.78
Construction	0.00	0.02	0.02	0.02	0.02	0.03	0.03	0.03	0.04	0.07	0.02	0.04	0.02	0.02
Textiles and Leather	0.00	0.00	0.01	0.01	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Non Specified (Industry)	0.01	0.02	0.03	0.03	0.04	0.04	0.05	0.05	0.23	0.08	0.00	0.00	0.00	0.01
Total Other Sectors	1.11	0.56	0.63	0.62	0.65	0.52	0.40	0.27	0.15	0.02	0.02	0.06	0.02	0.02
Commerce - Public Services	1.11	0.56	0.63	0.62	0.65	0.52	0.40	0.27	0.15	0.02	0.02	0.06	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
on 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 115: Net calorific values for 1990-2011 in [MJ/kg], [MJ/m³] taken from (IEA JQ 2012).

Fuel Code	Fuel Name		1990	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012
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	27.99	27.99	27.50	27.50	28.41	28.14	28.07	27.92	28.46	28.08	27.00	27.36	27.33
		T	28.00	26.74	27.72	27.37	27.43	28.42	27.92	27.78	27.79	27.97	27.99	26.90	27.29	27.24
104A	Hard Coal Briquettes	A	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	31.00
105A	Brown Coal	FC	10.90	14.71	15.15	15.79	17.06	14.49	15.99	20.64	21.93	20.76	17.17	17.18	17.72	19.35
		T	10.90	9.86	10.08	9.74	9.48	9.29	9.09	9.48	21.93	20.76	0.00	0.00	0.00	0.00
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	19.31	19.31	19.31	19.31
107A	Coke Oven Coke	T	28.50	29.00	29.00	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	8.30	8.30	8.30	8.80	8.80	8.80
304A	Coke Oven Gas	P	17.90	17.90	17.90	17.60	17.90	17.90	16.11	15.83	15.62	16.58	18.04	21.12	20.75	19.89
305A	Blast Furnace Gas	P	3.10	4.10	4.10	4.27	3.70	3.69	3.65	3.79	3.99	4.13	3.87	4.03	4.04	3.81
110A	Petrol Coke	A	34.30	33.92	33.92	31.33	31.33	31.33	32.11	32.58	33.03	34.16	34.59	34.88	34.97	35.20
201A	Crude Oil	A	42.50	42.52	42.50	42.50	42.52	42.52	42.51	42.74	42.52	42.71	42.77	42.79	42.71	42.50
203X	Residual Fuel Oil	A	41.00	41.49	42.13	41.45	41.42	41.41	41.72	41.17	41.63	41.56	41.08	41.22	40.60	40.36
204A	Gasoil	A	42.60	42.80	42.82	42.80	42.80	42.80	42.80	42.80	42.70	42.80	42.85	42.90	42.89	42.81
2050	Diesel	A	42.60	42.80	42.80	42.80	42.80	42.80	42.75	42.52	42.48	42.48	42.38	42.37	42.08	42.08
206A	Petroleum	A	43.60	43.30	43.30	43.30	43.30	43.30	43.30	43.30	43.30	43.30	43.30	43.36	43.36	43.34
206B	Kerosene	A	43.60	43.30	43.30	43.30	43.30	43.30	43.30	43.30	43.30	43.30	43.30	43.36	43.36	43.34
207A	Aviation Gasoline	A	42.50	42.50	42.51	42.49	42.49	42.48	42.49	43.21	43.18	43.16	42.12	42.35	42.36	41.34
2080	Motor Gasoline	A	42.50	42.50	42.51	42.49	42.49	42.48	42.49	43.21	43.18	43.16	42.12	42.35	42.36	41.34
217A	Refinery Feedstocks	A	41.87	42.56	42.65	42.77	42.05	42.91	42.39	42.51	42.39	42.97	42.36	42.61	42.49	42.57
219A	Lubricants	A	41.40	41.80	41.80	41.80	41.80	41.80	41.80	41.80	41.80	41.80	41.80	41.80	41.80	41.81
220A	White Spirit	A	41.60	42.50	42.51	42.49	42.49	42.48	42.49	43.21	43.18	43.16	42.12	42.35	42.36	41.34
222A	Bitumen	A	41.80	43.62	43.91	44.15	43.95	43.15	43.34	43.78	44.15	44.84	44.53	44.06	45.00	44.30
224A	Other Petroleum Products	FC	34.30	33.92	33.92	31.33	31.33	31.33	32.11	32.58	33.03	34.16	34.59	34.88	34.97	35.20
		NE	41.80	43.62	43.91	44.15	43.95	43.15	43.34	43.78	44.15	44.84	44.53	44.06	45.00	44.30
302A	NGL	A	42.50	42.52	42.50	42.50	42.52	42.52	42.51	42.74	42.52	42.71	42.77	42.79	42.71	42.50
303A	LPG	A	46.30	46.00	46.00	46.00	46.00	46.00	46.00	46.00	46.00	46.00	46.00	46.00	46.00	46.12
308A	Refinery Gas	A	49.00	37.18	25.65	35.14	31.09	36.00	30.68	30.68	30.68	30.68	30.68	30.68	32.00	32.00
301A	Natural Gas	A	36.00	35.85	35.85	35.85	35.85	36.23	36.00	36.00	36.00	36.00	36.09	36.26	36.26	36.26

Legend: A…Average; T…Transformation; FC…Final Consumption; P…Production; NE…Non Energy use; NGL…Natural Gas Liquids; LPG…Liquified Petroleum Gas

Table A 116 presents the net calorific values from STATISTIK AUSTRIA, which are used for default unit conversion.

Table A 116: 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 117 presents the IPCC default values of net calorific values of gaseous biofuels which are used for default unit conversion.

Table A 117: Default net calorific values from IPCC Guidelines.

Fuel Name	NCV	Unit
Sewage Sludge Gas	27.00	MJ/m^3

ANNEX 5: RECALCULATIONS

This Annex presents the implication of recalculations for emission levels by category for CO_2, CH_4, N_2O and FCs and the recalculation differences of national total emissions by gas.

Table A 118: IPCC codes and names of categories

Category	Name	Category	Name
Total	National Total without LULUCF	3	SOLVENT AND OTHER PRODUCT USE
1	ENERGY	3.A	PAINT APPLICATION
1.A.1	Energy Industries	3.B	DEGREASING AND DRY CLEANING
1.A.2	Manufacturing Industries and Construction	3.C	CHEMICAL PRODUCTS, MANUFACTURE AND PROCESSING
1.A.3	Transport	3.D.5	Other Solvent Use
1.A.4	Other Sectors	4	AGRICULTURE
1.A.5	Other	4.A.1	Cattle
1.B	Fugitive Emissions From Fuels	4.A.9	Poultry
2	INDUSTRIAL PROCESSES	4.B.1	Cattle
2.A.3	Limestone and Dolomite Use	4.F	FIELD BURNING OF AGRICULTURAL RESIDUES
2.A.4	Soda Ash Production and use	5	LAND USE, LAND USE CHANGE AND FORESTRY
2.A.7.c	Glass Production	6	WASTE
2.B.1	Ammonia Production	6.B.1	Industrial Wastewater
2.B.5	Other	6.B.2	Domestic and Commercial Wastewater
2.C.1	Iron and Steel Production	6.D.2	Compost production
2.C.2	Ferroalloys Production	-	-

Recalculation of CO_2 Emissions by Categories

Explanations are provided in Chapter 9 Recalculations and Improvements and in the sector specific chapters of this report.

Table A 119: Recalculation Difference of CO_2 Emissions 1990-1999.

IPCC Cat.	CO_2 [Gg] Differences with respect to Submission 2013									
	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999
Total	-41.84	-41.79	-38.12	-33.96	-22.67	-19.93	-18.44	-17.53	-19.02	-1.68
1	0.00	0.01	0.01	-0.03	-0.03	-0.01	0.01	0.05	0.04	18.37
1.A.1	0.00	0.00	0.00	0.00	-	-	0.00	-	-	0.00
1.A.2	0.00	0.01	0.00	-0.01	-0.02	0.00	0.00	0.02	0.02	11.35
1.A.3	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
1.A.4	0.00	0.01	0.01	-0.02	-0.02	-0.01	0.01	0.03	0.02	7.01
1.A.5	-	-	-	-	-	-	-	0.00	-	-
1.B	-	-	-	-	-	-	-	-	-	-
2	-41.84	-41.80	-38.13	-33.93	-22.63	-19.92	-18.45	-17.58	-19.06	-20.05
2.A.2	-	-	-	-	-	-	-	-	-	-
2.C.1	-	-	-	-	-	-	-	-	-	-
2.C.2	-	-	-	-	-	-	-	-	-	-
2.B.1	-41.84	-41.80	-38.13	-33.93	-22.63	-19.92	-18.45	-17.58	-19.06	-20.05
3	0.00	-	-	-	-	-	-	-	-	-
4	-	-	-	-	-	-	-	-	-	-
5	69.99	64.95	60.00	49.14	-15.97	35.50	-44.38	-121.47	-198.46	-240.44
6	-	-	-	-	-	-	-	-	-	-

Table A 120: Recalculation Difference of CO_2 Emissions 2000-2011.

IPCC Cat.	CO_2 [Gg] Differences with respect to Submission 2013											
	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011
Total	23.18	29.95	33.63	42.75	13.33	-330.74	-399.42	-294.55	-117.26	170.81	-224.69	-101.79
1	44.13	50.06	61.40	72.23	43.76	-306.38	-356.66	-274.03	-91.45	187.28	-198.26	19.80
1.A.1	0.00	0.00	0.00	0.00	0.00	-51.57	-84.25	-48.65	-40.99	-141.93	-158.47	-137.91
1.A.2	29.44	31.37	44.66	51.75	33.39	-202.66	-219.41	-176.91	0.00	-111.06	481.59	726.03
1.A.3	0.00	0.00	0.00	0.00	0.00	-3.65	-4.76	-4.48	-5.74	7.41	-13.29	-12.78
1.A.4	14.70	18.70	16.74	20.48	10.38	-48.50	-48.24	-43.99	-44.73	432.87	-508.09	-555.54
1.A.5	-	-	-	-	-	-	-	-	-	0.00	0.00	0.00
1.B	-	-	-	-	-	-	-	-	-	-	-	-
2	-20.96	-20.12	-27.76	-29.49	-30.44	-24.35	-42.77	-20.51	-25.80	-16.47	-26.43	-121.62
2.A.2	-	-	-3.78	-5.01	-5.99	-	-16.03	-	-	-	-	-
2.C.1	-	-	-	-	-	-	-	-	-	-	-	-95.47
2.C.2	-	-	-	-	-	-	-	-	-	-	-	-
2.B.1	-20.96	-20.12	-23.98	-24.48	-24.44	-24.35	-26.74	-20.51	-25.80	-16.47	-26.43	-26.15
3	-	0.00	-	-	-	-	-	-	-	-	-	0.03
4	-	-	-	-	-	-	-	-	-	-	-	-
5	-281.54	-323.44	-199.23	-233.07	-234.62	-311.58	-304.77	-309.04	-318.65	-340.64	-350.60	-354.64
6	-	-	-	-	-	-	-	-	-	-	-	-

Recalculation of CH_4 Emissions by Categories

Explanations are provided in Chapter 9 Recalculations and Improvements and in the sector specific chapters of this report.

Table A 121: Recalculation Difference of CH_4 Emissions 1990-1999.

IPCC Cat.	CH_4 [Gg] Differences with respect to Submission 2013									
	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999
Total	1.33	1.76	1.74	1.81	1.42	1.63	1.49	1.21	1.68	2.36
1	1.33	1.76	1.74	1.81	1.41	1.62	1.48	1.20	1.67	2.33
1.A.1	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.04
1.A.2	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
1.A.3	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
1.A.4	0.04	0.05	0.05	0.06	0.04	0.06	0.06	0.06	0.10	0.06
1.B	1.24	1.66	1.64	1.70	1.32	1.51	1.38	1.10	1.52	2.24
1.B.1	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03
1.B.2	1.21	1.63	1.61	1.67	1.29	1.48	1.35	1.07	1.49	2.21
2	-	-	-	-	-	-	-	-	-	-
3	-	-	-	-	-	-	-	-	-	-
4.	0.00	0.00	0.00	0.00	0.00	0.01	0.01	0.01	0.02	0.03
4.B	0.00	0.00	0.00	0.00	0.00	0.01	0.01	0.01	0.02	0.03
5	-	-	-	-	-	-	-	-	-	-
6.	-	-	-	-	-	-	-	-	-	-
6.A	-	-	-	-	-	-	-	-	-	-
6.B	-	-	-	-	-	-	-	-	-	-
6.D	-	-	-	-	-	-	-	-	-	-

Table A 122: Recalculation Difference of CH_4 Emissions 2000-2011.

IPCC Cat.	CH_4 [Gg] Differences with respect to Submission 2013											
	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011
Total	2.56	2.79	2.78	3.05	1.64	0.76	0.81	0.73	1.80	0.84	1.24	1.51
1	2.52	2.75	2.74	3.01	1.61	0.73	0.79	0.73	0.22	-0.01	-0.09	-0.15
1.A.1	0.04	0.04	0.04	0.04	0.03	0.05	0.05	0.05	0.05	0.04	0.04	0.05
1.A.2	0.00	0.00	0.01	0.01	0.00	-0.01	-0.01	0.00	0.00	0.00	-0.04	-0.05
1.A.3	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
1.A.4	0.07	0.08	0.08	0.10	0.10	0.07	0.08	0.07	0.08	0.07	0.07	0.03
1.B	2.41	2.62	2.61	2.87	1.48	0.62	0.67	0.61	0.09	-0.12	-0.16	-0.18
1.B.1	0.03	0.03	0.03	0.03	0.03	0.03	0.04	0.04	0.04	0.04	0.04	0.04
1.B.2	2.38	2.59	2.58	2.84	1.45	0.59	0.63	0.57	0.05	-0.16	-0.20	-0.21
2	-	-	-	-	-	-	-	-	-	-	-	-
3	-	-	-	-	-	-	-	-	-	-	-	-
4.	0.04	0.04	0.04	0.04	0.03	0.03	0.02	0.00	-0.01	0.04	0.13	0.13
4.B	0.04	0.04	0.04	0.04	0.03	0.03	0.02	0.00	-0.01	0.04	0.13	0.13
5	-	-	-	-	-	-	-	-	-	-	-	-
6.	-	-	-	-	-	-	-	0.00	1.60	0.81	1.19	1.53
6.A	-	-	-	-	-	-	-	-	1.60	0.81	1.23	1.59
6.B	-	-	-	-	-	-	-	0.00	0.00	0.00	0.00	0.00
6.D	-	-	-	-	-	-	-	0.00	0.00	-	-0.04	-0.05

Recalculation of N_2O Emissions by Categories

Explanations are provided in Chapter 9 Recalculations and in the sector specific chapters of this report.

Table A 123: Recalculation Difference of N_2O Emissions 1990-1999.

IPCC Cat.	N_2O [Gg] Differences with respect to Submission 2013									
	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	0.00	0.00	0.00
1	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	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	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
1.A.3	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
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	-	-	-	-	-	-	-	-	-	-
2	-	-	-	-	-	-	-	-	-	-
3	-	-	-	-	-	-	-	-	-	-
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	-0.07	-0.07	-0.07	-0.07	-0.06	-0.06	-0.06	-0.06	-0.06	-0.06
6.	-	-	-	-	-	-	-	-	-	-
6.B	-	-	-	-	-	-	-	-	-	-
6.D	-	-	-	-	-	-	-	-	-	-

Table A 124: Recalculation Difference of N_2O Emissions 2000-2011.

IPCC Cat.	N_2O [Gg] Differences with respect to Submission 2013											
	2000	**2001**	**2002**	**2003**	**2004**	**2005**	**2006**	**2007**	**2008**	**2009**	**2010**	**2011**
Total	0.01	0.01	0.01	0.01	0.01	0.00	0.00	0.00	0.00	0.01	-0.02	-0.03
1	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.02	-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	-0.01	0.00
1.A.2	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.01	0.00
1.A.3	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
1.A.4	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01	-0.01	-0.01
1.B	-	-	-	-	-	-	-	-	-	-	-	-
2	-	-	-	-	-	-	-	-	-	-	-	-
3	-	-	-	-	-	-	-	-	-	-	-	-0.01
4.	0.00	0.00	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	0.01	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	0.00	0.00
5	-0.06	-0.06	-0.06	-0.06	-0.06	-0.06	-0.06	-0.07	-0.08	-0.08	-0.08	-0.09
6.	-	-	-	-	-	-	-	0.00	0.00	0.00	-0.01	-0.01
6.B	-	-	-	-	-	-	-	0.00	0.00	0.00	0.00	0.00
6.D	-	-	-	-	-	-	-	0.00	0.00	-	-0.01	-0.01

Recalculation of National Total GHG Emissions

Table A 125 compares the national total GHG emissions of NIR submission 2014 with NIR submission 2013 (AT_Submission_2013_v1.2_CRF)[1]. Explanations are provided in Chapter 9 Recalculations and in the sector specific chapters of this report.

Table A 125: Recalculation Difference of National Total GHG Emissions.

Year	National Total GHG emissions without LUCF		
	Submission 2013 [Gg CO_2e]	Submission 2014 [Gg CO_2e]	Recalculation Difference [%]
1990*	78 156.71	78 086.35	-0.09%
1991	82 196.38	82 135.09	-0.07%
1992	75 434.73	75 410.77	-0.03%
1993	75 479.84	75 484.11	0.01%
1994	76 338.09	76 345.45	0.01%
1995	79 728.99	79 743.56	0.02%
1996	82 741.53	82 754.78	0.02%
1997	82 269.28	82 277.81	0.01%
1998	81 635.24	81 653.02	0.02%
1999	79 917.14	79 966.28	0.06%
2000	80 198.10	80 276.96	0.10%
2001	84 184.16	84 274.66	0.11%
2002	85 881.45	85 975.56	0.11%
2003	91 875.53	91 984.60	0.12%
2004	91 519.54	91 569.35	0.05%
2005	92 894.51	92 580.94	-0.34%
2006	90 092.19	89 710.79	-0.42%
2007	87 246.19	86 967.42	-0.32%
2008	86 962.39	86 882.03	-0.09%
2009	79 955.99	80 147.97	0.24%
2010	85 012.22	84 807.85	-0.24%
2011	82 841.60	82 760.84	-0.10%

**Base year is 1990 for all gases*

[1] Data has been resubmitted on 18 November 2013 in response to a recommendation from the In-Country-Review 2013 (AT_Submission_2013_v1.2_CRF)

Table A 126 and A 127 present recalculation differences per gas.

Table A 126: Recalculation Difference of National CO_2 and CH_4 Emissions.

Year	CO_2 [Gg CO_2e]			CH_4 [Gg CO_2e]		
	Submission 2013	Submission 2014	Recalc. Difference [%]	Submission 2013	Submission 2014	Recalc. Difference [%]
1990*	62 059.59	62 017.75	-0.07%	8 304.12	8 332.12	0.34%
1991	65 643.84	65 602.05	-0.06%	8 267.63	8 304.63	0.45%
1992	60 138.33	60 100.21	-0.06%	7 985.55	8 022.12	0.46%
1993	60 516.13	60 482.17	-0.06%	7 934.14	7 972.23	0.48%
1994	60 899.75	60 877.09	-0.04%	7 708.08	7 737.86	0.39%
1995	63 943.97	63 924.04	-0.03%	7 617.77	7 651.93	0.45%
1996	67 383.73	67 365.30	-0.03%	7 398.17	7 429.43	0.42%
1997	67 180.02	67 162.49	-0.03%	7 093.61	7 119.09	0.36%
1998	66 763.01	66 743.98	-0.03%	6 943.09	6 978.46	0.51%
1999	65 344.86	65 343.17	0.00%	6 774.04	6 823.58	0.73%
2000	65 969.68	65 992.86	0.04%	6 622.89	6 676.68	0.81%
2001	69 999.37	70 029.31	0.04%	6 486.50	6 545.01	0.90%
2002	71 713.99	71 747.63	0.05%	6 389.07	6 447.39	0.91%
2003	77 758.25	77 800.99	0.05%	6 383.62	6 447.66	1.00%
2004	78 215.90	78 229.22	0.02%	6 242.47	6 277.01	0.55%
2005	79 723.67	79 392.94	-0.41%	6 083.38	6 099.43	0.26%
2006	77 032.51	76 633.08	-0.52%	5 961.77	5 978.84	0.29%
2007	74 274.62	73 980.07	-0.40%	5 851.22	5 866.55	0.26%
2008	73 921.74	73 804.48	-0.16%	5 705.51	5 743.37	0.66%
2009	67 396.95	67 567.76	0.25%	5 624.69	5 642.35	0.31%
2010	72 590.80	72 366.12	-0.31%	5 536.08	5 562.12	0.47%
2011	70 455.49	70 353.70	-0.14%	5 361.81	5 393.54	0.59%

**Base year is 1990 for all gases*

Table A 127: Recalculation Difference of National N_2O and HFC, PFC, SF_6 Emissions.

Year	N_2O [Gg CO_2e]			HFC, PFC, SF_6 [Gg CO_2e]		
	Submission 2013	Submission 2014	Recalc. Difference [%]	Submission 2013	Submission 2014	Recalc. Difference [%]
1990*	6 197.85	6 197.92	0.00%	1 595.16	1 538.56	-3.55%
1991	6 529.28	6 529.38	0.00%	1 755.62	1 699.03	-3.22%
1992	6 134.05	6 134.15	0.00%	1 176.80	1 154.30	-1.91%
1993	5 960.08	5 960.22	0.00%	1 069.50	1 069.50	0.00%
1994	6 440.75	6 441.00	0.00%	1 289.51	1 289.51	0.00%
1995	6 606.02	6 606.37	0.01%	1 561.22	1 561.22	0.00%
1996	6 267.45	6 267.87	0.01%	1 692.18	1 692.18	0.00%
1997	6 299.36	6 299.94	0.01%	1 696.29	1 696.29	0.00%
1998	6 417.50	6 418.93	0.02%	1 511.64	1 511.64	0.00%
1999	6 392.58	6 393.87	0.02%	1 405.65	1 405.65	0.00%
2000	6 289.00	6 290.90	0.03%	1 316.52	1 316.52	0.00%
2001	6 174.72	6 176.77	0.03%	1 523.58	1 523.58	0.00%
2002	6 177.26	6 179.42	0.04%	1 601.13	1 601.13	0.00%
2003	6 103.38	6 105.65	0.04%	1 630.29	1 630.29	0.00%
2004	5 408.45	5 410.39	0.04%	1 652.73	1 652.73	0.00%
2005	5 447.92	5 449.04	0.02%	1 639.53	1 639.53	0.00%
2006	5 481.95	5 482.90	0.02%	1 615.97	1 615.97	0.00%
2007	5 509.77	5 510.22	0.01%	1 610.58	1 610.58	0.00%
2008	5 695.12	5 694.16	-0.02%	1 640.02	1 640.02	0.00%
2009	5 413.91	5 417.43	0.06%	1 520.44	1 520.44	0.00%
2010	5 184.26	5 178.53	-0.11%	1 701.08	1 701.08	0.00%
2011	5 293. 69	5 283.00	-0.20%	1 730.61	1 730.60	0.00%

**Base year is 1990 for all gases*

ANNEX 6: ADDITIONAL INFORMATION

Additional information on NISA

Austria's Obligations

Regarding Austria's obligations under the United Nations Framework Convention on Climate Change UNFCCC and the Kyoto Protocol the relevant COP (Conference of the Parties) or CMP (Meeting of the Parties to the Kyoto Protocol) Decisions and Guidelines are:

- Decision 11/CP.4 National communications from Parties included in Annex I to the Convention.
- Decision 3/CP.5 Guidelines for the Preparation of National Communications by Parties included in Annex I to the Convention, Part I: UNFCCC Reporting Guidelines on Annual Inventories (referring to Document FCCC/CP/1999/7) revised with Decision 18/CP.8 (referring to Document FCCC/CP/2002/8).
- Decision 4/CP.5 Guidelines for the Preparation of National Communications by Parties included in Annex I to the Convention, Part II: UNFCCC Reporting Guidelines on National Communications (referring to Document FCCC/CP/1999/7) revised with Decision 19/CP.8 (referring to Document FCCC/CP/2002/8).
- Decision 20/CP.7 (19/CMP.1): Guidelines for national systems under Article 5, paragraph 1, of the Kyoto Protocol;
- Decision 21/CP.7 (20/CMP.1): Good practice guidance and adjustments under Article 5, paragraph 2, of the Kyoto Protocol;
- Decision 22/C.7 (15.CMP.1): Guidance for the preparation of the information required under Article 7 of the Kyoto Protocol;
- Decision 23/CP.7 (22/CMP.1): Guidelines for review under Article 8 of the Kyoto Protocol.
- Decision 6/CMP.3 Good practice guidance for land use, land-use change and forestry activities under Article 3, paragraphs 3 and 4, of the Kyoto Protocol

In addition to the obligation under the UNFCCC and the Kyoto Protocol Austria has to comply with the following obligations regarding air emissions:

- Austria's annual obligations under the European Council Decision 280/2004/EC ("Monitoring Decision"; replacing Decision 389/1992/EEC amended by Decision 296/1999/EEC) concerning a mechanism for monitoring Community greenhouse gas emissions and for implementing the Kyoto Protocol.
- Austria's annual obligation under the UNECE Convention on Long-range Transboundary Air Pollution (CLRTAP) and its Protocols (1979) comprising the annual reporting of national emission data on SO2, NOX, NMVOCs, NH3, CO, TSP, PM10, and PM2.5 as well as on the heavy metals Pb, Cd and Hg and persistent organic hydrocarbons (PAHs), dioxins and furans and hexachlorobenzene (HCB).
- Obligation under the Austrian Ambient Air Quality Law[2] concerning the reporting of national emission data on SO_2, NOx, NMVOC, CO, heavy metals (Pb, Cd, Hg), benzene and particulate matter.

[2] 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 SO_2 under EMEP in 1978 (Cooperative Programme for Monitoring and Evaluation of the Long-range Transmission of Air Pollutants in Europe).
- As an EFTA country Austria participated in CORINAIR 90, which was an air emission inventory for Europe. It was part of the CORINE (Coordination d'Information Environmentale) work plan set up by the European Council of Ministers in 1985. The aim of CORINAIR 90 was to produce a complete, consistent and transparent emission inventory for the pollutants: SOx as SO_2, NO_X as NO_2, NMVOC, CH_4, CO, CO_2, N_2O and NH_3.
- Austria signed the UNFCCC on June 8, 1992 and subsequently submitted its instrument of ratification on February 28, 1994.
- In 1994, the first so-called Austrian Air Emission Inventory (Österreichische Luftschadstoff-Inventur, OLI) was prepared.
- In 1997, a consistent time series for the emission data from 1980 to 1995 was reported for the first time.
- In 1998, also emissions of HM, POPs and FCs were included in the inventory.
- Inventory data for particulate matter were included in the inventory in 2001.
- In 2005: accreditation according to ISO/IEC 17020 as *Inspection Body for Emission Inventories.*

Adaptation of NISA according to the Kyoto Protocol

Regulations under the UNFCCC and the Kyoto Protocol defined new standards for national emission inventories. These standards include more stringent requirements related to transparency, consistency, comparability, completeness and accuracy of inventories. Each Party shall have in place a national system. This national system shall include all institutional, legal and procedural arrangements made within a Party for estimating anthropogenic emissions by sources and removals by sinks of all greenhouse gases not controlled by the Montreal Protocol, and for reporting and archiving inventory information.

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

The emission inventory system has a structure as illustrated in Figure 1.

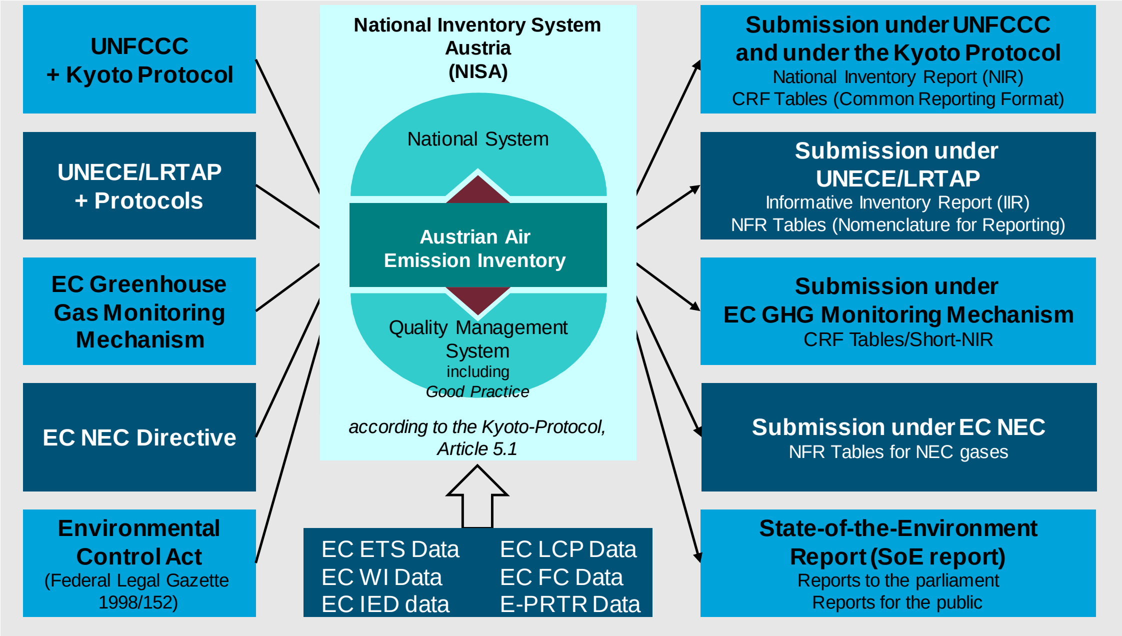

Figure 1: Structure of the emission inventory system in Austria (NISA).

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

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

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

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

The general functions are

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

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

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

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

- the Umweltbundesamt has been designated as the single national entity with the overall responsibility for the national inventory by law: the Environmental Control Act ("Umweltkontrollgesetz"; Federal Law Gazette I No. 152/1998) regulates responsibilities of environmental control in Austria and lists the tasks of the Umweltbundesamt. One task is the preparation of technical expertise and basic data for the fulfilment of the obligations under the UNFCCC and the UNECE LRTAP Convention. For further institutional arrangements, please refer to sub-chapter 1.2.4)
- The responsibilities for inventory planning, preparation and management are specified and allocated within the Umweltbundesamt. Following internal Umweltbundesamt quality management regulation, a yearly plan is implemented to ensure capacity for timely performance of the functions defined in the guidelines for national systems. The technical competence of the staff involved in the inventory preparation process is ensured by arrangements according to the internal Umweltbundesamt training plan.
- The inventory preparation, including identification of key categories, uncertainty estimates and QC procedures, is performed according to the 2000 Intergovernmental Panel on Climate Change (IPCC) Good Practice Guidance (GPG) and Uncertainty Management of Greenhouse Gas Inventories and to the 2003 IPCC GPG for Land Use, Land-Use Change and Forestry.
- A Quality Management System (QMS) has been developed and implemented.
- The national greenhouse gas inventory is prepared by the inspection body for GHG inventories within the Umweltbundesamt which is accredited as inspection body according to the International Standard ISO/IEC 17020 General Criteria for the operation of various types of bodies performing inspections. The accreditation audit of the Umweltbundesamt as inspection body took place in September 2005. The accreditation was completed officially in December 2005.
- The QMS also includes the necessary procedures to ensure quality improvement of the emission inventory. They comprise documentation of allocated responsibilities, of any discrepancies and of the findings by UNFCCC review experts in particular.
- The inventory management as part of the QMS includes a control system for data and calculations, for records and their archiving as well as documentation of QA/QC activities. This ensures the necessary documentation and archiving for future reconstruction of the inventory and for the timely response to requests during the review process.
- Part of the legal and institutional arrangements in place to provide a basis for the national system pertains to data availability for the annual compilation of the GHG inventory. The main data source for the Austrian inventory preparation is the Austrian statistical office (Statistik Austria). The compilation of several statistics is regulated by law; the compilation of the national energy balance is regulated by contracts. Other data sources include reporting obligations under national and European regulations and reports of companies and associations.
- A process for official consideration and approval of the inventory prior to its submission is established. The inventory information is provided by the Umweltbundesamt to the Federal Ministry of Agriculture, Forestry, Environment and Water Management, where the National Focal Point for the UNFCCC is established. The inventory is then submitted by the Ministry to the UNFCCC secretariat.

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

Additional information on the Inspection Body for Emission Inventories

History of the Austrian QMS

A quality management system (QMS) has been designed to achieve the objectives of *good practice guidance*, namely to improve transparency, consistency, comparability, completeness and confidence in national inventories of emissions estimates. After having been effectively implemented during the development of the UNFCCC submission 2004, the accreditation audit of the Umweltbundesamt (Environment Agency Austria) as *Inspection Body for Emission inventories (IBE)* took place in autumn 2005. Accreditation was awarded in December 2005 and renewed in January 2011.

Table A 128: presents the timetable for the implementation of the quality management system.

Table A 128: *Timetable for the implementation of the Austrian QMS.*

	Date
Development of a quality management system including Quality Manual	1999–2002
Development of the quality management system Implementation of the quality management system	2003–2005
Accreditation Audit Accreditation as Inspection Body for Greenhouse Gas Inventories	September 2005 December 2005
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 17020[3]. 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 inspections.* This standard has been drawn up with the objective of promoting confidence in those bodies performing inspections which conform to it.

[3] The International Standard ISO/IEC 17020 superseded the European Standard EN 45004.

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

Accreditation Act

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

The Austrian Accreditation Act ("Akkreditierungsgesetz", Federal Law Gazette 28/2012) 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.

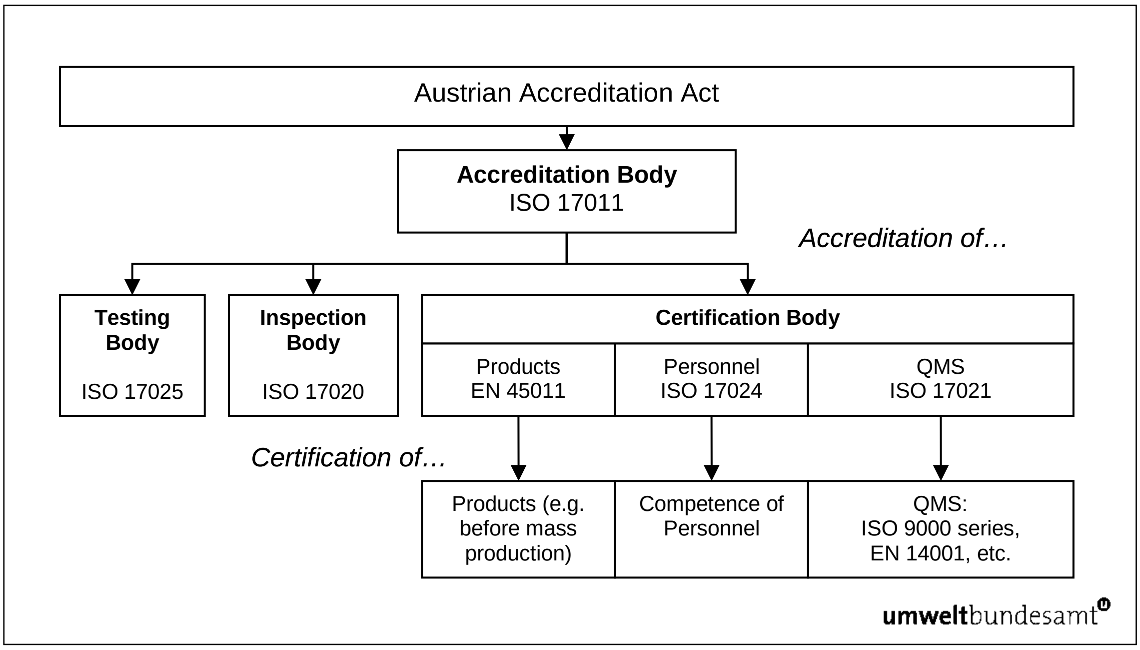

Figure 2: Inter-relationship between the Austrian Accreditation Act, the EN 45000/ISO 17000 and the ISO 9000 series.

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.

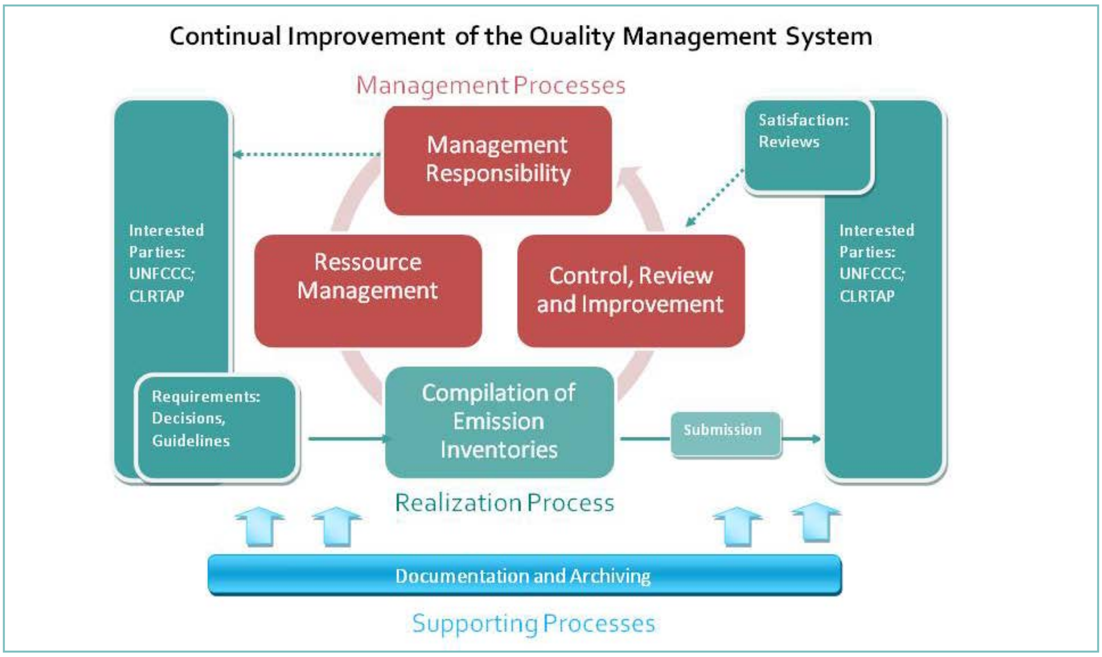

Figure 3: Process-based QMS of the IBE

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.

Additional Information on Agriculture

Annex 6 includes additional information for sector agriculture as recommended by the ERT in the ARR 2013.

The first section presents tables on the fractions of livestock manure handled in different animal waste management systems (AWMS) for all animal subcategories and all reporting years (ARR 2013, para 49).

The second section includes a schematic diagram of the Austrian N flow and additional description of the country specific method used in the Austrian inventory (ARR 2013, para 51 and para 52).

AWMS for all animal subcategories and all reporting years

Dairy cattle

Table A 129: Manure Management System distribution in Austria for dairy cattle 1990 – 2012.

Livestock category	Liquid/Slurry	Solid Storage	Pasture/Range/ Paddock	Other Systems
Dairy cattle	**[%]**	**[%]**	**[%]**	**[%]**
1990	32.7	49.4	10.7	7.3
1991	32.6	49.4	10.2	7.7
1992	32.6	49.4	9.8	8.2
1993	32.6	49.4	9.4	8.6
1994	32.6	49.4	8.9	9.1
1995	32.6	49.3	8.5	9.6
1996	32.6	49.3	8.1	10.0
1997	32.5	49.3	7.6	10.5
1998	32.5	49.3	7.2	11.0
1999	32.5	49.3	6.8	11.5
2000	32.4	49.2	6.4	12.0
2001	32.4	49.2	5.9	12.5
2002	32.4	49.2	5.5	12.9
2003	32.3	49.2	5.1	13.4
2004	32.3	49.2	4.6	13.9
2005	32.3	49.1	4.2	14.4
2006	32.3	49.1	3.8	14.8
2007	32.2	49.1	3.3	15.3
2008	32.2	49.1	2.9	15.8
2009	32.2	49.1	2.9	15.8
2010	32.2	49.1	2.9	15.8
2011	32.2	49.0	2.9	15.8
2012	32.2	49.0	2.9	15.9

Table A 130: Other systems in detail for dairy cattle 1990 – 2012.

Livestock category	Yard	Composting	Deep Litter	Aerobic Treatment	Anaerobic Digestion
Dairy cattle	**[%]**	**[%]**	**[%]**	**[%]**	**[%]**
1990	0.9	3.1	1.3	0.0	2.0
1991	1.0	3.4	1.3	0.0	2.1
1992	1.0	3.6	1.3	0.0	2.3
1993	1.1	3.8	1.3	0.0	2.4
1994	1.1	4.1	1.3	0.1	2.6
1995	1.2	4.3	1.3	0.1	2.7
1996	1.3	4.5	1.3	0.1	2.9
1997	1.3	4.8	1.3	0.1	3.0
1998	1.4	5.0	1.3	0.1	3.2
1999	1.4	5.2	1.3	0.2	3.3
2000	1.5	5.5	1.3	0.2	3.5
2001	1.6	5.7	1.3	0.3	3.6
2002	1.6	5.9	1.3	0.3	3.8
2003	1.7	6.2	1.3	0.3	3.9
2004	1.7	6.4	1.3	0.4	4.0
2005	1.8	6.6	1.3	0.4	4.2
2006	1.9	6.9	1.3	0.4	4.3
2007	1.9	7.1	1.3	0.5	4.5
2008	2.0	7.4	1.4	0.5	4.6
2009	2.0	7.4	1.4	0.5	4.6
2010	2.0	7.4	1.4	0.5	4.6
2011	2.0	7.4	1.4	0.5	4.6
2012	2.0	7.4	1.4	0.5	4.6

Non-dairy cattle

Table A 131: Manure Management System distribution in Austria for non-dairy cattle 1990 – 2012.

Livestock category	Liquid/Slurry	Solid Storage	Pasture/Range/ Paddock	Other Systems
Non-dairy cattle	**[%]**	**[%]**	**[%]**	**[%]**
1990	27.5	44.5	10.4	17.6
1991	27.5	44.4	10.1	18.0
1992	27.4	44.4	9.8	18.4
1993	28.3	43.9	9.8	18.1
1994	27.9	43.9	9.5	18.7
1995	26.5	43.9	9.6	20.1
1996	26.2	43.9	9.4	20.5
1997	26.4	43.8	9.2	20.6
1998	26.3	43.8	8.9	21.0

Livestock category	Liquid/Slurry	Solid Storage	Pasture/Range/ Paddock	Other Systems
Non-dairy cattle	**[%]**	**[%]**	**[%]**	**[%]**
1999	25.9	43.8	8.7	21.6
2000	24.8	43.7	8.7	22.8
2001	24.5	43.7	8.4	23.4
2002	24.6	43.6	8.1	23.7
2003	24.6	43.6	7.8	24.0
2004	24.3	43.5	7.6	24.6
2005	24.1	43.3	7.4	25.1
2006	24.1	43.2	7.1	25.5
2007	24.2	43.1	6.8	25.9
2008	24.2	43.0	6.5	26.3
2009	24.5	43.0	6.4	26.2
2010	24.6	42.9	6.3	26.1
2011	24.5	42.9	6.4	26.2
2012	24.5	43.0	6.3	26.3

Table A 132: Other systems in detail for non-dairy cattle 1990 – 2012.

Livestock category	Yard	Composting	Deep Litter	Aerobic Treatment	Anaerobic Digestion
Non-dairy cattle	**[%]**	**[%]**	**[%]**	**[%]**	**[%]**
1990	0.8	2.6	12.6	0.0	1.6
1991	0.9	2.8	12.6	0.0	1.7
1992	0.9	3.0	12.7	0.0	1.8
1993	1.0	3.1	12.0	0.0	1.9
1994	1.0	3.3	12.3	0.1	2.0
1995	1.1	3.5	13.2	0.1	2.1
1996	1.2	3.7	13.3	0.1	2.2
1997	1.2	3.9	13.0	0.1	2.3
1998	1.3	4.1	13.0	0.1	2.4
1999	1.4	4.3	13.2	0.2	2.5
2000	1.5	4.6	14.0	0.2	2.5
2001	1.5	4.8	14.2	0.3	2.6
2002	1.6	4.9	14.1	0.3	2.7
2003	1.6	5.1	14.0	0.3	2.9
2004	1.7	5.3	14.2	0.4	3.0
2005	1.8	5.5	14.4	0.4	3.0
2006	1.8	5.7	14.5	0.4	3.1
2007	1.9	5.9	14.5	0.5	3.2
2008	1.9	6.1	14.5	0.5	3.3
2009	1.9	6.0	14.4	0.5	3.4
2010	1.9	6.0	14.3	0.5	3.4

Livestock category	Yard	Composting	Deep Litter	Aerobic Treatment	Anaerobic Digestion
Non-dairy cattle	**[%]**	**[%]**	**[%]**	**[%]**	**[%]**
2011	1.9	6.0	14.4	0.5	3.4
2012	1.9	6.0	14.4	0.5	3.4

Suckling cows

Table A 133: Manure Management System distribution in Austria for suckling cows 1990 – 2012.

Livestock category	Liquid/Slurry	Solid Storage	Pasture/Range/ Paddock	Other Systems
Suckling cows	**[%]**	**[%]**	**[%]**	**[%]**
1990	17.2	46.0	10.7	26.2
1991	17.1	45.7	10.9	26.4
1992	17.0	45.3	11.1	26.6
1993	16.8	45.0	11.3	26.9
1994	16.7	44.7	11.5	27.2
1995	16.6	44.4	11.7	27.4
1996	16.4	44.0	11.9	27.7
1997	16.3	43.7	12.1	27.9
1998	16.1	43.4	12.3	28.2
1999	16.0	43.0	12.5	28.5
2000	15.8	42.7	12.7	28.8
2001	15.7	42.4	12.9	29.1
2002	15.5	42.1	13.1	29.3
2003	15.4	41.7	13.3	29.6
2004	15.2	41.4	13.5	29.9
2005	15.1	41.1	13.7	30.2
2006	14.9	40.7	13.9	30.4
2007	14.8	40.4	14.1	30.7
2008	14.7	40.1	14.3	31.0
2009	14.7	40.1	14.3	31.0
2010	14.7	40.0	14.3	31.0
2011	14.7	40.0	14.3	31.0
2012	14.7	40.0	14.3	31.0

Table A 134: Other systems in detail for suckling cows 1990 – 2012.

Livestock category	Yard	Composting	Deep Litter	Aerobic Treatment	Anaerobic Digestion
Suckling cows	**[%]**	**[%]**	**[%]**	**[%]**	**[%]**
1990	1.1	2.9	21.2	0.0	1.1
1991	1.1	3.0	21.1	0.0	1.1
1992	1.2	3.2	21.1	0.0	1.2
1993	1.3	3.4	21.0	0.0	1.2
1994	1.3	3.5	20.9	0.1	1.3
1995	1.4	3.7	20.9	0.1	1.4
1996	1.5	3.9	20.8	0.1	1.4
1997	1.5	4.1	20.7	0.1	1.5
1998	1.6	4.2	20.7	0.1	1.6
1999	1.7	4.4	20.6	0.2	1.6
2000	1.8	4.6	20.5	0.2	1.7
2001	1.8	4.8	20.5	0.3	1.8
2002	1.9	4.9	20.4	0.3	1.8
2003	2.0	5.1	20.3	0.3	1.9
2004	2.0	5.3	20.3	0.4	1.9
2005	2.1	5.4	20.2	0.4	2.0
2006	2.2	5.6	20.1	0.4	2.1
2007	2.2	5.8	20.1	0.5	2.1
2008	2.3	6.0	20.0	0.5	2.2
2009	2.3	6.0	20.0	0.5	2.2
2010	2.3	6.0	20.0	0.5	2.2
2011	2.3	6.0	20.0	0.5	2.2
2012	2.3	6.0	20.0	0.5	2.2

Young cattle <1year

Table A 135: Manure Management System distribution in Austria for young cattle <1 year 1990 – 2012.

Livestock category	Liquid/Slurry	Solid Storage	Pasture/Range/ Paddock	Other Systems
Young cattle <1 year	**[%]**	**[%]**	**[%]**	**[%]**
1990	16.9	51.0	4.8	27.3
1991	16.8	50.9	4.6	27.7
1992	16.8	50.7	4.5	28.1
1993	16.7	50.6	4.3	28.4
1994	16.6	50.4	4.2	28.9
1995	16.5	50.2	4.0	29.3
1996	16.4	50.1	3.8	29.7
1997	16.4	49.9	3.7	30.1
1998	16.3	49.7	3.5	30.5

Livestock category	Liquid/Slurry	Solid Storage	Pasture/Range/ Paddock	Other Systems
Young cattle <1 year	**[%]**	**[%]**	**[%]**	**[%]**
1999	16.2	49.6	3.4	30.9
2000	16.1	49.4	3.2	31.3
2001	16.0	49.2	3.0	31.8
2002	15.9	49.1	2.9	32.2
2003	15.8	48.9	2.7	32.6
2004	15.7	48.8	2.6	33.0
2005	15.6	48.6	2.4	33.4
2006	15.5	48.4	2.2	33.8
2007	15.4	48.3	2.1	34.2
2008	15.4	48.1	1.9	34.6
2009	15.4	48.1	1.9	34.6
2010	15.4	48.1	1.9	34.7
2011	15.4	48.0	1.9	34.7
2012	15.3	48.0	1.9	34.7

Table A 136: Other systems in detail for young cattle <1 year 1990 – 2012.

Livestock category	Yard	Composting	Deep Litter	Aerobic Treatment	Anaerobic Digestion
Young cattle <1 year	**[%]**	**[%]**	**[%]**	**[%]**	**[%]**
1990	0.8	3.2	22.0	0.0	1.2
1991	0.9	3.4	22.1	0.0	1.3
1992	0.9	3.6	22.1	0.0	1.4
1993	1.0	3.9	22.1	0.0	1.5
1994	1.0	4.1	22.1	0.1	1.6
1995	1.1	4.3	22.2	0.1	1.6
1996	1.1	4.5	22.2	0.1	1.7
1997	1.2	4.7	22.2	0.1	1.8
1998	1.2	5.0	22.2	0.1	1.9
1999	1.3	5.2	22.3	0.2	2.0
2000	1.3	5.4	22.3	0.2	2.1
2001	1.4	5.6	22.3	0.3	2.2
2002	1.4	5.8	22.3	0.3	2.2
2003	1.5	6.1	22.4	0.3	2.3
2004	1.5	6.3	22.4	0.4	2.4
2005	1.6	6.5	22.4	0.4	2.5
2006	1.7	6.7	22.4	0.4	2.6
2007	1.7	6.9	22.5	0.5	2.7
2008	1.8	7.2	22.5	0.5	2.7
2009	1.8	7.2	22.5	0.5	2.7
2010	1.8	7.2	22.5	0.5	2.7

Livestock category	Yard	Composting	Deep Litter	Aerobic Treatment	Anaerobic Digestion
Young cattle <1 year	[%]	[%]	[%]	[%]	[%]
2011	1.8	7.2	22.5	0.5	2.7
2012	1.8	7.2	22.5	0.5	2.7

Breeding heifers 1-2 years

Table A 137: Manure Management System distribution in Austria for breeding heifers 1-2 years 1990 – 2012.

Livestock category	Liquid/Slurry	Solid Storage	Pasture/Range/ Paddock	Other Systems
Breeding heifers 1-2 years	[%]	[%]	[%]	[%]
1990	25.7	37.9	26.2	10.2
1991	26.0	38.3	25.1	10.7
1992	26.3	38.7	23.9	11.2
1993	26.5	39.0	22.8	11.6
1994	26.8	39.4	21.7	12.2
1995	27.1	39.7	20.5	12.6
1996	27.4	40.1	19.4	13.1
1997	27.6	40.5	18.3	13.6
1998	27.9	40.8	17.1	14.1
1999	28.1	41.2	16.0	14.7
2000	28.4	41.6	14.9	15.2
2001	28.7	41.9	13.7	15.7
2002	28.9	42.3	12.6	16.2
2003	29.2	42.7	11.5	16.7
2004	29.4	43.0	10.3	17.2
2005	29.7	43.4	9.2	17.7
2006	30.0	43.8	8.1	18.2
2007	30.2	44.1	6.9	18.7
2008	30.5	44.5	5.8	19.2
2009	30.5	44.5	5.8	19.2
2010	30.5	44.4	5.8	19.2
2011	30.5	44.4	5.8	19.2
2012	30.5	44.4	5.8	19.3

Table A 138: Other systems in detail for breeding heifers 1-2 years 1990 – 2012.

Livestock category	Yard	Composting	Deep Litter	Aerobic Treatment	Anaerobic Digestion
Breeding heifers 1-2 years	**[%]**	**[%]**	**[%]**	**[%]**	**[%]**
1990	0.8	2.4	5.9	0.0	1.1
1991	0.8	2.6	6.0	0.0	1.2
1992	0.9	2.8	6.1	0.0	1.3
1993	0.9	3.1	6.2	0.0	1.4
1994	1.0	3.3	6.3	0.1	1.5
1995	1.0	3.5	6.4	0.1	1.6
1996	1.1	3.8	6.5	0.1	1.8
1997	1.1	4.0	6.6	0.1	1.9
1998	1.2	4.2	6.7	0.1	2.0
1999	1.2	4.4	6.7	0.2	2.1
2000	1.3	4.7	6.8	0.2	2.2
2001	1.3	4.9	6.9	0.3	2.3
2002	1.4	5.1	7.0	0.3	2.4
2003	1.4	5.4	7.1	0.3	2.5
2004	1.5	5.6	7.2	0.4	2.6
2005	1.5	5.8	7.3	0.4	2.7
2006	1.6	6.0	7.4	0.4	2.8
2007	1.6	6.3	7.4	0.5	2.9
2008	1.7	6.5	7.5	0.5	3.0
2009	1.7	6.5	7.5	0.5	3.0
2010	1.7	6.5	7.5	0.5	3.0
2011	1.7	6.5	7.5	0.5	3.0
2012	1.7	6.5	7.5	0.5	3.0

Fattening heifers, bulls, oxen 1-2 year

Table A 139: Manure Management System distribution in Austria for fattening heifers, bulls, oxen 1-2 years 1990 – 2012.

Livestock category	Liquid/Slurry	Solid Storage	Pasture/Range/ Paddock	Other Systems
Fattening heifers, bulls, oxen 1-2 years	**[%]**	**[%]**	**[%]**	**[%]**
1990	46.5	41.4	0.6	11.4
1991	46.4	41.3	0.6	11.8
1992	46.2	41.1	0.6	12.1
1993	46.1	41.0	0.5	12.4
1994	45.9	40.8	0.5	12.7
1995	45.8	40.7	0.5	13.0
1996	45.6	40.6	0.5	13.4

Livestock category	**Liquid/Slurry**	**Solid Storage**	**Pasture/Range/ Paddock**	**Other Systems**
Fattening heifers, bulls, oxen 1-2 years	**[%]**	**[%]**	**[%]**	**[%]**
1997	45.4	40.4	0.5	13.7
1998	45.3	40.3	0.4	14.0
1999	45.1	40.1	0.4	14.4
2000	44.9	40.0	0.4	14.7
2001	44.7	39.8	0.4	15.1
2002	44.5	39.7	0.4	15.4
2003	44.4	39.6	0.3	15.7
2004	44.2	39.4	0.3	16.1
2005	44.0	39.3	0.3	16.4
2006	43.9	39.1	0.3	16.7
2007	43.7	39.0	0.3	17.1
2008	43.5	38.8	0.2	17.4
2009	43.5	38.8	0.2	17.4
2010	43.5	38.8	0.2	17.4
2011	43.5	38.8	0.2	17.4
2012	43.5	38.8	0.2	17.4

Table A 140: Other systems in detail for fattening heifers, bulls, oxen 1-2 years 1990 – 2012.

Livestock category	**Yard**	**Composting**	**Deep Litter**	**Aerobic Treatment**	**Anaerobic Di-gestion**
Fattening heifers, bulls, oxen 1-2 years	**[%]**	**[%]**	**[%]**	**[%]**	**[%]**
1990	0.8	1.9	6.8	0.0	2.0
1991	0.8	2.0	6.8	0.0	2.1
1992	0.9	2.2	6.8	0.0	2.2
1993	0.9	2.3	6.8	0.0	2.4
1994	1.0	2.4	6.8	0.1	2.5
1995	1.0	2.5	6.8	0.1	2.6
1996	1.1	2.7	6.8	0.1	2.8
1997	1.1	2.8	6.8	0.1	2.9
1998	1.2	2.9	6.8	0.1	3.0
1999	1.2	3.0	6.8	0.2	3.2
2000	1.3	3.2	6.8	0.2	3.3
2001	1.3	3.3	6.8	0.3	3.4
2002	1.4	3.4	6.8	0.3	3.5
2003	1.4	3.5	6.8	0.3	3.7
2004	1.5	3.7	6.8	0.4	3.8
2005	1.5	3.8	6.8	0.4	3.9

Livestock category	Yard	Composting	Deep Litter	Aerobic Treatment	Anaerobic Digestion
Fattening heifers, bulls, oxen 1-2 years	**[%]**	**[%]**	**[%]**	**[%]**	**[%]**
2006	1.6	3.9	6.8	0.4	4.1
2007	1.6	4.0	6.8	0.5	4.2
2008	1.7	4.2	6.8	0.5	4.3
2009	1.7	4.2	6.8	0.5	4.3
2010	1.7	4.2	6.8	0.5	4.3
2011	1.7	4.2	6.8	0.5	4.3
2012	1.7	4.2	6.8	0.5	4.3

Other cattle >2 year

Table A 141: Manure Management System distribution in Austria for other cattle >2 years 1990 – 2012.

Livestock category	Liquid/Slurry	Solid Storage	Pasture/Range/ Paddock	Other Systems
Other cattle >2 years	**[%]**	**[%]**	**[%]**	**[%]**
1990	27.4	42.6	17.8	12.2
1991	27.4	42.7	17.2	12.7
1992	27.4	42.8	16.6	13.2
1993	27.4	42.9	16.0	13.7
1994	27.3	43.0	15.4	14.3
1995	27.3	43.0	14.8	14.8
1996	27.3	43.1	14.2	15.3
1997	27.3	43.2	13.6	15.8
1998	27.3	43.3	13.1	16.4
1999	27.2	43.4	12.5	16.9
2000	27.2	43.5	11.9	17.5
2001	27.2	43.6	11.3	18.0
2002	27.1	43.6	10.7	18.6
2003	27.1	43.7	10.1	19.1
2004	27.1	43.8	9.5	19.6
2005	27.1	43.9	8.9	20.1
2006	27.0	44.0	8.3	20.7
2007	27.0	44.1	7.7	21.2
2008	27.0	44.1	7.1	21.7
2009	27.0	44.1	7.1	21.7
2010	27.0	44.1	7.1	21.8
2011	27.0	44.1	7.1	21.8
2012	27.0	44.1	7.1	21.8

Table A 142: Other systems in detail for other cattle >2 years 1990 – 2012.

Livestock category	Yard	Composting	Deep Litter	Aerobic Treatment	Anaerobic Digestion
Other cattle >2 years	**[%]**	**[%]**	**[%]**	**[%]**	**[%]**
1990	1.0	2.6	6.2	0.0	2.4
1991	1.0	2.8	6.3	0.0	2.6
1992	1.1	3.0	6.3	0.0	2.8
1993	1.1	3.2	6.4	0.0	3.0
1994	1.2	3.4	6.4	0.1	3.2
1995	1.3	3.6	6.5	0.1	3.4
1996	1.3	3.8	6.5	0.1	3.6
1997	1.4	4.0	6.5	0.1	3.8
1998	1.5	4.2	6.6	0.1	4.0
1999	1.5	4.4	6.6	0.2	4.2
2000	1.6	4.6	6.7	0.2	4.4
2001	1.6	4.8	6.7	0.3	4.6
2002	1.7	5.0	6.7	0.3	4.8
2003	1.8	5.2	6.8	0.3	4.9
2004	1.8	5.4	6.8	0.4	5.1
2005	1.9	5.7	6.9	0.4	5.3
2006	2.0	5.9	6.9	0.4	5.5
2007	2.0	6.1	6.9	0.5	5.7
2008	2.1	6.3	7.0	0.5	5.9
2009	2.1	6.3	7.0	0.5	5.9
2010	2.1	6.3	7.0	0.5	5.9
2011	2.1	6.3	7.0	0.5	5.9
2012	2.1	6.3	7.0	0.5	5.9

Swine (total)

Table A 143: Manure Management System distribution in Austria for swine (total) 1990 – 2012.

Livestock category	Liquid/Slurry	Solid Storage	Pasture/Range/ Paddock	Other Systems
Swine (total)	**[%]**	**[%]**	**[%]**	**[%]**
1990	69.1	11.1	0.0	19.8
1991	69.5	10.9	0.0	19.6
1992	70.0	10.7	0.0	19.3
1993	70.4	10.6	0.0	19.0
1994	70.5	10.5	0.0	19.1
1995	70.8	10.4	0.0	18.8
1996	71.2	10.2	0.0	18.6
1997	71.5	10.0	0.0	18.5
1998	72.1	9.6	0.0	18.3

Livestock category	Liquid/Slurry	Solid Storage	Pasture/Range/ Paddock	Other Systems
Swine (total)	**[%]**	**[%]**	**[%]**	**[%]**
1999	72.1	9.4	0.0	18.5
2000	72.3	9.2	0.0	18.5
2001	72.5	9.1	0.0	18.4
2002	72.7	8.9	0.0	18.4
2003	73.0	8.7	0.0	18.3
2004	73.2	8.5	0.0	18.3
2005	73.8	8.2	0.0	18.0
2006	73.9	8.2	0.0	17.9
2007	74.7	7.7	0.0	17.6
2008	74.8	7.6	0.0	17.6
2009	75.1	7.4	0.0	17.4
2010	75.3	7.3	0.0	17.4
2011	75.0	7.4	0.0	17.6
2012	75.2	7.2	0.0	17.6

Table A 144: Other systems in detail for swine (total) 1990 – 2012.

Livestock category	Yard	Composting	Deep Litter	Aerobic Treatment	Anaerobic Digestion
Swine (total)	**[%]**	**[%]**	**[%]**	**[%]**	**[%]**
1990	0.7	0.6	16.9	0.1	1.5
1991	0.8	0.7	16.4	0.1	1.6
1992	0.8	0.7	15.9	0.1	1.7
1993	0.9	0.7	15.4	0.2	1.8
1994	0.9	0.8	14.9	0.5	1.9
1995	1.0	0.8	14.4	0.6	2.0
1996	1.0	0.9	13.9	0.7	2.2
1997	1.1	0.9	13.4	0.9	2.3
1998	1.1	0.9	12.9	1.0	2.4
1999	1.2	0.9	12.4	1.5	2.5
2000	1.2	1.0	11.9	1.8	2.6
2001	1.3	1.0	11.4	2.0	2.7
2002	1.3	1.0	10.9	2.3	2.9
2003	1.4	1.1	10.4	2.5	3.0
2004	1.4	1.1	9.9	2.8	3.1
2005	1.5	1.1	9.3	2.9	3.2
2006	1.5	1.2	8.8	3.1	3.3
2007	1.5	1.2	8.2	3.3	3.4
2008	1.6	1.2	7.7	3.5	3.6
2009	1.6	1.2	7.6	3.5	3.6
2010	1.6	1.1	7.6	3.6	3.6

Livestock category	Yard	Composting	Deep Litter	Aerobic Treatment	Anaerobic Digestion
Swine (total)	**[%]**	**[%]**	**[%]**	**[%]**	**[%]**
2011	1.6	1.1	7.6	3.8	3.6
2012	1.6	1.1	7.5	3.8	3.6

Young & fattening pigs >20kg

Table A 145: Manure Management System distribution in Austria for young & fattening pigs >20kg 1990 – 2012.

Livestock category	Liquid/Slurry	Solid Storage	Pasture/Range/ Paddock	Other Systems
Young & fattening pigs >20kg	**[%]**	**[%]**	**[%]**	**[%]**
1990	69.9	7.9	0.0	22.2
1991	70.9	7.6	0.0	21.6
1992	71.8	7.2	0.0	20.9
1993	72.8	6.9	0.0	20.3
1994	73.5	6.6	0.0	20.0
1995	74.4	6.2	0.0	19.4
1996	75.3	5.9	0.0	18.8
1997	76.2	5.5	0.0	18.3
1998	77.0	5.2	0.0	17.8
1999	77.5	4.8	0.0	17.6
2000	78.3	4.5	0.0	17.3
2001	79.1	4.1	0.0	16.8
2002	79.8	3.8	0.0	16.4
2003	80.6	3.4	0.0	16.0
2004	81.3	3.1	0.0	15.7
2005	82.2	2.7	0.0	15.1
2006	83.0	2.4	0.0	14.6
2007	83.9	2.0	0.0	14.1
2008	84.6	1.7	0.0	13.7
2009	84.6	1.7	0.0	13.7
2010	84.5	1.7	0.0	13.8
2011	84.3	1.8	0.0	13.9
2012	84.2	1.8	0.0	14.0

Table A 146: Other systems in detail for young & fattening pigs >20kg 1990 – 2012.

Livestock category	Yard	Composting	Deep Litter	Aerobic Treatment	Anaerobic Digestion
Young & fattening pigs >20kg	**[%]**	**[%]**	**[%]**	**[%]**	**[%]**
1990	0.6	0.3	19.9	0.1	1.3
1991	0.6	0.3	19.1	0.1	1.4
1992	0.6	0.3	18.2	0.1	1.6
1993	0.7	0.3	17.4	0.2	1.7
1994	0.7	0.3	16.6	0.5	1.8
1995	0.7	0.3	15.8	0.6	2.0
1996	0.8	0.3	14.9	0.7	2.1
1997	0.8	0.3	14.1	0.9	2.2
1998	0.8	0.3	13.3	1.0	2.4
1999	0.9	0.3	12.5	1.5	2.5
2000	0.9	0.3	11.7	1.8	2.6
2001	1.0	0.3	10.8	2.0	2.7
2002	1.0	0.3	10.0	2.3	2.9
2003	1.0	0.3	9.2	2.5	3.0
2004	1.1	0.3	8.4	2.8	3.1
2005	1.1	0.3	7.5	2.9	3.3
2006	1.1	0.3	6.7	3.1	3.4
2007	1.2	0.3	5.9	3.3	3.5
2008	1.2	0.2	5.1	3.5	3.7
2009	1.2	0.2	5.1	3.5	3.7
2010	1.2	0.2	5.1	3.6	3.7
2011	1.2	0.2	5.1	3.8	3.7
2012	1.2	0.2	5.1	3.8	3.7

Breeding sows >50kg

Table A 147: Manure Management System distribution in Austria for breeding sows >50kg 1990 – 2012.

Livestock category	Liquid/Slurry	Solid Storage	Pasture/Range/ Paddock	Other Systems
Breeding sows >50kg	**[%]**	**[%]**	**[%]**	**[%]**
1990	67.3	17.9	0.0	14.8
1991	66.6	18.1	0.0	15.3
1992	65.9	18.3	0.0	15.8
1993	65.2	18.5	0.0	16.3
1994	64.1	18.7	0.0	17.1
1995	63.4	19.0	0.0	17.7
1996	62.6	19.2	0.0	18.2
1997	61.7	19.4	0.0	18.9

Livestock category	Liquid/Slurry	Solid Storage	Pasture/Range/ Paddock	Other Systems
Breeding sows >50kg	**[%]**	**[%]**	**[%]**	**[%]**
1998	60.9	19.6	0.0	19.5
1999	59.7	19.8	0.0	20.5
2000	58.7	20.0	0.0	21.3
2001	57.9	20.2	0.0	21.9
2002	56.9	20.4	0.0	22.7
2003	56.0	20.6	0.0	23.4
2004	55.0	20.8	0.0	24.2
2005	54.2	21.1	0.0	24.8
2006	53.3	21.3	0.0	25.4
2007	52.4	21.5	0.0	26.1
2008	51.5	21.7	0.0	26.8
2009	51.5	21.7	0.0	26.8
2010	51.4	21.8	0.0	26.9
2011	51.2	21.8	0.0	27.1
2012	51.1	21.8	0.0	27.1

Table A 148: Other systems in detail for breeding sows >50kg 1990 – 2012.

Livestock category	Yard	Composting	Deep Litter	Aerobic Treatment	Anaerobic Di-gestion
Breeding sows >50kg	**[%]**	**[%]**	**[%]**	**[%]**	**[%]**
1990	1.2	1.2	10.6	0.1	1.8
1991	1.2	1.3	10.7	0.1	1.9
1992	1.3	1.5	10.9	0.1	1.9
1993	1.4	1.6	11.1	0.2	2.0
1994	1.5	1.7	11.3	0.5	2.1
1995	1.5	1.8	11.5	0.6	2.2
1996	1.6	2.0	11.7	0.7	2.3
1997	1.7	2.1	11.9	0.9	2.4
1998	1.8	2.2	12.1	1.0	2.5
1999	1.8	2.3	12.3	1.5	2.5
2000	1.9	2.5	12.5	1.8	2.6
2001	2.0	2.6	12.7	2.0	2.7
2002	2.1	2.7	12.8	2.3	2.8
2003	2.1	2.8	13.0	2.5	2.9
2004	2.2	3.0	13.2	2.8	3.0
2005	2.3	3.1	13.4	2.9	3.1
2006	2.4	3.2	13.6	3.1	3.1
2007	2.5	3.3	13.8	3.3	3.2
2008	2.5	3.5	14.0	3.5	3.3

Livestock category	**Yard**	**Composting**	**Deep Litter**	**Aerobic Treatment**	**Anaerobic Di-gestion**
Breeding sows >50kg	**[%]**	**[%]**	**[%]**	**[%]**	**[%]**
2009	2.5	3.5	14.0	3.5	3.3
2010	2.5	3.5	14.0	3.6	3.3
2011	2.5	3.5	14.0	3.8	3.3
2012	2.5	3.5	14.0	3.8	3.3

Chicken

Table A 149: Manure Management System distribution in Austria for chicken 1990 – 2012.

Livestock category	**Liquid/Slurry (without litter)**	**Solid system (with litter)**	**Digested**
Chicken	**[%]**	**[%]**	**[%]**
1990	44.1	55.7	0.2
1991	41.9	57.9	0.3
1992	39.6	60.1	0.3
1993	37.4	62.2	0.4
1994	34.9	64.0	1.1
1995	31.6	67.1	1.3
1996	30.0	68.4	1.5
1997	30.5	67.8	1.7
1998	25.9	71.9	2.1
1999	22.8	74.3	2.9
2000	20.6	75.3	4.1
2001	18.8	76.8	4.4
2002	16.6	78.5	4.8
2003	14.5	80.5	5.1
2004	12.3	82.3	5.4
2005	10.2	84.1	5.7
2006	8.0	86.0	6.0
2007	5.9	87.5	6.6
2008	3.8	89.1	7.1
2009	3.8	88.7	7.5
2010	3.8	89.2	7.0
2011	3.8	88.8	7.4
2012	3.8	88.7	7.5

Other poultry

Table A 150: Manure Management System distribution in Austria for other poultry 1990 – 2012.

Livestock category	Liquid/Slurry (without litter)	Solid system (with litter)	Digested
Other poultry	**[%]**	**[%]**	**[%]**
1990	0.0	100.0	0.0
1991	0.0	100.0	0.0
1992	0.0	100.0	0.0
1993	0.0	100.0	0.0
1994	0.0	100.0	0.0
1995	0.0	100.0	0.0
1996	0.0	100.0	0.0
1997	0.0	100.0	0.0
1998	0.0	100.0	0.0
1999	0.0	100.0	0.0
2000	0.0	100.0	0.0
2001	0.0	100.0	0.0
2002	0.0	100.0	0.0
2003	0.0	100.0	0.0
2004	0.0	100.0	0.0
2005	0.0	100.0	0.0
2006	0.0	100.0	0.0
2007	0.0	100.0	0.0
2008	0.0	100.0	0.0
2009	0.0	100.0	0.0
2010	0.0	100.0	0.0
2011	0.0	100.0	0.0
2012	0.0	100.0	0.0

Sheep

Table A 151: Manure Management System distribution in Austria for sheep 1990 – 2012.

Livestock category	Liquid/Slurry	Solid Storage	Pasture/Range/ Paddock	Other Systems
Sheep	**[%]**	**[%]**	**[%]**	**[%]**
1990	0.0	50.0	50.0	0.0
1991	0.0	50.0	50.0	0.0
1992	0.0	50.0	50.0	0.0
1993	0.0	50.0	50.0	0.0
1994	0.0	50.0	50.0	0.0
1995	0.0	50.0	50.0	0.0
1996	0.0	50.0	50.0	0.0

Livestock category	Liquid/Slurry	Solid Storage	Pasture/Range/ Paddock	Other Systems
Sheep	**[%]**	**[%]**	**[%]**	**[%]**
1997	0.0	50.0	50.0	0.0
1998	0.0	50.0	50.0	0.0
1999	0.0	50.0	50.0	0.0
2000	0.0	50.0	50.0	0.0
2001	0.0	50.0	50.0	0.0
2002	0.0	50.0	50.0	0.0
2003	0.0	50.0	50.0	0.0
2004	0.0	50.0	50.0	0.0
2005	0.0	50.0	50.0	0.0
2006	0.0	50.0	50.0	0.0
2007	0.0	50.0	50.0	0.0
2008	0.0	50.0	50.0	0.0
2009	0.0	50.0	50.0	0.0
2010	0.0	50.0	50.0	0.0
2011	0.0	50.0	50.0	0.0
2012	0.0	50.0	50.0	0.0

Goats

Table A 152: Manure Management System distribution in Austria for goats 1990 – 2012.

Livestock category	Liquid/Slurry	Solid Storage	Pasture/Range/ Paddock	Other Systems
Goats	**[%]**	**[%]**	**[%]**	**[%]**
1990	0.0	50.0	50.0	0.0
1991	0.0	50.0	50.0	0.0
1992	0.0	50.0	50.0	0.0
1993	0.0	50.0	50.0	0.0
1994	0.0	50.0	50.0	0.0
1995	0.0	50.0	50.0	0.0
1996	0.0	50.0	50.0	0.0
1997	0.0	50.0	50.0	0.0
1998	0.0	50.0	50.0	0.0
1999	0.0	50.0	50.0	0.0
2000	0.0	50.0	50.0	0.0
2001	0.0	50.0	50.0	0.0
2002	0.0	50.0	50.0	0.0
2003	0.0	50.0	50.0	0.0
2004	0.0	50.0	50.0	0.0
2005	0.0	50.0	50.0	0.0
2006	0.0	50.0	50.0	0.0

Livestock category	Liquid/Slurry	Solid Storage	Pasture/Range/ Paddock	Other Systems
Goats	**[%]**	**[%]**	**[%]**	**[%]**
2007	0.0	50.0	50.0	0.0
2008	0.0	50.0	50.0	0.0
2009	0.0	50.0	50.0	0.0
2010	0.0	50.0	50.0	0.0
2011	0.0	50.0	50.0	0.0
2012	0.0	50.0	50.0	0.0

Horses

Table A 153: Manure Management System distribution in Austria for horses 1990 – 2012.

Horses	Liquid/Slurry	Solid Storage	Pasture/Range/ Paddock	Other Systems (Digested)
	[%]	**[%]**	**[%]**	**[%]**
1990	0.0	79.8	20.0	0.2
1991	0.0	79.7	20.0	0.3
1992	0.0	79.7	20.0	0.3
1993	0.0	79.6	20.0	0.4
1994	0.0	79.0	20.0	1.0
1995	0.0	79.0	20.0	1.0
1996	0.0	78.9	20.0	1.1
1997	0.0	78.6	20.0	1.4
1998	0.0	78.4	20.0	1.6
1999	0.0	77.9	20.0	2.1
2000	0.0	77.6	20.0	2.4
2001	0.0	77.2	20.0	2.8
2002	0.0	76.9	20.0	3.1
2003	0.0	76.9	20.0	3.1
2004	0.0	76.6	20.0	3.4
2005	0.0	76.5	20.0	3.5
2006	0.0	76.3	20.0	3.7
2007	0.0	75.9	20.0	4.1
2008	0.0	76.9	20.0	3.1
2009	0.0	77.9	20.0	2.1
2010	0.0	78.9	20.0	1.1
2011	0.0	80.0	20.0	0.0
2012	0.0	80.0	20.0	0.0

Other animals (deer)

Table A 154: Manure Management System distribution in Austria for other animals (deer) 1990 – 2012.

Livestock category	Liquid/Slurry	Solid Storage	Pasture/Range/ Paddock	Other Systems
Other animals (deer)	**[%]**	**[%]**	**[%]**	**[%]**
1990	0.0	50.0	50.0	0.0
1991	0.0	50.0	50.0	0.0
1992	0.0	50.0	50.0	0.0
1993	0.0	50.0	50.0	0.0
1994	0.0	50.0	50.0	0.0
1995	0.0	50.0	50.0	0.0
1996	0.0	50.0	50.0	0.0
1997	0.0	50.0	50.0	0.0
1998	0.0	50.0	50.0	0.0
1999	0.0	50.0	50.0	0.0
2000	0.0	50.0	50.0	0.0
2001	0.0	50.0	50.0	0.0
2002	0.0	50.0	50.0	0.0
2003	0.0	50.0	50.0	0.0
2004	0.0	50.0	50.0	0.0
2005	0.0	50.0	50.0	0.0
2006	0.0	50.0	50.0	0.0
2007	0.0	50.0	50.0	0.0
2008	0.0	50.0	50.0	0.0
2009	0.0	50.0	50.0	0.0
2010	0.0	50.0	50.0	0.0
2011	0.0	50.0	50.0	0.0
2012	0.0	50.0	50.0	0.0

Austria's N-flow model

For the calculation of N_2O emissions from agricultural soils Austria uses country specific methods which are consistent with the N-flow approach. IPCC does not provide higher Tier methods for the calculation of N_2O emissions from agricultural soils. The approach used by Austria is more complex than the IPCC Tier 1b method in order to allow for the consideration of the management practices in Austria as those may differ from other countries.

As recommended in the EMEP/EEA Emission Inventory Guidebook 2013 for higher tier methods, NH_3 emissions from cattle and swine are calculated on the basis of the amount of total ammoniacal nitrogen (TAN). TAN is present in the urine of animals and considered to be equivalent to the N content of urine. This calculation method is more precise than the calculation on the basis of total N excretion because emissions of NH_3 arise from TAN. The calculation addresses both N pools (N excretion and TAN) for the different stages of manure management (housing -> storage -> spreading) in terms of NH_3, NO_x and N_2O emissions and includes information of the total N amount within each relevant stage (N excretion), and the fraction of that amount that is present as TAN. Detailed information on parameters and methods used is provided in Austria's Informative Inventory Report 2014, chapter 6 (UMWELTBUNDESAMT 2014).

The N-flow model used by Austria was developed by the University of Natural Resources and Applied Life Sciences Vienna on behalf of the Umweltbundesamt in 2001 and further improved in 2008 and 2009 (AMON et al. 2002, 2008 & 2010). Calculations are in line with the revised 1996 IPCC guidelines, the IPCC Good Practice Guidance 2002 and the EMEP/EEA guidebook 2013.

The following figure illustrates the pathways of N in the calculation of N-species emissions from the N excreted by livestock.

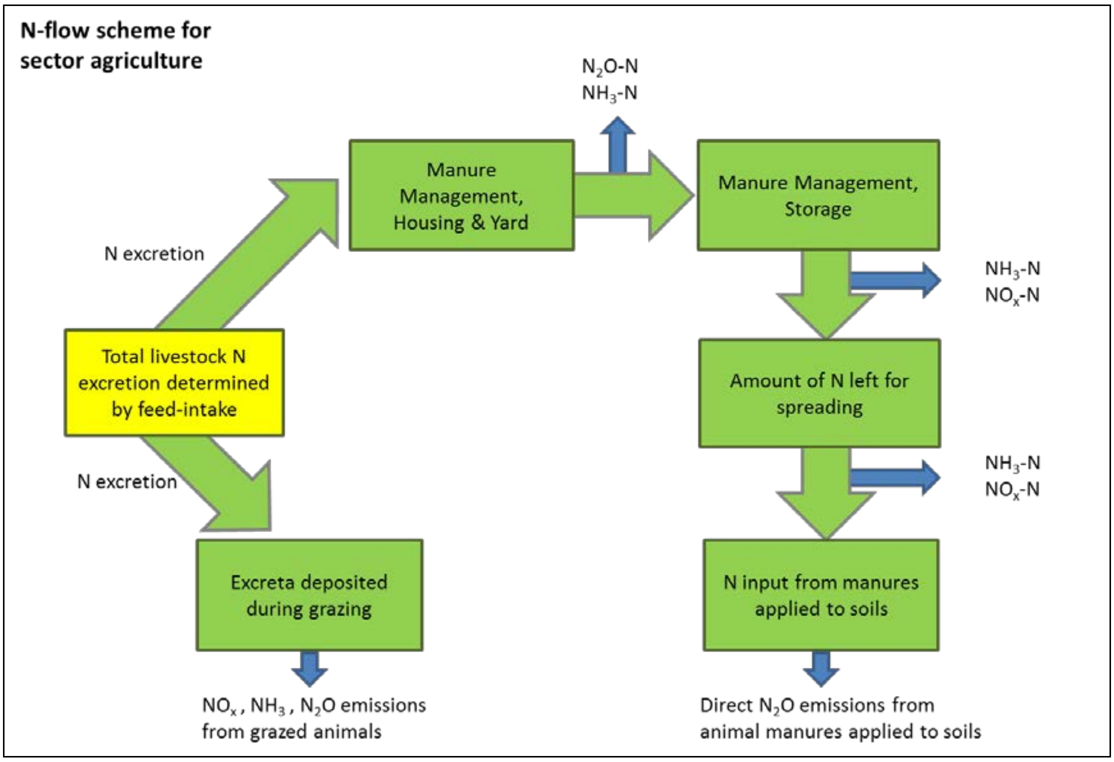

Figure 4 Schematic diagram of the Austrian N flow

For the calculation of N_2O emissions occurring from N-input from manures applied to soils, the chain beginning with the feeding, the housing, the transfer to the storage, the transfer to the application machine and finally the spreading to the fields is relevant. All those emissions are accounted at the appropriate stage of the process.

Feeding

In the first step, N excretion for a given animal category is determined on the basis of national feed-intake data.

Grazing

In the second step the resulting N amount relating to the share excreted on pasture is subtracted based on the proportion of time spent on pasture.

<u>Housing:</u>

For each animal category, the amount of N accruing from the housing is split based on the relative share of animal-housing systems used in Austria. These systems vary in terms of their emission behaviour (e.g. tied and loose housing systems, liquid versus solid manure systems).

<u>Storage:</u>

The remaining N is then transferred to the different storage systems used in Austria (e.g. covered or uncovered storage).

For all stages of manure NH_3 emissions from cattle and swine are calculated in proportion to the available TAN amount. Emission factors were derived from the Swiss DYNAMO-model, peer reviewed by the EAGER group and published in (REIDY et al. 2008, 2009). For the calculation of NH_3-N losses from the other animal categories (no key sources), default NH_3 emission factors were used.[4]

N losses from manure management resulting from emissions of N_2O and NO_x are calculated on the basis of N excretion per AWMS, jointly for housing and storage, as recommended by the IPCC guidelines. Throughout the inventory the same AWMS distribution is used.

<u>Application on agricultural soils</u>

The remaining amount of animal manure nitrogen ("N left for spreading") is split according the different application techniques used in Austria (broadcast spreading, band spreading).

NH_3 and NO_X emissions

At this stage volatile losses of NH_3-N and NO_x-N are considered in the calculations according to different application procedures which result in different N-losses. In particular, volatile NH_3-N losses of cattle and swine manure are subtracted from the TAN content per animal category; volatile losses from NO_x are subtracted from the N amount per animal category available for spreading.

Direct N_2O-emissions

The remaining amount of N corresponds to the amount which is available in the soil for microbial processes of nitrification and denitrification resulting in the production of direct N_2O emissions.

Indirect N_2O emissions from leaching and run-off

Calculation basis is the nitrogen amount available for application on soils ("N left for spreading") as a result from the Austrian N-flow model. This amount is multiplied with the default value of $Frac_{LEACH}$.

At present specific research activities are going on at the Institute for Land & Water Management Research Petzenkirchen (Federal Agency for Water Management) in cooperation with the Institute of Hydraulic Engineering and Water Resources Management (Vienna University of Technology). Within the national research project a CS value of $Frac_{LEACH}$ will be derived, first results indicate that this factor is considerable smaller than the IPCC default value of 0.3 currently used in the Austrian inventory (EDER et al. 2013). The final report is expected for autumn 2014.

[4] Emission factors for different categories of animals differ to the extent they include the processes identified in Figure 1

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

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

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

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

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

Choosing to apply a quasi-standardized value conforms to the claim of (WINIWARTER 2007) that application of similar parameters between countries allows for a smaller error in an inter-comparison, even if the difference to a "true value" might be larger.

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

Table A 155: Tier 1 Uncertainty Analysis (Table 6.1 GPG) – excluding LULUCF

IPCC Key category	Gas	Base year emissions 1990	Year 2012 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	√ (E² + F²)	G * D / ∑D	Note B	D / ∑C	I * F Note C	J * E * √2 Note D	√ (K² + L2)
		Gg CO2 equivalent	Gg CO2 equivalent	%	%	%	%	%	%	%	%	%
1.A Stationary Combustion - Biomass	CH4	318	201	5.0	50.0	50.2	0.13	0.00	0.00	-0.08	0.02	0.08
1.A Stationary Combustion - Biomass	N2O	110	230	5.0	50.0	50.2	0.14	0.00	0.00	0.08	0.02	0.08
1.A Stationary Combustion - Gaseous Fuels	CH4	7	7	2.0	50.0	50.0	0.00	0.00	0.00	0.00	0.00	0.00
1.A Stationary Combustion - Gaseous Fuels	CO2	11 076	16 093	2.0	0.5	2.1	0.41	0.06	0.21	0.03	0.58	0.58
1.A Stationary Combustion - Gaseous Fuels	N2O	26	38	2.0	50.0	50.0	0.02	0.00	0.00	0.01	0.00	0.01
1.A Stationary Combustion - Liquid Fuels	CH4	6	4	0.5	50.0	50.0	0.00	0.00	0.00	0.00	0.00	0.00
1.A Stationary Combustion - Liquid Fuels	CO2	14 538	9 975	0.5	0.5	0.7	0.09	-0.06	0.13	-0.03	0.09	0.10
1.A Stationary Combustion - Liquid Fuels	N2O	162	148	0.5	50.0	50.0	0.09	0.00	0.00	-0.01	0.00	0.01
1.A Stationary Combustion - Other fuels	CH4	2	8	10.0	50.0	51.0	0.01	0.00	0.00	0.00	0.00	0.00
1.A Stationary Combustion - Other fuels	CO2	732	2 216	10.0	20.0	22.4	0.62	0.02	0.03	0.38	0.40	0.55
1.A Stationary Combustion - Other fuels	N2O	4	15	10.0	50.0	51.0	0.01	0.00	0.00	0.01	0.00	0.01
1.A Stationary Combustion - Solid Fuels	CH4	65	6	0.5	50.0	50.0	0.00	0.00	0.00	-0.04	0.00	0.04
1.A Stationary Combustion - Solid Fuels	CO2	13 917	8 547	0.5	0.5	0.7	0.08	-0.07	0.11	-0.04	0.08	0.09
1.A Stationary Combustion - Solid Fuels	N2O	60	38	0.5	50.0	50.0	0.02	0.00	0.00	-0.01	0.00	0.01
1.A.3.a Transport - Civil Aviation	CH4	0	0	3.0	30.0	30.1	0.00	0.00	0.00	0.00	0.00	0.00
1.A.3.a Transport - Civil Aviation	CO2	32	55	3.0	3.0	4.2	0.00	0.00	0.00	0.00	0.00	0.00
1.A.3.a Transport - Civil Aviation	N2O	0	1	3.0	30.0	30.1	0.00	0.00	0.00	0.00	0.00	0.00
1.A.3.b Transport - Road Transportation - Diesel	CH4	2	3	3.0	30.0	30.1	0.00	0.00	0.00	0.00	0.00	0.00
1.A.3.b Transport - Road Transportation - Diesel	CO2	5 361	15 808	3.0	3.0	4.2	0.84	0.13	0.20	0.40	0.86	0.95
1.A.3.b Transport - Road Transportation - Diesel	N2O	41	129	3.0	30.0	30.1	0.05	0.00	0.00	0.03	0.01	0.03
1.A.3.b Transport - Road Transportation - Gaseous	CO2	0	24	3.0	3.0	4.2	0.00	0.00	0.00	0.00	0.00	0.00
1.A.3.b Transport - Road Transportation - Gasoline	CH4	62	9	3.0	30.0	30.1	0.00	0.00	0.00	-0.02	0.00	0.02
1.A.3.b Transport - Road Transportation - Gasoline	CO2	7 936	4 950	3.0	3.0	4.2	0.26	-0.04	0.06	-0.12	0.27	0.30
1.A.3.b Transport - Road Transportation - Gasoline	N2O	133	58	3.0	70.0	70.1	0.05	0.00	0.00	-0.07	0.00	0.07
1.A.3.b Transport - Road Transportation - LPG	CO2	27	54	3.0	3.0	4.2	0.00	0.00	0.00	0.00	0.00	0.00
1.A.3.c Transport - Railways	CH4	0	0	3.0	30.0	30.1	0.00	0.00	0.00	0.00	0.00	0.00
1.A.3.c Transport - Railways	CO2	178	124	3.0	3.0	4.2	0.01	0.00	0.00	0.00	0.01	0.01
1.A.3.c Transport - Railways	N2O	19	16	3.0	30.0	30.1	0.01	0.00	0.00	0.00	0.00	0.00
1.A.3.d Transport - Navigation	CH4	0	0	3.0	30.0	30.1	0.00	0.00	0.00	0.00	0.00	0.00
1.A.3.d Transport - Navigation	CO2	14	12	3.0	3.0	4.2	0.00	0.00	0.00	0.00	0.00	0.00
1.A.3.d Transport - Navigation	N2O	1	0	3.0	70.0	70.1	0.00	0.00	0.00	0.00	0.00	0.00
1.A.3.e Transport - Other Transportation	CH4	0	0	2.0	50.0	50.0	0.00	0.00	0.00	0.00	0.00	0.00
1.A.3.e Transport - Other Transportation	CO2	224	394	2.0	0.5	2.1	0.01	0.00	0.01	0.00	0.01	0.01
1.A.3.e Transport - Other Transportation	N2O	0	0	2.0	50.0	50.0	0.00	0.00	0.00	0.00	0.00	0.00
1.A.5.b Mobile	CH4	0	0	1.0	50.0	50.0	0.00	0.00	0.00	0.00	0.00	0.00
1.A.5.b Mobile	CO2	35	47	1.0	0.5	1.1	0.00	0.00	0.00	0.00	0.00	0.00
1.A.5.b Mobile	N2O	1	1	1.0	50.0	50.0	0.00	0.00	0.00	0.00	0.00	0.00

IPCC Key category	Gas	Base year emissions 1990	Year 2012 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	√ (E² + F²)	G * D / ∑D	Note B	D / ∑C	I * F Note C	J * E * √2 Note D	√ (K² + L2)
		Gg CO2 equivalent	Gg CO2 equivalent	%	%	%	%	%	%	%	%	%
1.B.1.a Fugitive Emission - Coal Mining and Handling	CH4	11	0	5.0	50.0	50.2	0.00	0.00	0.00	-0.01	0.00	0.01
1.B.1.b Fugitive Emission - Solid Fuel Transformation	CH4	1	1	100.0	100.0	141.4	0.00	0.00	0.00	0.00	0.00	0.00
1.B.2.a Fugitive Emission from Oil	CH4	126	133	0.5	50.0	50.0	0.08	0.00	0.00	0.00	0.00	0.00
1.B.2.a Fugitive Emission from Oil	CO2	43	145	0.5	0.5	0.7	0.00	0.00	0.00	0.00	0.00	0.00
1.B.2.b Fugitive Emission from Natural Gas	CH4	96	110	5.0	10.0	11.2	0.02	0.00	0.00	0.00	0.01	0.01
1.B.2.b Fugitive Emission from Natural Gas	CO2	59	92	5.0	0.5	5.0	0.01	0.00	0.00	0.00	0.01	0.01
2.A.1 Cement Production	CO2	2 033	1 673	1.1	2.0	2.3	0.05	-0.01	0.02	-0.01	0.03	0.03
2.A.2 Lime Production	CO2	396	569	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	256	19.6	2.0	19.7	0.06	0.00	0.00	0.00	0.09	0.09
2.A.4 Soda Ash Use	CO2	5	14	0.0	0.0	0.0	0.00	0.00	0.00	0.00	0.00	0.00
2.A.7.a Glass, Bricks and Ceramics - Bricks and Tiles (decarbonizing)	CO2	116	93	2.0	5.0	5.4	0.01	0.00	0.00	0.00	0.00	0.00
2.A.7.b Glass, Bricks and Ceramics - Sinter Production	CO2	481	305	2.0	5.0	5.4	0.02	0.00	0.00	-0.01	0.01	0.02
2.A.7.c Glass, Bricks and Ceramics - Glass Production	CO2	39	37	2.1	5.0	5.4	0.00	0.00	0.00	0.00	0.00	0.00
2.B.1 Chemical Industry - Ammonia Production	CH4	1	2	2.0	5.0	5.4	0.00	0.00	0.00	0.00	0.00	0.00
2.B.1 Chemical Industry - Ammonia Production	CO2	472	511	2.0	0.0	2.0	0.01	0.00	0.01	0.00	0.02	0.02
2.B.2 Chemical Industry - Nitric Acid Production	CO2	0	0	2.0	0.5	2.1	0.00	0.00	0.00	0.00	0.00	0.00
2.B.2 Chemical Industry - Nitric Acid Production	N2O	912	53	2.0	5.0	5.4	0.00	-0.01	0.00	-0.06	0.00	0.06
2.B.4 Chemical Industry - Carbide Production	CO2	38	49	0.0	0.0	0.0	0.00	0.00	0.00	0.00	0.00	0.00
2.B.4 Chemical Industry - Carbide Production	N2O	0	0	0.0	0.0	0.0	0.00	0.00	0.00	0.00	0.00	0.00
2.B.5 Chemical Industry - Other	CH4	13	17	2.0	50.0	50.0	0.01	0.00	0.00	0.00	0.00	0.00
2.B.5 Chemical Industry - Other	CO2	31	28	2.0	0.5	2.1	0.00	0.00	0.00	0.00	0.00	0.00
2.C.1 Metal Production - Iron and Steel Production	CH4	0	0	0.5	50.0	50.0	0.00	0.00	0.00	0.00	0.00	0.00
2.C.1 Metal Production - Iron and Steel Production	CO2	3 546	5 454	0.5	0.5	0.7	0.05	0.02	0.07	0.01	0.05	0.05
2.C.2 Metal Production - Ferroalloys Production	CO2	21	20	2.0	0.5	2.1	0.00	0.00	0.00	0.00	0.00	0.00
2.C.3 Metal Production - Aluminium production	CO2	158	0	2.0	0.5	2.1	0.00	0.00	0.00	0.00	0.00	0.00
2.C.3 Metal Production - Aluminium production	PFC	994	0	2.0	50.0	50.0	0.00	-0.01	0.00	-0.65	0.00	0.65
2.C.3 Metal Production - SF6 Used in Aluminium and Magnesium Foundr	SF6	253	5	0.0	5.0	5.0	0.00	0.00	0.00	-0.02	0.00	0.02
2.F.1 Refrigeration and Air Conditioning Equipment	HFC	0	1 389	20.0	50.0	53.9	0.93	0.02	0.02	0.89	0.50	1.02
2.F.2 Foam Blowing	HFC	0	12	20.0	50.0	53.9	0.01	0.00	0.00	0.01	0.00	0.01
2.F.3 Fire Extinguishers	HFC	0	10	20.0	50.0	53.9	0.01	0.00	0.00	0.01	0.00	0.01
2.F.4 Aerosols	HFC	20	19	20.0	50.0	53.9	0.01	0.00	0.00	0.00	0.01	0.01
2.F.5 Solvents	HFC	0	0	20.0	50.0	53.9	0.00	0.00	0.00	0.00	0.00	0.00
2.F.7 Semiconductor Manufacture	HFC	2	2	5.0	10.0	11.2	0.00	0.00	0.00	0.00	0.00	0.00
2.F.7 Semiconductor Manufacture	PFC	29	40	5.0	10.0	11.2	0.01	0.00	0.00	0.00	0.00	0.00
2.F.7 Semiconductor Manufacture	SF6	102	42	5.0	10.0	11.2	0.01	0.00	0.00	-0.01	0.00	0.01
2.F.8 Electrical equipment	SF6	11	32	25.0	50.0	55.9	0.02	0.00	0.00	0.01	0.01	0.02
2.F.9 Other Sources of SF6	PFC	0	0	25.0	50.0	55.9	0.00	0.00	0.00	0.00	0.00	0.00
2.F.9 Other Sources of SF6	SF6	127	247	25.0	50.0	55.9	0.17	0.00	0.00	0.08	0.11	0.13

IPCC Key category	Gas	Base year emissions 1990	Year 2012 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	√ (E² + F²)	G * D / ∑D	Note B	D / ∑C	I * F Note C	J * E * √2 Note D	√ (K² + L2)
		Gg CO2 equivalent	Gg CO2 equivalent	%	%	%	%	%	%	%	%	%
3.A Paint Application	CO2	118	59	5.0	10.0	11.2	0.01	0.00	0.00	-0.01	0.01	0.01
3.B Degreasing and Dry Cleaning	CO2	36	29	0.0	0.0	0.0	0.00	0.00	0.00	0.00	0.00	0.00
3.C Chemical Products, Manufacture and Processing	CO2	28	13	0.0	0.0	0.0	0.00	0.00	0.00	0.00	0.00	0.00
3.D Other	CO2	98	88	5.0	10.0	11.2	0.01	0.00	0.00	0.00	0.01	0.01
3.D Other	N2O	233	146	5.0	20.0	20.6	0.04	0.00	0.00	-0.02	0.01	0.03
4.A.1 Cattle	CH4	3 551	2 985	10.0	20.0	22.4	0.83	-0.01	0.04	-0.17	0.54	0.57
4.A.3 Sheep	CH4	52	61	10.0	20.0	22.4	0.02	0.00	0.00	0.00	0.01	0.01
4.A.4 Goats	CH4	4	8	10.0	30.0	31.6	0.00	0.00	0.00	0.00	0.00	0.00
4.A.6 Horses	CH4	19	31	10.0	30.0	31.6	0.01	0.00	0.00	0.00	0.01	0.01
4.A.8 Swine	CH4	116	94	10.0	30.0	31.6	0.04	0.00	0.00	-0.01	0.02	0.02
4.A.9 Poultry	CH4	6	6	10.0	30.0	31.6	0.00	0.00	0.00	0.00	0.00	0.00
4.A-10 Other	CH4	6	8	10.0	30.0	31.6	0.00	0.00	0.00	0.00	0.00	0.00
4.B.1 Cattle	CH4	283	224	10.0	50.0	51.0	0.14	0.00	0.00	-0.04	0.04	0.06
4.B.1 Cattle	N2O	759	731	10.0	100.0	100.5	0.92	0.00	0.01	-0.06	0.13	0.15
4.B.3 Sheep	CH4	1	1	10.0	50.0	51.0	0.00	0.00	0.00	0.00	0.00	0.00
4.B.3 Sheep	N2O	20	23	10.0	100.0	100.5	0.03	0.00	0.00	0.00	0.00	0.01
4.B.4 Goats	CH4	0	0	10.0	50.0	51.0	0.00	0.00	0.00	0.00	0.00	0.00
4.B.4 Goats	N2O	2	4	10.0	100.0	100.5	0.01	0.00	0.00	0.00	0.00	0.00
4.B.6 Horses	CH4	1	2	10.0	50.0	51.0	0.00	0.00	0.00	0.00	0.00	0.00
4.B.6 Horses	N2O	18	30	10.0	100.0	100.5	0.04	0.00	0.00	0.01	0.01	0.02
4.B.8 Swine	CH4	123	73	10.0	50.0	51.0	0.05	0.00	0.00	-0.03	0.01	0.04
4.B.8 Swine	N2O	87	55	10.0	100.0	100.5	0.07	0.00	0.00	-0.04	0.01	0.04
4.B.9 Poultry	CH4	23	22	10.0	50.0	51.0	0.01	0.00	0.00	0.00	0.00	0.00
4.B.9 Poultry	N2O	46	71	10.0	100.0	100.5	0.09	0.00	0.00	0.03	0.01	0.03
4.B-10 Other	CH4	0	0	10.0	50.0	51.0	0.00	0.00	0.00	0.00	0.00	0.00
4.B-10 Other	N2O	2	3	10.0	100.0	100.5	0.00	0.00	0.00	0.00	0.00	0.00
4.D Agricultural Soils	CH4	7	9	5.0	100.0	100.1	0.01	0.00	0.00	0.00	0.00	0.00
4.D Agricultural Soils	N2O	3 430	3 055	5.0	150.0	150.1	5.73	-0.01	0.04	-0.89	0.28	0.93
4.F Field Burning of Agricultural Residues	CH4	1	1	100.0	40.0	107.7	0.00	0.00	0.00	0.00	0.00	0.00
4.F Field Burning of Agricultural Residues	N2O	0	0	100.0	50.0	111.8	0.00	0.00	0.00	0.00	0.00	0.00
6. D Other Waste	CH4	11	54	15.0	0.0	15.0	0.01	0.00	0.00	0.00	0.01	0.01
6. D Other Waste	N2O	24	110	15.0	0.0	15.0	0.02	0.00	0.00	0.00	0.03	0.03
6.A Solid Waste Disposal on Land	CH4	3 314	1 201	12.0	25.0	27.7	0.42	-0.03	0.02	-0.70	0.26	0.75
6.B Wastewater Handling	CH4	102	23	20.0	50.0	53.9	0.02	0.00	0.00	-0.05	0.01	0.05
6.B Wastewater Handling	N2O	109	266	20.0	50.0	53.9	0.18	0.00	0.00	0.10	0.10	0.14
6.C Waste Incineration	CH4	0	0	7.0	0.0	7.0	0.00	0.00	0.00	0.00	0.00	0.00
6.C Waste Incineration	CO2	27	2	7.0	20.0	21.2	0.00	0.00	0.00	-0.01	0.00	0.01
6.C Waste Incineration	N2O	0.1	0.0	7.0	0.0	7.0	0.00	0.00	0.00	0.00	0.00	0.00
Total Key Categories excluding LULUCF	Gg CO2 e	**78 086**	**80 059**				**6.07**					**2.23**

Table A 156: Tier 1 Uncertainty Analysis (Table 6.1 GPG) – including LULUCF

IPCC Key category	Gas	Base year emissions 1990	Year 2012 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	√ (E² + F²)	G * D / ∑D	Note B	D / ∑C	I * F Note C	J * E * √2 Note D	√ (K² + L2)
		Gg CO2 equivalent	Gg CO2 equivalent	%	%	%	%	%	%	%	%	%
1.A Stationary Combustion - Biomass	CH4	318	201	5.0	50.0	50.2	0.13	0.00	0.00	-0.11	0.02	0.12
1.A Stationary Combustion - Biomass	N2O	110	230	5.0	50.0	50.2	0.15	0.00	0.00	0.08	0.02	0.08
1.A Stationary Combustion - Gaseous Fuels	CH4	7	7	2.0	50.0	50.0	0.00	0.00	0.00	0.00	0.00	0.00
1.A Stationary Combustion - Gaseous Fuels	CO2	11 076	16 093	2.0	0.5	2.1	0.44	0.05	0.24	0.03	0.67	0.67
1.A Stationary Combustion - Gaseous Fuels	N2O	26	38	2.0	50.0	50.0	0.03	0.00	0.00	0.01	0.00	0.01
1.A Stationary Combustion - Liquid Fuels	CH4	6	4	0.5	50.0	50.0	0.00	0.00	0.00	0.00	0.00	0.00
1.A Stationary Combustion - Liquid Fuels	CO2	14 538	9 975	0.5	0.5	0.7	0.09	-0.09	0.15	-0.05	0.10	0.11
1.A Stationary Combustion - Liquid Fuels	N2O	162	148	0.5	50.0	50.0	0.10	0.00	0.00	-0.02	0.00	0.02
1.A Stationary Combustion - Other fuels	CH4	2	8	10.0	50.0	51.0	0.01	0.00	0.00	0.00	0.00	0.00
1.A Stationary Combustion - Other fuels	CO2	732	2 216	10.0	20.0	22.4	0.65	0.02	0.03	0.41	0.46	0.62
1.A Stationary Combustion - Other fuels	N2O	4	15	10.0	50.0	51.0	0.01	0.00	0.00	0.01	0.00	0.01
1.A Stationary Combustion - Solid Fuels	CH4	65	6	0.5	50.0	50.0	0.00	0.00	0.00	-0.05	0.00	0.05
1.A Stationary Combustion - Solid Fuels	CO2	13 917	8 547	0.5	0.5	0.7	0.08	-0.10	0.13	-0.05	0.09	0.10
1.A Stationary Combustion - Solid Fuels	N2O	60	38	0.5	50.0	50.0	0.03	0.00	0.00	-0.02	0.00	0.02
1.A.3.a Transport - Civil Aviation	CH4	0	0	3.0	30.0	30.1	0.00	0.00	0.00	0.00	0.00	0.00
1.A.3.a Transport - Civil Aviation	CO2	32	55	3.0	3.0	4.2	0.00	0.00	0.00	0.00	0.00	0.00
1.A.3.a Transport - Civil Aviation	N2O	0	1	3.0	30.0	30.1	0.00	0.00	0.00	0.00	0.00	0.00
1.A.3.b Transport - Road Transportation - Diesel	CH4	2	3	3.0	30.0	30.1	0.00	0.00	0.00	0.00	0.00	0.00
1.A.3.b Transport - Road Transportation - Diesel	CO2	5 361	15 808	3.0	3.0	4.2	0.88	0.14	0.23	0.43	0.98	1.07
1.A.3.b Transport - Road Transportation - Diesel	N2O	41	129	3.0	30.0	30.1	0.05	0.00	0.00	0.04	0.01	0.04
1.A.3.b Transport - Road Transportation - Gaseous	CO2	0	24	3.0	3.0	4.2	0.00	0.00	0.00	0.00	0.00	0.00
1.A.3.b Transport - Road Transportation - Gasoline	CH4	62	9	3.0	30.0	30.1	0.00	0.00	0.00	-0.03	0.00	0.03
1.A.3.b Transport - Road Transportation - Gasoline	CO2	7 936	4 950	3.0	3.0	4.2	0.28	-0.06	0.07	-0.17	0.31	0.35
1.A.3.b Transport - Road Transportation - Gasoline	N2O	133	58	3.0	70.0	70.1	0.05	0.00	0.00	-0.09	0.00	0.09
1.A.3.b Transport - Road Transportation - LPG	CO2	27	54	3.0	3.0	4.2	0.00	0.00	0.00	0.00	0.00	0.00
1.A.3.c Transport - Railways	CH4	0	0	3.0	30.0	30.1	0.00	0.00	0.00	0.00	0.00	0.00
1.A.3.c Transport - Railways	CO2	178	124	3.0	3.0	4.2	0.01	0.00	0.00	0.00	0.01	0.01
1.A.3.c Transport - Railways	N2O	19	16	3.0	30.0	30.1	0.01	0.00	0.00	0.00	0.00	0.00
1.A.3.d Transport - Navigation	CH4	0	0	3.0	30.0	30.1	0.00	0.00	0.00	0.00	0.00	0.00
1.A.3.d Transport - Navigation	CO2	14	12	3.0	3.0	4.2	0.00	0.00	0.00	0.00	0.00	0.00
1.A.3.d Transport - Navigation	N2O	1	0	3.0	70.0	70.1	0.00	0.00	0.00	0.00	0.00	0.00
1.A.3.e Transport - Other Transportation	CH4	0	0	2.0	50.0	50.0	0.00	0.00	0.00	0.00	0.00	0.00
1.A.3.e Transport - Other Transportation	CO2	224	394	2.0	0.5	2.1	0.01	0.00	0.01	0.00	0.02	0.02
1.A.3.e Transport - Other Transportation	N2O	0	0	2.0	50.0	50.0	0.00	0.00	0.00	0.00	0.00	0.00
1.A.5.b Mobile	CH4	0	0	1.0	50.0	50.0	0.00	0.00	0.00	0.00	0.00	0.00
1.A.5.b Mobile	CO2	35	47	1.0	0.5	1.1	0.00	0.00	0.00	0.00	0.00	0.00
1.A.5.b Mobile	N2O	1	1	1.0	50.0	50.0	0.00	0.00	0.00	0.00	0.00	0.00

IPCC Key category	Gas	Base year emissions 1990	Year 2012 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 / ∑D	Note B	D / ∑C	I * F Note C	J * E * √2 Note D	$\sqrt{K^2 + L^2}$
		Gg CO_2 equivalent	Gg CO_2 equivalent	%	%	%	%	%	%	%	%	%
1.B.1.a Fugitive Emission - Coal Mining and Handling	CH_4	11	0	5.0	50.0	50.2	0.00	0.00	0.00	-0.01	0.00	0.01
1.B.1.b Fugitive Emission - Solid Fuel Transformation	CH_4	1	1	100.0	100.0	141.4	0.00	0.00	0.00	0.00	0.00	0.00
1.B.2.a Fugitive Emission from Oil	CH_4	126	133	0.5	50.0	50.0	0.09	0.00	0.00	-0.01	0.00	0.01
1.B.2.a Fugitive Emission from Oil	CO_2	43	145	0.5	0.5	0.7	0.00	0.00	0.00	0.00	0.00	0.00
1.B.2.b Fugitive Emission from Natural Gas	CH_4	96	110	5.0	10.0	11.2	0.02	0.00	0.00	0.00	0.01	0.01
1.B.2.b Fugitive Emission from Natural Gas	CO_2	59	92	5.0	0.5	5.0	0.01	0.00	0.00	0.00	0.01	0.01
2.A.1 Cement Production	CO_2	2 033	1 673	1.1	2.0	2.3	0.05	-0.01	0.02	-0.02	0.04	0.04
2.A.2 Lime Production	CO_2	396	569	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	CO_2	203	256	19.6	2.0	19.7	0.07	0.00	0.00	0.00	0.10	0.10
2.A.4 Soda Ash Use	CO_2	5	14	0.0	0.0	0.0	0.00	0.00	0.00	0.00	0.00	0.00
2.A.7.a Glass, Bricks and Ceramics - Bricks and Tiles (decarbonizing)	CO_2	116	93	2.0	5.0	5.4	0.01	0.00	0.00	0.00	0.00	0.00
2.A.7.b Glass, Bricks and Ceramics - Sinter Production	CO_2	481	305	2.0	5.0	5.4	0.02	0.00	0.00	-0.02	0.01	0.02
2.A.7.c Glass, Bricks and Ceramics - Glass Production	CO_2	39	37	2.1	5.0	5.4	0.00	0.00	0.00	0.00	0.00	0.00
2.B.1 Chemical Industry - Ammonia Production	CH_4	1	2	2.0	5.0	5.4	0.00	0.00	0.00	0.00	0.00	0.00
2.B.1 Chemical Industry - Ammonia Production	CO_2	472	511	2.0	0.0	2.0	0.01	0.00	0.01	0.00	0.02	0.02
2.B.2 Chemical Industry - Nitric Acid Production	CO_2	0	0	2.0	0.5	2.1	0.00	0.00	0.00	0.00	0.00	0.00
2.B.2 Chemical Industry - Nitric Acid Production	N_2O	912	53	2.0	5.0	5.4	0.00	-0.01	0.00	-0.07	0.00	0.07
2.B.4 Chemical Industry - Carbide Production	CO_2	38	49	0.0	0.0	0.0	0.00	0.00	0.00	0.00	0.00	0.00
2.B.4 Chemical Industry - Carbide Production	N_2O	0	0	0.0	0.0	0.0	0.00	0.00	0.00	0.00	0.00	0.00
2.B.5 Chemical Industry - Other	CH_4	13	17	2.0	50.0	50.0	0.01	0.00	0.00	0.00	0.00	0.00
2.B.5 Chemical Industry - Other	CO_2	31	28	2.0	0.5	2.1	0.00	0.00	0.00	0.00	0.00	0.00
2.C.1 Metal Production - Iron and Steel Production	CH_4	0	0	0.5	50.0	50.0	0.00	0.00	0.00	0.00	0.00	0.00
2.C.1 Metal Production - Iron and Steel Production	CO_2	3 546	5 454	0.5	0.5	0.7	0.05	0.02	0.08	0.01	0.06	0.06
2.C.2 Metal Production - Ferroalloys Production	CO_2	21	20	2.0	0.5	2.1	0.00	0.00	0.00	0.00	0.00	0.00
2.C.3 Metal Production - Aluminium production	CO_2	158	0	2.0	0.5	2.1	0.00	0.00	0.00	0.00	0.00	0.00
2.C.3 Metal Production - Aluminium production	PFC	994	0	2.0	50.0	50.0	0.00	-0.02	0.00	-0.81	0.00	0.81
2.C.3 Metal Production - SF6 Used in Aluminium and Magnesium Foundr	SF_6	253	5	0.0	5.0	5.0	0.00	0.00	0.00	-0.02	0.00	0.02
2.F.1 Refrigeration and Air Conditioning Equipment	HFC	0	1 389	20.0	50.0	53.9	0.98	0.02	0.02	1.02	0.58	1.17
2.F.2 Foam Blowing	HFC	0	12	20.0	50.0	53.9	0.01	0.00	0.00	0.01	0.01	0.01
2.F.3 Fire Extinguishers	HFC	0	10	20.0	50.0	53.9	0.01	0.00	0.00	0.01	0.00	0.01
2.F.4 Aerosols	HFC	20	19	20.0	50.0	53.9	0.01	0.00	0.00	0.00	0.01	0.01
2.F.5 Solvents	HFC	0	0	20.0	50.0	53.9	0.00	0.00	0.00	0.00	0.00	0.00
2.F.7 Semiconductor Manufacture	HFC	2	2	5.0	10.0	11.2	0.00	0.00	0.00	0.00	0.00	0.00
2.F.7 Semiconductor Manufacture	PFC	29	40	5.0	10.0	11.2	0.01	0.00	0.00	0.00	0.00	0.00
2.F.7 Semiconductor Manufacture	SF_6	102	42	5.0	10.0	11.2	0.01	0.00	0.00	-0.01	0.00	0.01
2.F.8 Electrical equipment	SF_6	11	32	25.0	50.0	55.9	0.02	0.00	0.00	0.01	0.02	0.02
2.F.9 Other Sources of SF6	PFC	0	0	25.0	50.0	55.9	0.00	0.00	0.00	0.00	0.00	0.00
2.F.9 Other Sources of SF6	SF_6	127	247	25.0	50.0	55.9	0.18	0.00	0.00	0.08	0.13	0.15

IPCC Key category	Gas	Base year emissions 1990	Year 2012 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 / ∑D	Note B	D / ∑C	I * F Note C	J * E * √2 Note D	√ (K² + L2)
		Gg CO2 equivalent	Gg CO2 equivalent	%	%	%	%	%	%	%	%	%
3.A Paint Application	CO2	118	59	5.0	10.0	11.2	0.01	0.00	0.00	-0.01	0.01	0.01
3.B Degreasing and Dry Cleaning	CO2	36	29	0.0	0.0	0.0	0.00	0.00	0.00	0.00	0.00	0.00
3.C Chemical Products, Manufacture and Processing	CO2	28	13	0.0	0.0	0.0	0.00	0.00	0.00	0.00	0.00	0.00
3.D Other	CO2	98	88	5.0	10.0	11.2	0.01	0.00	0.00	0.00	0.01	0.01
3.D Other	N2O	233	146	5.0	20.0	20.6	0.04	0.00	0.00	-0.03	0.02	0.04
4.A.1 Cattle	CH4	3 551	2 985	10.0	20.0	22.4	0.88	-0.01	0.04	-0.29	0.62	0.68
4.A.3 Sheep	CH4	52	61	10.0	20.0	22.4	0.02	0.00	0.00	0.00	0.01	0.01
4.A.4 Goats	CH4	4	8	10.0	30.0	31.6	0.00	0.00	0.00	0.00	0.00	0.00
4.A.6 Horses	CH4	19	31	10.0	30.0	31.6	0.01	0.00	0.00	0.00	0.01	0.01
4.A.8 Swine	CH4	116	94	10.0	30.0	31.6	0.04	0.00	0.00	-0.02	0.02	0.03
4.A.9 Poultry	CH4	6	6	10.0	30.0	31.6	0.00	0.00	0.00	0.00	0.00	0.00
4.A-10 Other	CH4	6	8	10.0	30.0	31.6	0.00	0.00	0.00	0.00	0.00	0.00
4.B.1 Cattle	CH4	283	224	10.0	50.0	51.0	0.15	0.00	0.00	-0.07	0.05	0.08
4.B.1 Cattle	N2O	759	731	10.0	100.0	100.5	0.96	0.00	0.01	-0.17	0.15	0.23
4.B.3 Sheep	CH4	1	1	10.0	50.0	51.0	0.00	0.00	0.00	0.00	0.00	0.00
4.B.3 Sheep	N2O	20	23	10.0	100.0	100.5	0.03	0.00	0.00	0.00	0.00	0.01
4.B.4 Goats	CH4	0	0	10.0	50.0	51.0	0.00	0.00	0.00	0.00	0.00	0.00
4.B.4 Goats	N2O	2	4	10.0	100.0	100.5	0.01	0.00	0.00	0.00	0.00	0.00
4.B.6 Horses	CH4	1	2	10.0	50.0	51.0	0.00	0.00	0.00	0.00	0.00	0.00
4.B.6 Horses	N2O	18	30	10.0	100.0	100.5	0.04	0.00	0.00	0.01	0.01	0.02
4.B.8 Swine	CH4	123	73	10.0	50.0	51.0	0.05	0.00	0.00	-0.05	0.02	0.05
4.B.8 Swine	N2O	87	55	10.0	100.0	100.5	0.07	0.00	0.00	-0.06	0.01	0.06
4.B.9 Poultry	CH4	23	22	10.0	50.0	51.0	0.01	0.00	0.00	0.00	0.00	0.01
4.B.9 Poultry	N2O	46	71	10.0	100.0	100.5	0.09	0.00	0.00	0.03	0.01	0.03
4.B-10 Other	CH4	0	0	10.0	50.0	51.0	0.00	0.00	0.00	0.00	0.00	0.00
4.B-10 Other	N2O	2	3	10.0	100.0	100.5	0.00	0.00	0.00	0.00	0.00	0.00
4.D Agricultural Soils	CH4	7	9	5.0	100.0	100.1	0.01	0.00	0.00	0.00	0.00	0.00
4.D Agricultural Soils	N2O	3 430	3 055	5.0	150.0	150.1	6.02	-0.01	0.04	-1.71	0.32	1.74
4.F Field Burning of Agricultural Residues	CH4	1	1	100.0	40.0	107.7	0.00	0.00	0.00	0.00	0.00	0.00
4.F Field Burning of Agricultural Residues	N2O	0	0	100.0	50.0	111.8	0.00	0.00	0.00	0.00	0.00	0.00
5 Total land use categories	CH4	1	0			0.0	0.00	0.00	0.00	0.00	0.00	0.00
5 Total land use categories	N2O	20	25			396.9	0.13	0.00	0.00	0.00	0.00	0.00
5 Total land use categories	CO2	-9 898	-3 864			491.9	-24.93	0.11	-0.06	0.00	0.00	0.00
6. D Other Waste	CH4	11	54	15.0	0.0	15.0	0.01	0.00	0.00	0.00	0.02	0.02
6. D Other Waste	N2O	24	110	15.0	0.0	15.0	0.02	0.00	0.00	0.00	0.03	0.03
6.A Solid Waste Disposal on Land	CH4	3 314	1 201	12.0	25.0	27.7	0.44	-0.04	0.02	-0.92	0.30	0.96
6.B Wastewater Handling	CH4	102	23	20.0	50.0	53.9	0.02	0.00	0.00	-0.07	0.01	0.07
6.B Wastewater Handling	N2O	109	266	20.0	50.0	53.9	0.19	0.00	0.00	0.11	0.11	0.15
6.C Waste Incineration	CH4	0	0	7.0	0.0	7.0	0.00	0.00	0.00	0.00	0.00	0.00
6.C Waste Incineration	CO2	27	2	7.0	20.0	21.2	0.00	0.00	0.00	-0.01	0.00	0.01
6.C Waste Incineration	N2O	0.1	0.0	7.0	0.0	7.0	0.00	0.00	0.00	0.00	0.00	0.00
Total Key Categories excluding LULUCF	Gg CO2 e	**68 209**	**76 221**				**25.74**					**2.96**

Table A 157: Tier 2 Uncertainty Analysis (Table 6.2 GPG)

A	B	C	D	E	F	G	H	I	J	K
IPCC Source category	Gas	Base year emissions 1990	Year 2012 emissions	Uncertainty in year t emissions as % of emissions in the category		Uncertainty introduced on national total in year 2012	% change in emissions between 2012 and base year	Range of likely % change between 2012 and base year		Uncertainty introduced into the trend in total national emissions
		Gg CO2 equivalent	Gg CO2 equivalent	% below (2.5 percentile)	% above (97.5 percentile)	%	%	Lower % (2.5 percentile)	Upper % (97.5 percentile)	%-points
1 A 1 a biomass: Public Electricity and Heat Production	N2O	1	66	48	49	0.0	4 319	77	9 134	0.0
1 A 1 a gaseous: Public Electricity and Heat Production	CO2	3 295	4 021	2	2	0.1	22	15	29	0.1
1 A 1 a liquid: Public Electricity and Heat Production	CO2	1 229	219	1	1	0.0	-82	-84	-81	0.0
1 A 1 a other: Public Electricity and Heat Production	CO2	118	1 288	21	22	0.4	992	575	1 540	0.3
1 A 1 a solid: Public Electricity and Heat Production	CO2	6 247	3 454	1	1	0.0	-45	-46	-43	0.0
1 A 1 b gaseous: Petroleum refining	CO2	437	468	2	2	0.0	7	0	14	0.0
1 A 1 b liquid: Petroleum refining	CO2	1 958	2 368	1	1	0.0	21	19	23	0.0
1 A 1 c gaseous: Manufacture of Solid fuels and Other Energy Ind	CO2	506	506	2	2	0.0	0	-7	6	0.0
1 A 2 a gaseous: Iron and Steel	CO2	650	1 279	5	5	0.1	97	73	121	0.1
1 A 2 a liquid: Iron and Steel	CO2	448	383	1	1	0.0	-15	-18	-12	0.0
1 A 2 a solid: Iron and Steel	CO2	3 846	4 196	1	1	0.1	9	6	12	0.1
1 A 2 b gaseous: Non-ferrous Metals	CO2	75	216	5	5	0.0	188	155	223	0.0
1 A 2 c gaseous: Chemicals	CO2	519	1 198	5	5	0.1	131	103	159	0.1
1 A 2 c other: Chemicals	CO2	174	392	21	23	0.1	125	63	212	0.1
1 A 2 d gaseous: Pulp, Paper and Print	CO2	943	1 582	5	5	0.1	68	47	90	0.1
1 A 2 d liquid: Pulp, Paper and Print	CO2	853	41	1	1	0.0	-95	-98	-93	0.0
1 A 2 d solid: Pulp, Paper and Print	CO2	397	348	1	1	0.0	-13	-15	-10	0.0
1 A 2 e gaseous: Food Processing, Beverages and Tobacco	CO2	507	766	5	5	0.0	51	32	72	0.1
1 A 2 e liquid: Food Processing, Beverages and Tobacco	CO2	345	198	1	1	0.0	-43	-46	-40	0.0
1 A 2 f gaseous: Other	CO2	1 573	1 954	5	5	0.1	24	8	42	0.2
1 A 2 f liquid: Other	CO2	1 376	1 784	1	1	0.0	30	26	33	0.0
1 A 2 f other: Other	CO2	70	526	21	23	0.1	651	346	978	0.1
1 A 2 f solid: Other	CO2	625	288	1	1	0.0	-54	-56	-52	0.0
1 A 3 b diesel oil: Road Transportation	CO2	5 360	15 808	4	4	0.8	195	171	219	0.8
1 A 3 b diesel oil: Road Transportation	N2O	41	129	30	30	0.0	218	74	361	0.0
1 A 3 b gasoline: Road Transportation	CO2	7 935	4 950	4	4	0.3	-38	-47	-30	0.4
1 A 3 b gasoline: Road Transportation	N2O	133	58	30	70	0.0	-57	-264	-34	0.1
1 A 3 c liquid: Railways	CO2	171	123	4	4	0.0	-28	-38	-20	0.0
1 A 3 e gaseous: Other	CO2	224	394	2	2	0.0	75	66	85	0.0
1 A 4 a gaseous: Commercial/Institutional	CO2	707	1 216	5	5	0.1	72	51	95	0.1
1 A 4 a liquid: Commercial/Institutional	CO2	1 421	189	1	1	0.0	-87	-89	-84	0.0
1 A 4 a other: Commercial/Institutional	CO2	350	2	21	23	0.0	-99	-148	-56	0.1
1 A 4 b biomass: Residential	CH4	314	179	49	51	0.1	-43	-102	-3	0.1
1 A 4 b gaseous: Residential	CO2	1 847	2 850	5	5	0.2	54	35	75	0.2
1 A 4 b liquid: Residential	CO2	5 605	3 880	1	1	0.1	-31	-34	-28	0.1
1 A 4 b solid: Residential	CH4	59	3	49	49	0.0	-95	-195	8	0.0
1 A 4 b solid: Residential	CO2	2 512	149	1	1	0.0	-94	-97	-92	0.0
1 A 4 c liquid: Agriculture/Forestry/Fisheries	CO2	1 181	759	1	1	0.0	-36	-39	-33	0.0

A	B	C	D	E	F	G	H	I	J	K
IPCC Source category	Gas	Base year emissions 1990	Year 2012 emissions	Uncertainty in year t emissions as % of emissions in the category		Uncertainty introduced on national total in year 2012	% change in emissions between 2012 and base year	Range of likely % change between 2012 and base year		Uncertainty introduced into the trend in total national emissions
		Gg CO2 equivalent	Gg CO2 equivalent	% below (2.5 percentile)	% above (97.5 percentile)	%	%	Lower % (2.5 percentile)	Upper % (97.5 percentile)	%-points
1 B 2 a: Oil	CH4	126	133	49	49	0.1	5	0	11	0.0
1 B 2 a: Oil	CO2	43	145	1	1	0.0	237	233	242	0.0
2 A 1: Cement Production	CO2	2 033	1 673	2	2	0.0	-18	-28	-7	0.1
2 A 2: Lime Production	CO2	396	569	5	5	0.0	44	0	84	0.1
2 A 3: Limestone and Dolomite Use	CO2	203	256	19	19	0.1	26	-38	90	0.1
2 A 7 b: Sinter Production	CO2	481	305	5	5	0.0	-37	-43	-31	0.0
2 B 1: Ammonia Production	CO2	472	511	2	2	0.0	8	2	15	0.0
2 B 2: Nitric Acid Production	N2O	912	53	5	5	0.0	-94	-105	-84	0.1
2 C 1: Iron and Steel Production	CO2	3 546	5 455	1	1	0.0	54	52	56	0.0
2 C 3: Aluminium production	PFC	993	0	0	0	0.0	-100	-200	3	0.6
2 C 4: SF6 used in Al and Mg Foundries	SF6	253	5	5	5	0.0	-98	-109	-88	0.0
2 F 1: Refrigeration and Air Conditioning Equipment	HFC	0	1 392	53	53	0.9	0	0	0	1.0
2 F 9: Other Sources of SF6	SF6	127	247	54	55	0.2	95	-165	345	0.2
3 D: OTHER	N2O	232	145	20	20	0.0	-37	-86	18	0.1
4 A 1: Cattle	CH4	3 549	2 983	20	21	0.8	-16	-40	2	0.4
4 B 1: Cattle	CH4	283	224	50	50	0.1	-21	-64	1	0.1
4 B 1: Cattle	N2O	757	729	50	101	0.7	-4	-51	52	0.1
4 B 8: Swine	CH4	123	73	50	50	0.0	-40	-100	2	0.0
4 B 8: Swine	N2O	87	55	50	102	0.1	-37	-224	-8	0.0
4 B 9: Poultry	N2O	46	71	50	102	0.1	54	13	273	0.0
4 D 1: Direct Soil Emissions	N2O	1 904	1 802	70	203	3.5	-5	-110	28	0.3
4 D 2: Pasture, Range and Paddock Manure	N2O	168	94	70.0	202.8	0.2	-44	-927	-8	0.1
4 D 3: Indirect Emissions	N2O	1 348	1 151	70.0	202.8	2.2	-15	-305	-1	0.4
5: Forest land remaining forest land	CO2	-9 923	-3 862	-482.5	-481.2	23.7	-61	428	-622	33.9
6 A: SOLID WASTE DISPOSAL ON LAND	CH4	3 312	1 201	26.5	28.3	0.4	-64	-114	-22	0.9
6 B: WASTEWATER HANDLING	CH4	102	23	50.6	55.3	0.0	-77	-186	2	0.1
6 B: WASTEWATER HANDLING	N2O	110	267	50.3	55.3	0.2	143	-1	385	0.1

Conclusions

The comparison of Tier 1 and Tier 2 (see Table A-128 and A-130) results shows that, basically, both approaches yield very similar results in terms of contribution to level or trend uncertainty for an individual source category. Differences become visible where distributions are not symmetric (in the case of Austria, lognormal distributions have been applied to N_2O emissions only, most visible for N_2O from soils). This is also seen in the difference between the "lower range" vs. "upper range" uncertainties, and those determined by standard deviations (2s).

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

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

Figure 5 shows the resulting probability density distribution for Austria. The distribution is most strongly influenced by the lognormal distribution of the uncertainty in soil N_2O emissions. If the previous (WINIWARTER & RYPDAL 2001) assumption on "random" N_2O emission factor uncertainty is taken (triangular distribution between 50% and 200% of the given emission factor), the total level uncertainty of the Austrian inventory decreases considerably. This is again proof of the importance on assumptions taken on N_2O emissions on the overall uncertainty of a national GHG inventory.

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

As is also shown in Figure 6, studying the sensitivity of the output to the input parameters yields a result virtually fully determined by soil N_2O emission factor. While, compared to previously, other components have improved, it is now virtually N_2O alone that determines the uncertainty. It should be noted that even at quite low uncertainty, transport has taken over a considerable role due to its large overall contribution to emissions, albeit not at all challenging the leading role of N_2O.

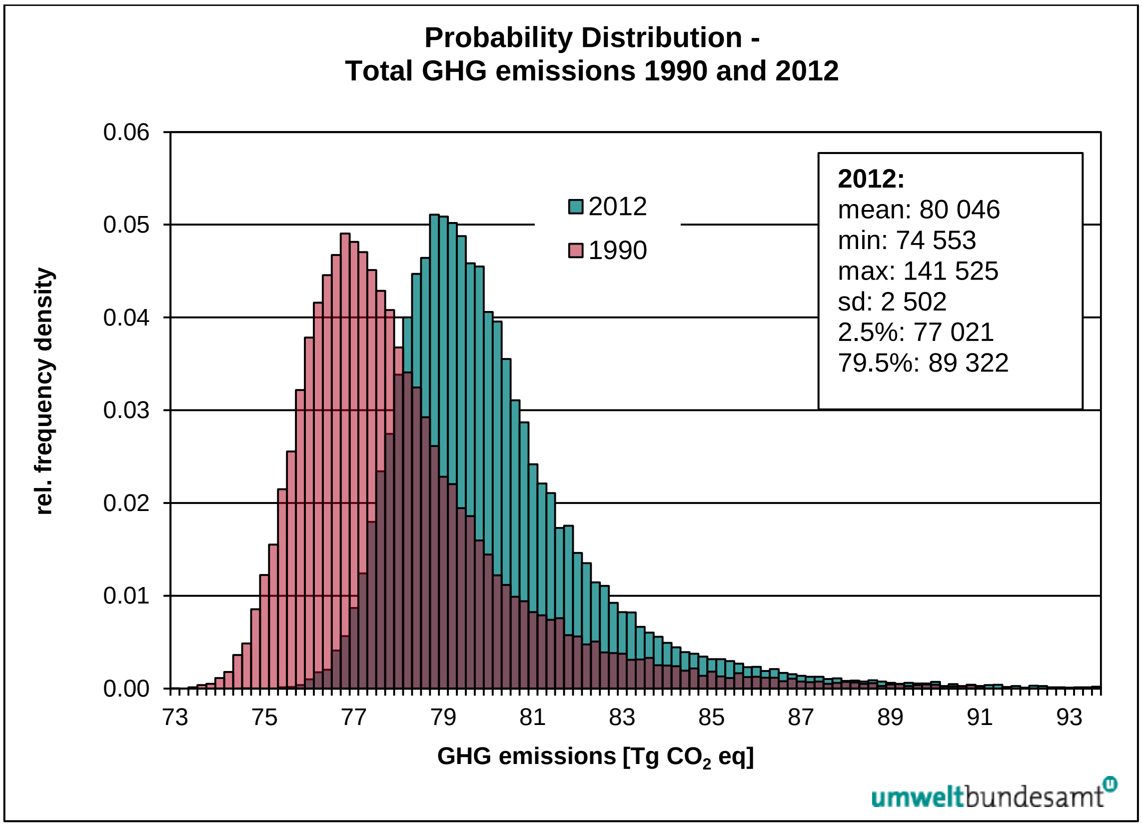

Figure 5: Austria's greenhouse gas emissions 1990 und 2012 without LULUCF – probability bins according to uncertainty analysis.

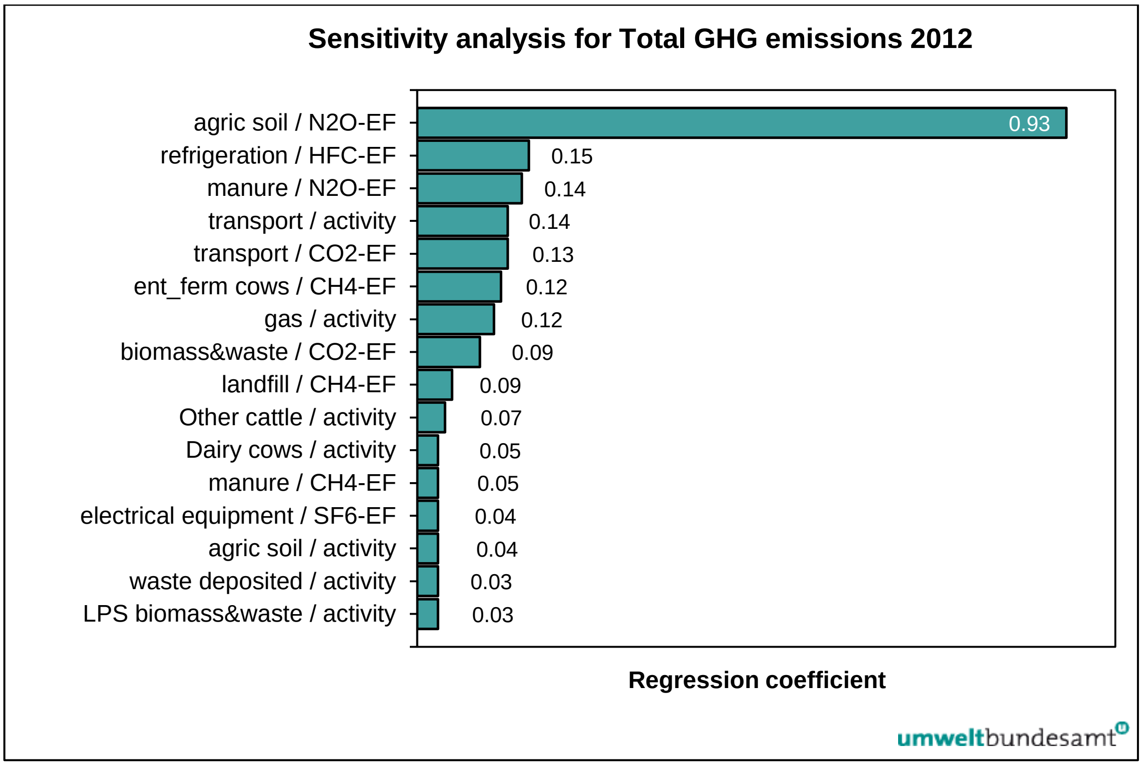

Figure 6: Sensitivity analysis: regression coefficients between total GHG emissions 2012 (without LULUCF) and input parameters.

Table A 131 and A 132 present a comparison to the previous study on uncertainties of the Austrian GHG inventory (WINIWARTER & RYPDAL 2001). As is evident from the 1990 emission figures (mean value), methodical problems of the underlying inventory as of the late 1990s only allow for a limited evaluation (differences to the state-of-the-art compilation methods, then not implemented in the national inventory, were regarded as systematic error and are not included in this analysis). The low uncertainty for CO_2, the dominating greenhouse gas, could be sustained. Improved analysis leads to better understanding of CH_4 emissions, thus reducing uncertainty. For N_2O, as discussed above, some of the uncertainty considered systematic and method-relevant had to be included into the random uncertainty after adaptation of the method. This is also the main reason for the change in total uncertainty, which is mostly determined by the N_2O uncertainty and hardly influenced by uncertainties from the additionally evaluated F-gases.

Differences also become obvious when comparing between years (1990 vs. 2011). This is not due to the method, but only due to shifts in activities. Abolishing Al-production in Austria stops the highly uncertain emissions and decreases PFC uncertainty. The increase in uncertainty on CO_2 is due to a shift of the activity into transport, which is considered more uncertain than most other parts of fossil fuel consumption. The increase in uncertainty for individual gas emissions still allows for a decrease of the overall inventory, as the weight of CO_2 emissions becomes larger, and N_2O emissions actually have been reduced in that period.

Table A 158: Key results of the first comprehensive study on the Austrian GHG inventory uncertainty (WINIWARTER & RYPDAL 2001).

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

Table A 159: Key results of the Austrian GHG inventory uncertainty analysis 2014 – including and excluding LULUCF.

Random uncertainty		excl. LULUCF							incl. LULUCF
		CO_2	CH_4	N_2O	PFC	HFC	SF_6	Total GHG	Total GHG
1990	Mean value [Tg]	62.02	8.33	6.19	1.02	0.02	0.49	78.07	68.17
	Standard deviation	0.37	0.62	2.65	0.25	0.01	0.04	2.76	9.67
	2s	**1.2%**	**14.9%**	**85.7%**	**48.4%**	**49.4%**	**16.0%**	**7.1%**	**28.4%**
2012	Mean value [Tg]	67.73	5.30	5.21	0.04	1.43	0.33	80.05	76.21
	Standard deviation	0.59	0.38	2.37	0.00	0.39	0.08	2.50	9.80
	2s	**1.7%**	**14.4%**	**90.9%**	**11.2%**	**54.0%**	**47.9%**	**6.3%**	**25.7%**

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 2012

The full set of tables is submitted electronically together with this report.

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- Table1.A(a)s2
- Table1.A(a)s3
- Table1.A(a)s4
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TABLE 1 SECTORAL REPORT FOR ENERGY
(Sheet 1 of 2)

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	CO_2	CH_4	N_2O	NO_X	CO	NMVOC	SO_2
	(Gg)						
Total Energy	58 534.31	22.99	2.18	171.25	579.15	49.77	16.00
A. Fuel Combustion Activities (Sectoral Approach)	58 297.14	11.36	2.18	171.25	579.15	47.86	15.75
1. Energy Industries	12 324.99	0.50	0.36	14.37	5.94	0.89	2.86
a. Public Electricity and Heat Production	8 982.81	0.43	0.34	12.09	5.43	0.88	2.44
b. Petroleum Refining	2 836.13	0.05	0.02	0.91	0.42	IE	0.42
c. Manufacture of Solid Fuels and Other Energy Industries	506.05	0.01	0.00	1.37	0.09	0.00	NA
2. Manufacturing Industries and Construction	15 409.01	0.64	0.51	32.27	150.10	2.17	10.76
a. Iron and Steel	5 858.51	0.09	0.05	4.42	120.67	0.26	5.23
b. Non-Ferrous Metals	244.87	0.01	0.00	0.21	0.03	0.00	0.06
c. Chemicals	1 793.27	0.11	0.02	1.82	1.58	0.26	0.88
d. Pulp, Paper and Print	1 977.98	0.14	0.08	5.04	1.96	0.25	1.00
e. Food Processing, Beverages and Tobacco	981.45	0.02	0.00	0.94	0.14	0.02	0.23
f. Other *(as specified in table 1.A(a) sheet 2)*	4 552.93	0.26	0.35	19.84	25.72	1.37	3.37
Other non-specified	4 552.93	0.26	0.35	19.84	25.72	1.37	3.37
3. Transport	21 418.45	0.61	0.66	104.08	132.28	13.30	0.20
a. Civil Aviation	54.67	0.00	0.00	0.20	2.13	0.10	0.02
b. Road Transportation	20 835.03	0.59	0.60	101.10	126.80	12.70	0.12
c. Railways	123.71	0.01	0.05	1.65	1.44	0.24	0.06
d. Navigation	11.52	0.00	0.00	0.06	1.84	0.25	0.00
e. Other Transportation *(as specified in table 1.A(a) sheet 3)*	393.52	0.01	0.00	1.07	0.07	0.00	NA
Pipeline transport	393.52	0.01	0.00	1.07	0.07	0.00	NA

TABLE 1 SECTORAL REPORT FOR ENERGY
(Sheet 2 of 2)

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	CO_2	CH_4	N_2O	NO_X	CO	NMVOC	SO_2
				(Gg)			
4. Other Sectors	9 097.29	9.60	0.64	20.44	290.55	31.48	1.93
a. Commercial/Institutional	1 423.37	0.19	0.04	1.15	5.47	0.49	0.16
b. Residential	6 879.69	8.75	0.37	11.38	255.15	26.21	1.63
c. Agriculture/Forestry/Fisheries	794.24	0.67	0.24	7.90	29.93	4.79	0.14
5. Other *(as specified in table 1.A(a) sheet 4)*	47.40	0.00	0.00	0.08	0.28	0.02	0.01
a. Stationary	NA	NA	NA	NA	NA	NA	NA
b. Mobile	47.40	0.00	0.00	0.08	0.28	0.02	0.01
Military use	47.40	0.00	0.00	0.08	0.28	0.02	0.01
B. Fugitive Emissions from Fuels	237.17	11.63	IE,NA	IE,NA	IE,NA	1.90	0.25
1. Solid Fuels	IE,NA,NO	0.04	NA	NA	NA	NA,NO	NA
a. Coal Mining and Handling	IE,NA,NO	IE,NO	NA	NA	NA	NO	
b. Solid Fuel Transformation	NA	0.04	NA	NA	NA	NA	NA
c. Other *(as specified in table 1.B.1)*	NA	NA	NA	NA	NA	NA	NA
2. Oil and Natural Gas	237.17	11.58	IE,NA	IE,NA	IE,NA	1.90	0.25
a. Oil	145.00	6.34	IE,NA	NA	NA	1.89	NA
b. Natural Gas	92.17	5.25				0.02	0.25
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	2 118.29	0.05	0.09	9.22	2.91	0.90	0.67
Aviation	2 072.66	0.04	0.07	8.71	2.47	0.90	0.66
Marine	45.63	0.00	0.02	0.51	0.44	NA	0.02
Multilateral Operations	NO	NO	NO	NO	NO	NO	NO
CO_2 Emissions from Biomass	25 166.69						

[(1)] Countries are asked to report emissions from international aviation and marine bunkers and multilateral operations, as well as CO_2 emissions from biomass, under Memo Items. These emissions should not be included in the national total emissions from the Energy sector. Amounts of biomass used as fuel are included in the national energy consumption but the corresponding CO_2 emissions are not included in the national total as it is assumed that the biomass is produced in a sustainable manner. If the biomass is harvested at an unsustainable rate, net CO_2 emissions are accounted for as a loss of biomass stocks in the Land Use, Land-Use Change and Forestry sector.

Documentation Box:

Parties should provide detailed explanations on the Energy sector in Chapter 3: Energy (CRF sector 1) of the NIR. Use this documentation box to provide references to relevant sections of the NIR if any additional information and/or further details are needed to understand the content of this table.

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.1 Solid Fuels/2012:1 B 1 b: Emissions from coke ovens are included in 1 A 2 a Iron and Steel.
1 B 1 a ii: emissions from Post-Mining are included in Mining.
1.B.1.B Solid Fuel Transformation:Since the resubmission in Nov/2013 category 1.B.1.b includes emissions from char coal production. Emissions from coke ovens are considered in category 1.A.2.a.
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".
1.B.2 Oil and Natural Gas/2012:1 B 2 a i, 1 B 2 b i and 1 B 2 b ii exept CO2 emissions from processing of sour gas are included in 1 B 2 a ii.
1 B 2 a v also includes storage in storage tanks and refinery dispatch station - only NMVOC emissions are estimated.
1 B 2 a iv CO2 is included in 1 A 1 b, flaring in the refinery is also included in 1 A 1 b.
1 B 2 b iiiTransmission includes fugitve and venting.

TABLE 1.A(a) SECTORAL BACKGROUND DATA FOR ENERGY Inventory 2012
Fuel Combustion Activities - Sectoral Approach Submission 2014 v1.4
(Sheet 1 of 4) AUSTRIA

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	AGGREGATE ACTIVITY DATA		IMPLIED EMISSION FACTORS [2]			EMISSIONS		
	Consumption		CO_2	CH_4	N_2O	CO_2	CH_4	N_2O
	(TJ)	NCV/GCV[1]	(t/TJ)	(kg/TJ)		(Gg)		
1.A. Fuel Combustion	1 076 307.75	NCV				58 297.14	11.36	2.18
Liquid Fuels	414 152.54	NCV	74.91	1.89	2.75	31 023.66	0.78	1.14
Solid Fuels	87 859.08	NCV	97.28	3.05	1.40	8 547.35	0.27	0.12
Gaseous Fuels	298 097.29	NCV	55.38	1.08	0.42	16 509.86	0.32	0.12
Biomass	242 520.92	NCV	103.77	39.51	3.06 [3]		9.58	0.74
Other Fuels	33 677.92	NCV	65.81	12.00	1.40	2 216.26	0.40	0.05
1.A.1. Energy Industries	241 657.54	NCV				12 324.99	0.50	0.36
Liquid Fuels	34 392.60	NCV	75.23	1.25	0.61	2 587.26	0.04	0.02
Solid Fuels	37 175.63	NCV	92.91	0.10	1.63	3 454.13	0.00	0.06
Gaseous Fuels	90 169.24	NCV	55.40	0.75	0.41	4 995.38	0.07	0.04
Biomass	59 297.44	NCV	110.21	2.32	3.57 [3]	6 535.27	0.14	0.21
Other Fuels	20 622.62	NCV	62.47	12.00	1.40	1 288.22	0.25	0.03
a. Public Electricity and Heat Production	192 485.63	NCV				8 982.81	0.43	0.34
Liquid Fuels	2 806.46	NCV	78.15	1.13	1.17	219.33	0.00	0.00
Solid Fuels	37 175.63	NCV	92.91	0.10	1.63	3 454.13	0.00	0.06
Gaseous Fuels	72 583.47	NCV	55.40	0.57	0.49	4 021.12	0.04	0.04
Biomass	59 297.44	NCV	110.21	2.32	3.57 [3]	6 535.27	0.14	0.21
Other Fuels	20 622.62	NCV	62.47	12.00	1.40	1 288.22	0.25	0.03
b. Petroleum Refining	40 037.40	NCV				2 836.13	0.05	0.02
Liquid Fuels	31 586.14	NCV	74.97	1.26	0.56	2 367.93	0.04	0.02
Solid Fuels	NO	NCV	NO	NO	NO	NO	NO	NO
Gaseous Fuels	8 451.27	NCV	55.40	1.50	0.10	468.20	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. Manufacture of Solid Fuels and Other Energy Industries	9 134.50	NCV				506.05	0.01	0.00
Liquid Fuels	NO	NCV	NO	NO	NO	NO	NO	NO
Solid Fuels	NO	NCV	NO	NO	NO	NO	NO	NO
Gaseous Fuels	9 134.50	NCV	55.40	1.50	0.10	506.05	0.01	0.00
Biomass	NO	NCV	NO	NO	NO [3]	NO	NO	NO
Other Fuels	NO	NCV	NO	NO	NO	NO	NO	NO

Note: All footnotes for this table are given at the end of the table on sheet 4.

Note: For the coverage of fuel categories, refer to the IPCC Guidelines (Volume 1. Reporting Instructions - Common Reporting Framework, section 1.2, p. 1.19). If some derived gases (e.g. gas works, gas, coke oven gas, blast furnace gas) are considered, Parties should provide information on the allocation of these derived gases under the above fuel categories (liquid, solid, gaseous, biomass and other fuels) in the NIR (see also documentation box at the end of sheet 4 of this table).

TABLE 1.A(a) SECTORAL BACKGROUND DATA FOR ENERGY
Fuel Combustion Activities - Sectoral Approach
(Sheet 2 of 4)

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	AGGREGATE ACTIVITY DATA		IMPLIED EMISSION FACTORS [2]			EMISSIONS		
	Consumption		CO_2	CH_4	N_2O	CO_2	CH_4	N_2O
	(TJ)	NCV/GCV[1]	(t/TJ)	(kg/TJ)		(Gg)		
1.A.2 Manufacturing Industries and Construction	299 109.24	NCV				15 409.01	0.64	0.51
Liquid Fuels	33 583.55	NCV	76.25	1.44	6.02	2 560.66	0.05	0.20
Solid Fuels	48 895.80	NCV	100.73	1.99	1.19	4 925.15	0.10	0.06
Gaseous Fuels	126 392.74	NCV	55.36	1.46	0.10	6 997.43	0.18	0.01
Biomass	77 203.65	NCV	109.36	2.03	2.83 [3]	8 442.66	0.16	0.22
Other Fuels	13 033.49	NCV	71.03	12.00	1.40	925.77	0.16	0.02
a. Iron and Steel	69 087.77	NCV				5 858.51	0.09	0.05
Liquid Fuels	4 915.48	NCV	77.97	1.66	1.00	383.26	0.01	0.00
Solid Fuels	40 989.78	NCV	102.36	1.35	1.16	4 195.77	0.06	0.05
Gaseous Fuels	23 180.58	NCV	55.20	1.30	0.10	1 279.48	0.03	0.00
Biomass	1.93	NCV	110.00	2.00	4.00 [3]	0.21	0.00	0.00
Other Fuels	NO	NCV	NO	NO	NO	NO	NO	NO
b. Non-Ferrous Metals	4 258.16	NCV				244.87	0.01	0.00
Liquid Fuels	295.81	NCV	76.22	0.47	0.68	22.55	0.00	0.00
Solid Fuels	57.75	NCV	104.00	2.00	1.40	6.01	0.00	0.00
Gaseous Fuels	3 904.60	NCV	55.40	1.50	0.10	216.31	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	32 774.65	NCV				1 793.27	0.11	0.02
Liquid Fuels	1 666.97	NCV	79.19	1.09	0.81	132.01	0.00	0.00
Solid Fuels	729.88	NCV	96.96	5.00	1.40	70.77	0.00	0.00
Gaseous Fuels	21 634.23	NCV	55.40	1.50	0.10	1 198.54	0.03	0.00
Biomass	2 871.59	NCV	110.43	1.89	3.36 [3]	317.11	0.01	0.01
Other Fuels	5 871.98	NCV	66.75	12.00	1.40	391.96	0.07	0.01
d. Pulp, Paper and Print	71 253.60	NCV				1 977.98	0.14	0.08
Liquid Fuels	533.01	NCV	77.56	1.71	0.96	41.34	0.00	0.00
Solid Fuels	3 947.84	NCV	88.08	5.00	1.40	347.74	0.02	0.01
Gaseous Fuels	28 554.58	NCV	55.40	1.50	0.10	1 581.92	0.04	0.00
Biomass	38 158.17	NCV	110.02	2.09	1.90 [3]	4 198.02	0.08	0.07
Other Fuels	60.02	NCV	116.27	12.00	1.40	6.98	0.00	0.00
e. Food Processing, Beverages and Tobacco	17 289.28	NCV				981.45	0.02	0.00
Liquid Fuels	2 623.73	NCV	75.46	0.75	0.80	197.98	0.00	0.00
Solid Fuels	160.38	NCV	103.91	2.05	1.40	16.67	0.00	0.00
Gaseous Fuels	13 838.20	NCV	55.40	1.50	0.10	766.64	0.02	0.00
Biomass	665.31	NCV	111.13	1.54	1.22 [3]	73.94	0.00	0.00
Other Fuels	1.66	NCV	104.17	12.00	1.40	0.17	0.00	0.00
f. Other *(please specify)* [4]	104 445.77	NCV				4 552.93	0.26	0.35
Other non-specified								
Liquid Fuels	23 548.55	NCV	75.74	1.49	8.21	1 783.53	0.04	0.19
Solid Fuels	3 010.17	NCV	95.74	6.06	1.40	288.20	0.02	0.00
Gaseous Fuels	35 280.56	NCV	55.40	1.50	0.10	1 954.54	0.05	0.00
Biomass	35 506.65	NCV	108.53	2.00	3.81 [3]	3 853.39	0.07	0.14
Other Fuels	7 099.84	NCV	74.18	12.00	1.40	526.66	0.09	0.01

Note: All footnotes for this table are given at the end of the table on sheet 4.

TABLE 1.A(a) SECTORAL BACKGROUND DATA FOR ENERGY
Fuel Combustion Activities - Sectoral Approach
(Sheet 3 of 4)

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	AGGREGATE ACTIVITY DATA		IMPLIED EMISSION FACTORS [2]				EMISSIONS		
	Consumption		CO_2	CH_4	N_2O		CO_2	CH_4	N_2O
	(TJ)	NCV/GCV[1]	(t/TJ)	(kg/TJ)			(Gg)		
1.A.3 Transport	309 561.78	NCV					21 418.45	0.61	0.66
Liquid Fuels	280 749.54	NCV	74.80	2.14	2.35		21 000.99	0.60	0.66
Solid Fuels	4.44	NCV	95.00	6.83	6.83		0.42	0.00	0.00
Gaseous Fuels	7 527.68	NCV	55.40	1.42	0.09		417.03	0.01	0.00
Biomass	21 280.12	NCV	70.80	IE,NO	IE,NO		1 506.63	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	751.51	NCV					54.67	0.00	0.00
Aviation Gasoline	110.08	NCV	72.68	0.51	2.03		8.00	0.00	0.00
Jet Kerosene	641.43	NCV	72.75	6.57	4.03		46.67	0.00	0.00
b. Road Transportation	299 902.35	NCV					20 835.03	0.59	0.60
Gasoline	66 363.60	NCV	74.58	6.68	2.81		4 949.65	0.44	0.19
Diesel Oil	210 991.64	NCV	74.92	0.68	1.98		15 807.94	0.14	0.42
Liquefied Petroleum Gases (LPG)	842.60	NCV	64.00	IE	IE		53.93	IE	IE
Other Liquid Fuels (please specify)	NA	NCV					NA	NA	NA
Gaseous Fuels	424.40	NCV	55.40	IE	IE		23.51	IE	IE
Biomass	21 280.12	NCV	70.80	IE	IE	[3]	1 506.63	IE	IE
Other Fuels *(please specify)*	NA	NCV					NA	NA	NA
c. Railways	1 650.03	NCV					123.71	0.01	0.05
Liquid Fuels	1 645.59	NCV	74.92	3.63	30.91		123.29	0.01	0.05
Solid Fuels	4.44	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	154.61	NCV					11.52	0.00	0.00
Residual Oil (Residual Fuel Oil)	NO	NCV	NO	NO	NO		NO	NO	NO
Gas/Diesel Oil	42.50	NCV	74.92	3.27	26.79		3.18	0.00	0.00
Gasoline	112.11	NCV	74.33	34.61	2.68		8.33	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]	7 103.28	NCV					393.52	0.01	0.00
Pipeline transport	7 103.28	NCV					393.52	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	7 103.28	NCV	55.40	1.50	0.10		393.52	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)

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	AGGREGATE ACTIVITY DATA		IMPLIED EMISSION FACTORS [2]			EMISSIONS		
	Consumption		CO_2	CH_4	N_2O	CO_2	CH_4	N_2O
	(TJ)	NCV/GCV[1]	(t/TJ)	(kg/TJ)		(Gg)		
1.A.4 Other Sectors	225 325.80	NCV				9 097.29	9.60	0.64
Liquid Fuels	64 775.52	NCV	74.52	1.40	3.91	4 827.35	0.09	0.25
Solid Fuels	1 783.20	NCV	94.02	93.56	2.49	167.65	0.17	0.00
Gaseous Fuels	74 007.63	NCV	55.40	0.80	1.00	4 100.02	0.06	0.07
Biomass	84 737.64	NCV	102.46	109.59	3.68 [3]	8 681.98	9.29	0.31
Other Fuels	21.81	NCV	104.17	12.00	1.40	2.27	0.00	0.00
a. Commercial/Institutional	28 447.14	NCV				1 423.37	0.19	0.04
Liquid Fuels	2 709.46	NCV	69.77	0.85	0.96	189.03	0.00	0.00
Solid Fuels	159.84	NCV	95.76	90.00	3.39	15.31	0.01	0.00
Gaseous Fuels	21 963.07	NCV	55.40	0.80	1.00	1 216.75	0.02	0.02
Biomass	3 592.97	NCV	108.08	43.39	2.79 [3]	388.32	0.16	0.01
Other Fuels	21.81	NCV	104.17	12.00	1.40	2.27	0.00	0.00
b. Residential	175 800.47	NCV				6 879.69	8.75	0.37
Liquid Fuels	51 923.34	NCV	74.72	0.74	1.23	3 879.67	0.04	0.06
Solid Fuels	1 588.49	NCV	93.84	94.00	2.39	149.07	0.15	0.00
Gaseous Fuels	51 461.28	NCV	55.40	0.80	1.00	2 850.95	0.04	0.05
Biomass	70 827.36	NCV	102.02	120.26	3.52 [3]	7 225.73	8.52	0.25
Other Fuels	NO	NCV	NO	NO	NO	NO	NO	NO
c. Agriculture/Forestry/Fisheries	21 078.19	NCV				794.24	0.67	0.24
Liquid Fuels	10 142.72	NCV	74.80	4.89	18.40	758.65	0.05	0.19
Solid Fuels	34.88	NCV	93.93	90.00	2.76	3.28	0.00	0.00
Gaseous Fuels	583.28	NCV	55.40	0.80	1.00	32.31	0.00	0.00
Biomass	10 317.31	NCV	103.51	59.38	5.08 [3]	1 067.93	0.61	0.05
Other Fuels	NO	NCV	NO	NO	NO	NO	NO	NO
1.A.5 Other *(Not specified elsewhere)* [6]	653.39	NCV				47.40	0.00	0.00
a. Stationary *(please specify)* [7]	NA	NCV				NA	NA	NA
b. Mobile *(please specify)* [8]	653.39	NCV				47.40	0.00	0.00
Military use								
Liquid Fuels	651.33	NCV	72.77	2.35	4.87	47.40	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	2.06	NCV	70.80	IE	IE [3]	0.15	IE	IE
Other Fuels	NO	NCV	NO	NO	NO	NO	NO	NO

[1] If activity data are calculated using net calorific values (NCV) as specified by the IPCC Guidelines, write NCV in this column. If gross calorific values (GCV) are used, write GCV in this column.

[2] Accurate estimation of CH_4 and N_2O emissions depends on combustion conditions, technology and emission control policy, as well as on fuel characteristics. Therefore, caution should be used when comparing the implied emission factors across countries.

[3] Although carbon dioxide emissions from biomass are reported in this table, they will not be included in the total CO_2 emissions from fuel combustion. The value for total CO_2 from biomass is recorded in Table1 sheet 2 under the Memo Items.

[4] Use the cell below to list all activities covered under "f. Other"

[5] Use the cell below to list all activities covered under "e. Other transportation"

[6] Include military fuel use under this category

[7] Use the cell below to list all activities covered under "1.A.5.a Other - stationary".

[8] Use the cell below to list all activities covered under "1.A.5.b Other - mobile".

Documentation Box:

• Parties should provide detailed explanations on the fuel combustion sub-sector in the corresponding part of Chapter 3: Energy (CRF sub-sector 1.A) of the NIR. Use this documentation box to provide references to relevant sections of the NIR if any additional information and/or further details are needed to understand the content of this table.

• If estimates are based on GCV, use this documentation box to provide reference to the relevant section of the NIR where the information necessary to allow the calculation of the activity data based on NCV can be found.

• If some derived gases (e.g. gas works gas, coke oven gas, blast furnace gas) are considered, use this documentation box to provide a reference to the relevant section of the NIR containing the information on the allocation of these derived gases under the above fuel categories (liquid, soild, gaseous, biomass and other fuels).

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
CO_2 from Fuel Combustion Activities - Reference Approach (IPCC Worksheet 1-1)
(Sheet 1 of 1)

FUEL TYPES			Unit	Production	Imports	Exports	International bunkers	Stock change	Apparent consumption	Conversion factor (TJ/Unit)	NCV/ GCV [1]	Apparent consumption (TJ)	Carbon emission factor (t C/TJ)	Carbon content (Gg C)	Carbon stored (Gg C)	Net carbon emissions (Gg C)	Fraction of carbon oxidized	Actual CO_2 emissions (Gg CO_2)
Liquid Fossil	Primary Fuels	Crude Oil	Gg	840.07	7 471.91	NO		-36.95	8 348.92	42.50	NCV	354 829.22	20.00	7 096.58	NO	7 096.58	0.99	25 760.60
		Orimulsion	Gg	NO	NO	NO		NO	NO	NA	NCV	NA,NO	NA	NA,NO	NA	NA,NO	NA	NA,NO
		Natural Gas Liquids	Gg	78.84	44.13	NO		NO	122.97	42.50	NCV	5 226.27	17.20	89.89	NO	89.89	0.99	326.31
	Secondary Fuels	Gasoline	Gg		844.00	778.16	NO	-39.49	105.34	41.34	NCV	4 354.96	17.69	77.03	NO	77.03	0.99	279.62
		Jet Kerosene	Gg		92.11	23.70	657.36	-1.94	-587.01	43.34	NCV	-25 439.56	19.50	-496.07	NO	-496.07	0.99	-1 800.74
		Other Kerosene	Gg		6.11	2.23	NO	0.04	3.84	43.34	NCV	166.49	19.60	3.26	0.85	2.41	0.99	8.76
		Shale Oil	Gg		NO	NO		NO	NO	NA	NCV	NA,NO	NA	NA,NO	NA	NA,NO	NA	NA,NO
		Gas / Diesel Oil	Gg		4 448.53	1 011.45	1.23	16.96	3 418.89	42.08	NCV	143 879.40	18.84	2 709.98	NO	2 709.98	0.99	9 837.25
		Residual Fuel Oil	Gg		59.00	217.00	NO	-15.00	-143.00	40.36	NCV	-5 771.01	21.10	-121.77	NO	-121.77	0.99	-442.02
		Liquefied Petroleum Gas (LPG)	Gg		81.30	22.08		0.28	58.94	46.12	NCV	2 718.42	17.20	46.76	NO	46.76	0.99	169.73
		Ethane	Gg		IE	IE		IE	IE	NA	NCV	IE,NA	NA	IE,NA	NO	IE,NA,NO	NA	IE,NA,NO
		Naphtha	Gg		NO	186.00		-1.00	-185.00	45.01	NCV	-8 326.85	20.00	-166.54	556.32	-722.86	0.99	-2 623.98
		Bitumen	Gg		269.84	205.07		0.04	64.73	44.30	NCV	2 867.68	22.00	63.09	419.73	-356.64	0.99	-1 294.60
		Lubricants	Gg		102.00	45.64	NO	-0.99	57.35	41.81	NCV	2 397.58	20.00	47.95	24.76	23.19	0.99	84.19
		Petroleum Coke	Gg		88.25	0.09		9.14	79.02	35.20	NCV	2 781.68	27.50	76.50	29.48	47.01	0.99	170.66
		Refinery Feedstocks	Gg		143.41	NO		59.36	84.05	42.57	NCV	3 578.05	20.00	71.56	NO	71.56	0.99	259.77
		Other Oil	Gg		19.42	9.66		-3.51	13.28	44.30	NCV	588.22	20.00	11.76	44.58	-32.82	0.99	-119.12
Other Liquid Fossil												NA		NA	NA	NA		NA
Liquid Fossil Totals												483 850.56		9 510.00	1 075.72	8 434.28		30 616.42
Solid Fossil	Primary Fuels	Anthracite [2]	Gg	NO	6.00	NO		-4.00	10.00	28.00	NCV	280.00	26.80	7.50	NO	7.50	0.98	26.96
		Coking Coal	Gg	NO	1 797.20	NO		-12.45	1 809.66	29.07	NCV	52 606.72	25.45	1 338.64	70.74	1 267.90	0.98	4 556.00
		Other Bituminous Coal	Gg	NO	1 845.00	2.00	NO	162.00	1 681.00	27.33	NCV	45 935.58	25.75	1 182.97	NO	1 182.97	0.98	4 250.81
		Sub-bituminous Coal	Gg	NO	75.00	NO	NO	NO	75.00	21.73	NCV	1 629.98	26.20	42.71	NO	42.71	0.98	153.45
		Lignite	Gg	NO	15.00	NO		NO	15.00	19.35	NCV	290.28	27.19	7.89	NO	7.89	0.98	28.36
		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		30.19	0.80		0.04	29.35	19.30	NCV	566.53	25.80	14.62	0.50	14.12	0.98	50.73
		Coke Oven/Gas Coke	Gg		1 191.21	0.15		-14.24	1 205.30	29.00	NCV	34 953.75	29.65	1 036.27	6.11	1 030.16	0.98	3 701.70
Other Solid Fossil												NA		NA	NA	NA		NA
Solid Fossil Totals												136 267.24		3 630.73	77.35	3 553.38		12 768.48
Gaseous Fossil		Natural Gas (Dry)	TJ	65 499.77	486 957.60	219 084.06		22 940.76	310 432.55	1.00	NCV	310 432.55	15.19	4 713.92	NO	4 713.92	1.00	17 197.96
Other Gaseous Fossil												NA		NA	NA	NA		NA
Gaseous Fossil Totals												310 432.55		4 713.92	NA,NO	4 713.92		17 197.96
Total												930 550.34		17 854.65	1 153.07	16 701.58		60 582.86
Biomass total												218 899.70		6 545.10	NA,NO	6 545.10		21 223.63
		Solid Biomass	TJ	201 799.71	20 238.39	12 197.27		-371.44	210 212.27	1.00	NCV	210 212.27	29.90	6 285.35	NO	6 285.35	0.88	20 280.72
		Liquid Biomass	TJ	IE	IE	IE		IE	IE	NA	NCV	IE,NA	NA	IE,NA	NA	IE,NA	NA	IE,NA
		Gas Biomass	TJ	8 687.43	NO	NO		NO	8 687.43	1.00	NCV	8 687.43	29.90	259.75	NO	259.75	0.99	942.91

[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)

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)	483.85	416.92	30 616.42	414.15	31 023.66	0.67	-1.31
Solid Fuels (excluding international bunkers) [5]	136.27	104.99	12 768.48	87.86	8 547.35	19.50	49.39
Gaseous Fuels	310.43	297.14	17 197.96	298.10	16 509.86	-0.32	4.17
Other [5]	NA	NA	NA	33.68	2 216.26	-100.00	-100.00
Total [5]	***930.55***	***819.05***	***60 582.86***	***833.79***	***58 297.14***	***-1.77***	***3.92***

(1) "Sectoral approach" is used to indicate the approach (if different from the Reference approach) used by the Party to estimate CO_2 emissions from fuel combustion as reported in table 1.A(a), sheets 1-4.

(2) Difference in CO_2 emissions estimated by the Reference approach (RA) and the Sectoral approach (SA) (difference = 100% x ((RA-SA)/SA)). For calculating the difference in energy consumption between the two approaches, data as reported in the column "Apparent energy consumption (excluding non-energy use and feedstocks)" are used for the Reference approach.

(3) Apparent energy consumption data shown in this column are as in table 1.A(b).

(4) For the purposes of comparing apparent energy consumption from the Reference approach with energy consumption from the Sectoral approach, Parties should, in this column, subtract from the apparent energy consumption (Reference approach) the energy content corresponding to the fuel quantities used as feedstocks and/or for non-energy purposes, in accordance with the accounting of energy use in the Sectoral approach

(5) Emissions from biomass are not included.

Note: The Reporting Instructions of the Revised 1996 IPCC Guidelines for National Greenhouse Gas Inventories require that estimates of CO_2 emissions from fuel combustion, derived using a detailed Sectoral approach, be compared to those from the Reference approach (Worksheet 1-1 of the IPCC Guidelines, Volume 2, Workbook). This comparison is to assist in verifying the Sectoral data.

Documentation Box:

Parties should provide detailed explanations on the fuel combustion sub-sector, including information related to the comparison of CO_2 emissions calculated using the Sectoral approach with those calculated using the Reference approach, in the corresponding part of Chapter 3: Energy (CRF sub-sector 1.A) of the NIR. Use this documentation box to provide references to relevant sections of the NIR if any additional information and/or further details are needed to understand the content of this table.

If the CO_2 emission estimates from the two approaches differ by more than 2 per cent, Parties should briefly explain the cause of this difference in this documentation box and provide a reference to relevant section of the NIR where this difference is explained in more detail.

1.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 stati
1.AC Difference - Reference and Sectoral Approach/2012:Solid fuels CO2 emissions:

RA includes process emissions (mainly non energy use of coke and coal) from blast furnaces which are included in category 2 C 1 and process emissions from carbide production which are included in cat
Liquid fuels CO2 emissions:

The reference approach considers a share of feedstocks used for plastics production and solvent production as non-carbon-stored. In the sectoral approach a share of emissions from waste incineration
Gaseous fuels CO2 emissions:
The RA includes process emissions from ammonia-production which are included in category 2 B 1.
Other fuels:
The sectoral approach considers waste as an additional fuel type (e.g. municipal solid waste and industrial fuel waste).

TABLE 1.A(d) SECTORAL BACKGROUND DATA FOR ENERGY
Feedstocks and Non-Energy Use of Fuels
(Sheet 1 of 1)

Additional information [(a)]

FUEL TYPE	ACTIVITY DATA AND RELATED INFORMATION		IMPLIED EMISSION FACTOR	ESTIMATE	Additional information [(a)]			
	Fuel quantity (TJ)	Fraction of carbon stored	Carbon emission factor (t C/TJ)	Carbon stored in non-energy use of fuels (Gg C)	CO_2 not emitted ($Gg\ CO_2$)	Subtracted from energy sector *(specify source category)*	Associated CO_2 emissions (Gg)	Allocated under *(Specify source category, e.g. Waste Incineration)*
Naphtha [(1)]	37 088.24	0.75	20.00	556.32	2 039.85	NA	NE	NE
Lubricants	2 475.85	0.50	20.00	24.76	90.78	NA	NE	NE
Bitumen	19 078.49	1.00	22.00	419.73	1 539.00	NA	NE	NE
Coal Oils and Tars (from Coking Coal)	2 187.48	0.75	43.12	70.74	259.38	NA	NE	NE
Natural Gas[(1)]	13 205.63	NO	NO	NO	NO	NA	NE	NE
Gas/Diesel Oil [(1)]	NO	0.50	NO	NO	NO	NA	NE	NE
LPG [(1)]	NO	1.00	NO	NO	NO	NA	NE	NE
Ethane [(1)]	NO	NO	NO	NO	NO	NA	NE	NE
Other *(please specify)*				50.69				
Butane	NO	0.75	NO	NO	NO	NA	NE	NE
Coal	NO	0.50	NO	NO	NO	NA	NE	NE
Coke	29 444.60	0.01	29.65	6.11	22.41	NA	NE	NE
Gasoline	NO	0.50	NO	NO	NO	NA	NE	NE
Other petroleum products	2 972.07	0.75	20.00	44.58	163.46	NA	NE	NE

	Carbon stored (Gg C)	CO_2 not emitted ($Gg\ CO_2$)
Total	1 122.24	4 114.88
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	1 115.47	4 090.05

A fraction of energy carriers is stored in such products as plastics or asphalt. The non-stored fraction of the carbon in the energy carrier or product is oxidized, resulting in carbon dioxide emissions, either during use of the energy carriers in the industrial production (e.g. fertilizer production), or during use of the products (e.g. solvents, lubricants), or in both (e.g. monomers). To report associated emissions, use the above table.

(1) Enter data for those fuels that are used as feedstocks (fuel used as raw materials for manufacture of products such as plastics or fertilizers) or for other non-energy use (fuels not used as fuel or transformed into another fuel (e.g. bitumen for road construction, lubricants)).

(a) The fuel lines continue from the table to the left.

Documentation box:

• Parties should provide detailed explanations on the fuel combustion sub-sector, including information related to feedstocks, in the corresponding part of Chapter 3: Energy (CRF sub-sector 1.A) of the NIR. Use this documentation box to provide references to relevant sections of the NIR if any additional information and/or further details are needed to understand the content of this table.

• The above table is consistent with the IPCC Guidelines. Parties that take into account the emissions associated with the use and disposal of these feedstocks could continue to use their methodology, but should indicate this in this documentation box and provide a reference to the relevant section of the NIR where further explanation can be found.

TABLE 1.B.1 SECTORAL BACKGROUND DATA FOR ENERGY
Fugitive Emissions from Solid Fuels
(Sheet 1 of 1)

Inventory 2012
Submission 2014 v1.4
AUSTRIA

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	ACTIVITY DATA	IMPLIED EMISSION FACTORS		EMISSIONS		
				CH_4		
	Amount of fuel produced	CH_4 [1]	CO_2	Recovery/Flaring [2]	Emissions [3]	CO_2
	(Mt)	(kg/t)		(Gg)		
1. B. 1. a. Coal Mining and Handling	NO			NO	IE,NO	IE,NA,NO
i. Underground Mines[4]	NO	NO	NO	NO	NO	NO
Mining Activities		NO	NO	NO	NO	NO
Post-Mining Activities		NO	NO	NO	NO	NO
ii. Surface Mines[4]	NO	IE,NO	IE,NA	NO	IE,NO	IE,NA
Mining Activities		NO	NA	NO	NO	NA
Post-Mining Activities		IE	IE	NO	IE	IE
1. B. 1. b. Solid Fuel Transformation	0.04	1.00	NA	NO	0.04	NA
1. B. 1. c. Other *(please specify)* [5]				NA	NA	NA

(1) The IEFs for CH_4 are estimated on the basis of gross emissions as follows: (CH_4 emissions + amounts of CH_4 flared/recovered) / activity data.

(2) Amounts of CH4 drained (recovered), utilized or flared.

(3) Final CH4 emissions after subtracting the amounts of CH4 utilized or recovered.

(4) In accordance with the IPCC Guidelines, emissions from Mining Activities and Post-Mining Activities are calculated using the activity data of the amount of fuel produced for Underground Mines and Surface Mines.

(5) This category is to be used for reporting any other solid-fuel-related activities resulting in fugitive emissions, such as emissions from abandoned mines and waste piles.

Note: There are no clear references to the coverage of 1.B.1.b. and 1.B.1.c. in the IPCC Guidelines. Make sure that the emissions entered here are not reported elsewhere. If they are reported under another source category, indicate this by using notation key IE and making the necessary reference in Table 9 (completeness).

Documentation box:
- Parties should provide detailed explanations on the fugitive emissions from source category 1.B.1 Solid Fuels, in the corresponding part of Chapter 3: Energy (CRF source category 1.B.1) of the NIR. Use this documentation box to provide references to
- Regarding data on the amount of fuel produced entered in the above table, specify in this documentation box whether the fuel amount is based on the run-of-mine (ROM) production or on the saleable production.
- If entries are made for "Recovery/Flaring", indicate in this documentation box whether CH_4 is flared or recovered and provide a reference to the section in the NIR where further details on recovery/flaring can be found.
- If estimates are reported under 1.B.1.b. and 1.B.1.c., use this documentation box to provide information regarding activities covered under these categories and to provide a reference to the section in the NIR where the background information can be found.

1.B.1.B Solid Fuel Transformation:Since the resubmission in Nov/2013 category 1.B.1.b includes emissions from char coal production. Emissions from coke ovens are considered in category 1.A.2.a.

TABLE 1.B.2 SECTORAL BACKGROUND DATA FOR ENERGY
Fugitive Emissions from Oil, Natural Gas and Other Sources
(Sheet 1 of 1)

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	ACTIVITY DATA [(1)]			IMPLIED EMISSION FACTORS			EMISSIONS		
	Description [(1)]	Unit [(1)]	Value	CO_2	CH_4	N_2O	CO_2	CH_4	N_2O
				(kg/unit) [(2)]			(Gg)		
1. B. 2. a. Oil [(3)]							145.00	6.34	IE,NA
I. Exploration	*number of wells drilled*	number	669.00	IE	IE	IE	IE	IE	IE
ii. Production[(4)]	*Oil throughput*	Mt	0.84	172 605 563.63	7 227 390.07		145.00	6.07	
iii. Transport	*oil loaded in tankers*	number	NA	IE	IE		IE	IE	
iv. Refining / Storage	*Oil refined (SNAP 0401)*	Mt	8.35	NA	31 662.50	NA	NA	0.26	NA
v. Distribution of Oil Products	*Gasoline Consumption (SNAP 0505)*	Mt	1.85	NA	NA		NA	NA	
vi. Other	*NO*	Mt	NO	NO	NO		NO	NO	
1. B. 2. b. Natural Gas							92.17	5.25	
i. Exploration	*Gas produced*	10^6 m^3	1 807.00	NA	IE		NA	IE	
ii. Production [(4)] / Processing	*gas produced*	10^6 m^3	1 807.00	50 913.12	IE		92.00	IE	
iii. Transmission	*Pipelines length (km)*	km	7 109.00	24.50	385.94		0.17	2.74	
iv. Distribution	*Distribution network length*	km	29 259.66	NA	85.62		NA	2.51	
v. Other Leakage	*Gas consumed*	PJ	NO	NO	NO		NO	NO	
at industrial plants and power stations	*Gas consumed*	PJ	NO	NO	NO		NO	NO	
in residential and commercial sectors	*Gas consumed*	PJ	NO	NO	NO		NO	NO	
1. B. 2. c. Venting [(5)]							IE	IE	
i. Oil	*oil produced*	Mt	NA	IE	IE		IE	IE	
ii. Gas	*gas produced*	PJ	NA	IE	IE		IE	IE	
iii. Combined	*Oil Ptoduced*	Mt	NA	IE	IE		IE	IE	
Flaring							IE	IE	IE
i. Oil	*Oil consumed*	Mtoe	NA	IE	IE	IE	IE	IE	IE
ii. Gas	*gas consumed*	PJ	NA	IE	IE	IE	IE	IE	IE
iii. Combined	*oil consumed*	Mt	NA	IE	IE	IE	IE	IE	IE
1.B.2.d. Other *(please specify)* [(6)]							NA	NA	NA

(1) Specify the activity data used in the Description column (see examples). Specify the unit of the activity data in the Unit column using one of the following units: PJ, Tg, 10^6 m^3, 10^6 bbl/yr, km, number of sources (e.g. wells).

(2) The unit of the implied emission factor will depend on the unit of the activity data used, and is therefore not specified in this column.

(3) Use the category also to cover emissions from combined oil and gas production fields. Natural gas processing and distribution from these fields should be included under 1.B.2.b.ii and 1.B.2.b.iv, respectively.

(4) If using default emission factors, these categories will include emissions from production other than venting and flaring.

(5) If using default emission factors, emissions from Venting and Flaring from all oil and gas production should be accounted for under Venting.

(6) For example, fugitive CO_2 emissions from production of geothermal power could be reported here.

Documentation box:

- Parties should provide detailed explanations on the fugitive emissions from source category 1.B.2 Oil and Natural Gas, in the corresponding part of Chapter 3: Energy (CRF source category 1.B.2) of the NIR. Use this documentation box to provide references to relevant sections of the NIR if any additional information and/or further details are needed to understand the content of this table.
- Regarding data on the amount of fuel produced entered in this table, specify in this documentation box whether the fuel amount is based on the raw material production or on the saleable production. Note cases where more than one type of activity data is used to estimate emissions.
- Venting and Flaring: Parties using the IPCC software could report venting and flaring emissions together, indicating this in this documentation box.
- If estimates are reported under "1.B.2.d Other", use this documentation box to provide information regarding activities covered under this category and to provide a reference to the section in the NIR where background information can be found.

TABLE 1.C SECTORAL BACKGROUND DATA FOR ENERGY
International Bunkers and Multilateral Operations
(Sheet 1 of 1)

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	ACTIVITY DATA	IMPLIED EMISSION FACTORS			EMISSIONS		
	Consumption	CO_2	CH_4	N_2O	CO_2	CH_4	N_2O
	(TJ)	(t/TJ)			(Gg)		
Aviation Bunkers	28 488.56				2 072.66	0.04	0.07
Jet Kerosene	28 488.56	72.75	0.00	0.00	2 072.66	0.04	0.07
Gasoline	NO	NO	NO	NO	NO	NO	NO
Marine Bunkers	609.04				45.63	0.00	0.02
Gasoline	NO	NO	NO	NO	NO	NO	NO
Gas/Diesel Oil	609.04	74.92	0.00	0.03	45.63	0.00	0.02
Residual Fuel Oil	NO	NO	NO	NO	NO	NO	NO
Lubricants	NO	NO	NO	NO	NO	NO	NO
Coal	NO	NO	NO	NO	NO	NO	NO
Other *(please specify)*	NA				NA	NA	NA
Multilateral Operations [1]	NO	NO	NO	NO	NO	NO	NO

Additional information

Fuel consumption	Distribution [a] (per cent)	
	Domestic	International
Aviation	2.57	97.43
Marine	20.25	79.75

[a] For calculating the allocation of fuel consumption, the sums of fuel consumption for domestic navigation and aviation (table 1.A(a)) and for international bunkers (table 1.C) are used.

[1] Parties may choose to report or not report the activity data and implied emission factors for multilateral operations consistent with the principle of confidentiality stated in the UNFCCC repo
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 marine

Documentation box:
• Parties should provide detailed explanations on the fuel combustion sub-sector, including international bunker fuels, in the corresponding part of Chapter 3: Energy (CRF sub-sector 1.A) of the NIR. Use this documentation box to provide references to relevant sections of the NIR if any additional information and/or further details are needed to understand the content of this table.
• Provide in this documentation box a brief explanation on how the consumption of international marine and aviation bunker fuels was estimated and separated from domestic consumption, and include a reference to the section of the NIR where the explanation is provided in more detail.

TABLE 2(I) SECTORAL REPORT FOR INDUSTRIAL PROCESSES
(Sheet 1 of 2)

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	CO_2	CH_4	N_2O	HFCs[1]		PFCs[1]		SF_6		NO_x	CO	NMVOC	SO_2
				P	A	P	A	P	A				
	(Gg)			CO_2 equivalent (Gg)				(Gg)					
Total Industrial Processes	9 008.12	0.87	0.17	2 593.55	1 431.45	285.89	40.46	0.01	0.01	1.35	23.66	4.86	1.22
A. Mineral Products	2 946.15	NA	NA							NA	9.78	IE,NA	NA
1. Cement Production	1 672.55												NA
2. Lime Production	569.09												
3. Limestone and Dolomite Use	255.60												
4. Soda Ash Production and Use	13.94												
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)*	434.98	NA	NA							NA	NA	NA	NA
Glass Production	36.81	NA	NA							NA	NA	NA	NA
Bricks and Tiles (decarbonizing)	93.17	NA	NA							NA	NA	NA	NA
Sinter Production	304.99	NA	NA							NA	NA	NA	NA
B. Chemical Industry	587.78	0.87	0.17	NO	NO	NO	NO	NO	NO	0.41	11.09	1.32	0.77
1. Ammonia Production	510.89	0.08	NA							0.21	0.03	IE	NA
2. Nitric Acid Production			0.17							0.12			
3. Adipic Acid Production	NO		NO							NO	NO	NO	
4. Carbide Production	48.73	NA,NO								NA	NA	NA	NA
5. Other *(as specified in table 2(I).A-G)*	28.16	0.79	NA,NO	NO	NA,NO	NO	NA,NO	NO	NO	0.09	11.07	1.32	0.77
Carbon Black		NO											
Ethylene	NA	0.50	NA										
Dichloroethylene		NO											
Styrene		NO											
Methanol		NO											
CO2 from nitric acid production	0.39	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
Other Chemical Industry	27.77	0.29	NA	NO	NO	NO	NO	NO	NO	0.09	11.07	1.32	0.77
C. Metal Production	5 474.20	0.00	NA	NO	NO	NO	NO	NA,NO	0.00	0.10	2.18	0.43	0.45
1. Iron and Steel Production	5 454.48	0.00								0.08	1.86	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	0.20	0.40
Non-ferrous metals	NA	NA	NA	NO	NO	NO	NO	NO	NO	0.02	0.32	0.20	0.40

Note: P = Potential emissions based on Tier 1 approach of the IPCC Guidelines. A = Actual emissions based on Tier 2 approach of the IPCC Guidelines. This applies only to source categories where methods exist for both tiers.

[1] The emissions of HFCs and PFCs are to be expressed as CO_2 equivalent emissions. Data on disaggregated emissions of HFCs and PFCs are to be provided in Table 2(II).

TABLE 2(I) SECTORAL REPORT FOR INDUSTRIAL PROCESSES
(Sheet 2 of 2)

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	CO_2	CH_4	N_2O	HFCs[1]		PFCs[1]		SF_6		NO_x	CO	NMVOC	SO_2
				P	A	P	A	P	A				
	(Gg)			CO_2 equivalent (Gg)				(Gg)					
D. Other Production	NA									0.83	0.60	3.10	NA
1. Pulp and Paper										0.83	0.60	0.61	NA
2. Food and Drink[2]	NA											2.49	
E. Production of Halocarbons and SF_6					NA,NO		NA		NA				
1. By-product Emissions					NA,NO		NA		NA				
Production of HCFC-22					NO								
Other					NA		NA		NA				
2. Fugitive Emissions					NA		NA		NA				
3. Other *(as specified in table 2(II))*					NA		NA		NA				
F. Consumption of Halocarbons and SF_6				2 593.55	1 431.45	285.89	40.46	0.01	0.01				
1. Refrigeration and Air Conditioning Equipment				NA	1 388.79	NA	IE,NO	NA	NA				
2. Foam Blowing				NA	12.39	NA	NO	NA	NA				
3. Fire Extinguishers				NA	10.07	NA	NO	NA	NA				
4. Aerosols/ Metered Dose Inhalers				NA	18.55	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	1.65	NA	40.46	NA	0.00				
8. Electrical Equipment				NA	NO	NA	NO	NA	0.00				
9. Other *(as specified in table 2(II)*				NA	NA,NO	NA	NA,NO	NA	0.01				
Double glaze windows				NA	NA,NO	NA	NO	NA	0.01				
Research and other use				NA	NA,NO	NA	NO	NA	0.00				
G. Other *(as specified in tables 2(I).A-G and 2(II))*	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA

Note: P = Potential emissions based on Tier 1 approach of the IPCC Guidelines. A = Actual emissions based on Tier 2 approach of the IPCC Guidelines. This applies only to source categories where methods exist for both tiers.

(1) The emissions of HFCs and PFCs are to be expressed as CO_2 equivalent emissions. Data on disaggregated emissions of HFCs and PFCs are to be provided in Table 2(II).

(2) CO_2 from Food and Drink Production (e.g. gasification of water) can be of biogenic or non-biogenic origin. Only information on CO_2 emissions of non-biogenic origin should be reported.

(3) ODS: ozone-depleting substances.

Documentation box:
Parties should provide detailed explanations on the industrial processes sector in Chapter 4: Industrial processes (CRF sector 2) of the NIR. Use this documentation box to provide references to relevant sections of the NIR if any additional information and/or further details are needed to understand the content of this table.

TABLE 2(I).A-G SECTORAL BACKGROUND DATA FOR INDUSTRIAL PROCESSES
Emissions of CO_2, CH_4 and N_2O
(Sheet 1 of 2)

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	ACTIVITY DATA		IMPLIED EMISSION FACTORS [(2)]			EMISSIONS					
	Production/Consumption quantity		CO_2	CH_4	N_2O	CO_2		CH_4		N_2O	
						Emissions[(3)]	Recovery[(4)]	Emissions[(3)]	Recovery[(4)]	Emissions[(3)]	Recovery[(4)]
	Description [(1)]	(kt)	(t/t)			(Gg)					
A. Mineral Products						2 946.15	IE,NO	NA	NO	NA	NO
1. Cement Production	Clinker Production	3 206.06	0.52			1 672.55	NO				
2. Lime Production	Lime Produced	761.04	0.75			569.09	NO				
3. Limestone and Dolomite Use	Limestone and Dolomite used	563.08	0.45			255.60	NO				
4. Soda Ash						13.94	IE,NO				
Soda Ash Production	Soda Ash Production	NA	IE			IE	IE				
Soda Ash Use	Soda Ash Used	33.59	0.42			13.94	NO				
5. Asphalt Roofing	Roofing Material Production [Mio m2]	27.95	IE			IE	NO				
6. Road Paving with Asphalt	Asphalt Production	1 606.60	IE			IE	NO				
7. Other *(please specify)*						434.98	NO	NA	NO	NA	NO
Glass Production	Other glass production	472.04	0.08	NA	NA	36.81	NO	NA	NO	NA	NO
Bricks and Tiles (decarbonizing)	Bricks Production	1 749.30	0.05	NA	NA	93.17	NO	NA	NO	NA	NO
Sinter Production	MgCO3 sintered	625.26	0.49	NA	NA	304.99	NO	NA	NO	NA	NO
B. Chemical Industry						587.78	NO	0.87	NO	0.17	NO
1. Ammonia Production[(5)]	Ammonia Production	479.47	1.07	0.00	NA	510.89	NO	0.08	NO	NA	NO
2. Nitric Acid Production	Nitric Acid Production	534.64			0.00					0.17	NO
3. Adipic Acid Production	Adipic Acid Production	NO	NO		NO	NO	NO			NO	NO
4. Carbide Production	Carbide Production	37.61	1.30	NA,NO		48.73	NO	NA,NO	NO		
Silicon Carbide	Silicon Carbide Production	NO	NO	NO		NO	NO	NO	NO		
Calcium Carbide	Calcium Carbide Production	37.61	1.30	NA		48.73	NO	NA	NO		
5. Other *(please specify)*						28.16	NO	0.79	NO	NA,NO	NO
Carbon Black	Carbon Black Production	NO		NO				NO	NO		
Ethylene	Ethylene Production	500.00	NA	0.00	NA	NA	NO	0.50	NO	NA	NO
Dichloroethylene	Dichloroethylene Production	NO		NO				NO	NO		
Styrene	Styrene Production	NO		NO				NO	NO		
Methanol	Methanol Production	NO		NO				NO	NO		
CO2 from nitric acid production	(Specify)	NO	NO	NO	NO	0.39	NO	NO	NO	NO	NO
Other Chemical Industry	Other Chemical Products	NA	NA	NA	NA	27.77	NO	0.29	NO	NA	NO

(1) Where the IPCC Guidelines provide options for activity data, e.g. cement production or clinker production for estimating the emissions from Cement Production, specify the activity data used (as shown in the example in parentheses) in order to make the choice of emission factor more transparent and to facilitate comparisons of implied emission factors.
(2) The implied emission factors (IEF) are estimated on the basis of gross emissions as follows: IEF = (emissions plus amounts recovered, oxidized, destroyed or transformed) / activity data.
(3) Final emissions are to be reported (after subtracting the amounts of emission recovery, oxidation, destruction or transformation).
(4) Amounts of emission recovery, oxidation, destruction or transformation.
(5) To avoid double counting, make offsetting deductions for fuel consumption (e.g. natural gas) in Ammonia Production, first for feedstock use of the fuel, and then for a sequestering use of the feedstock.

TABLE 2(I).A-G SECTORAL BACKGROUND DATA FOR INDUSTRIAL PROCESSES
Emissions of CO_2, CH_4 and N_2O
(Sheet 2 of 2)

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	ACTIVITY DATA		IMPLIED EMISSION FACTORS [(2)]			EMISSIONS					
	Production/Consumption quantity		CO_2	CH_4	N_2O	CO_2		CH_4		N_2O	
						Emissions[(3)]	Recovery[(4)]	Emissions[(3)]	Recovery[(4)]	Emissions[(3)]	Recovery[(4)]
	Description [(1)]	(kt)	(t/t)			(Gg)					
C. Metal Production						5 474.20	NA,NO	0.00	NA,NO	NA	NO
1. Iron and Steel Production			0.31	0.00		5 454.48	NA,NO	0.00	NA,NO		
Steel	Steel Production	6 746.21	0.12	IE		806.43	NO	IE	NO		
Pig Iron	Iron Production	5 751.36	0.80	IE		4 601.94	NO	IE	NO		
Sinter	Sinter Production	3 527.74	NA	NA		NA	NA	NA	NA		
Coke	Coke Production	1 307.93	NA	NA		NA	NA	NA	NA		
Other *(please specify)*						46.11	NO	0.00	NO		
Electric Furnace Steel production	Electric Furnace Steel Production	674.46	0.07	0.00		46.11	NO	0.00	NO		
Foundries	Product	161.49	NA	NA		NA	NO	NA	NO		
Rolling mills	Product	6 746.21	NA	0.00		NA	NO	0.00	NO		
2. Ferroalloys Production	Ferroalloys Production	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	145.99	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	1 465.90	NA			NA	NO				
G. Other *(please specify)*						NA	NA	NA	NA	NA	NA

(1) Where the IPCC Guidelines provide options for activity data, e.g. cement production or clinker production for estimating the emissions from Cement Production, specify the activity data used (as shown in the example in parentheses) in order to make the choice of emission factor more transparent and to facilitate comparisons of implied emission factors.

(2) The implied emission factors (IEF) are estimated on the basis of gross emissions as follows: IEF = (emissions + amounts recovered, oxidized, destroyed or transformed) / activity data.

(3) Final emissions are to be reported (after subtracting the amounts of emission recovery, oxidation, destruction or transformation).

(4) Amounts of emission recovery, oxidation, destruction or transformation.

Documentation box:

- Parties should provide detailed explanations on the industrial processes sector in Chapter 4: Industrial processes (CRF sector 2) of the NIR. Use this documentation box to provide references to relevant sections of the NIR if any additional information and/or further details are needed to understand the content of this table.
- In relation to metal production, more specific information (e.g. data on virgin and recycled steel production) could be provided in this documentation box, or in the NIR, together with a reference to the relevant section.
- Confidentiality: Where only aggregate figures for activity data are provided, e.g. due to reasons of confidentiality, a note indicating this should be provided in this documentation box.

TABLE 2(II) SECTORAL REPORT FOR INDUSTRIAL PROCESSES - EMISSIONS OF HFCs, PFCs AND SF_6
(Sheet 1 of 2)

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	HFC-23	HFC-32	HFC-41	HFC-43-10mee	HFC-125	HFC-134	HFC-134a	HFC-152a	HFC-143	HFC-143a	HFC-227ea	HFC-236fa	HFC-245ca	Unspecified mix of listed HFCs [1]	Total HFCs	CF_4	C_2F_6	C_3F_8	C_4F_{10}	$c\text{-}C_4F_8$	C_5F_{12}	C_6F_{14}	Unspecified mix of listed PFCs [1]	Total PFCs	SF_6
	(t) [2]													CO_2 equivalent (Gg)	CO_2 equivalent (Gg)	(t) [2]							CO_2 equivalent (Gg)	CO_2 equivalent (Gg)	(t) [2]
Total Actual Emissions of Halocarbons (by chemical) and SF_6	0.86	55.21	NA,NO	NA,NO	141.36	NA,NO	470.80	NA,NO	NA,NO	98.95	0.00	NA,NO	NA,NO	1.65		IE,NA,NO	IE,NA,NO	IE,NA,NO	NA,NO	IE,NA,NO	NA,NO	NA,NO	40.46		13.65
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		0.20
Aluminium Production																NO	NO	NO	NO	NO	NO	NO	NO		
SF_6 Used in Aluminium Foundries																									0.00
SF_6 Used in Magnesium Foundries																									0.19
E. Production of Halocarbons and SF_6	NA,NO	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,NO	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	NO																								
Other	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA		NA	NA	NA	NA	NA	NA	NA	NA		NA
2. Fugitive Emissions	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA		NA	NA	NA	NA	NA	NA	NA	NA		NA
3. Other *(as specified in table 2(II).C,E)*	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA		NA	NA	NA	NA	NA	NA	NA	NA		NA
F(a). Consumption of Halocarbons and SF_6 (actual	0.86	55.21	NO	NO	141.36	NO	470.80	NO	NO	98.95	0.00	NO	NO	1.65		IE,NO	IE,NO	IE,NO	NO	IE,NO	NO	NO	40.46		13.45
1. Refrigeration and Air Conditioning Equipment	IE	55.21	NO	NO	141.36	NO	446.99	NO	NO	98.95	NO	NO	NO	NO		NO	NO	IE	NO	NO	NO	NO	NO		NA
2. Foam Blowing	NO	NO	NO	NO	NO	NO	9.53	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		NA
4. Aerosols/Metered Dose Inhalers	NO	NO	NO	NO	NO	NO	14.27	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		NA
6. Other applications using ODS [3] substitutes	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO		NO	NO	NO	NO	NO	NO	NO	NO		NA
7. Semiconductor Manufacture	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	1.65		IE	IE	IE	NO	IE	NO	NO	40.46		1.75
8. Electrical Equipment	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO		NO	NO	NO	NO	NO	NO	NO	NO		1.35
9. Other *(as specified in table 2(II)F)*	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NA		NO	NO	NO	NO	NO	NO	NO	NO		10.35
Double glaze windows	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NA		NO	NO	NO	NO	NO	NO	NO	NO		10.30
Research and other use	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NA		NO	NO	NO	NO	NO	NO	NO	NO		0.05
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

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).

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	HFC-23	HFC-32	HFC-41	HFC-43-10mee	HFC-125	HFC-134	HFC-134a	HFC-152a	HFC-143	HFC-143a	HFC-227ea	HFC-236fa	HFC-245ca	Unspecified mix of listed HFCs (1)	Total HFCs	CF_4	C_2F_6	C_3F_8	C_4F_{10}	$c\text{-}C_4F_8$	C_5F_{12}	C_6F_{14}	Unspecified mix of listed PFCs (1)	Total PFCs	SF_6
	(t)(2)													CO_2 equivalent (Gg)	CO_2 equivalent (Gg)	(t)(2)							CO_2 equivalent (Gg)	CO_2 equivalent (Gg)	(t)(2)
F(p). Total Potential Emissions of Halocarbons (by chemical) and SF_6 (4)	C,IE,NE,NO	128.26	NO	NO	255.99	NO	882.21	IE,NE,NO	NO	164.41	0.83	NO	NO	19.38		C,IE,NO	C,IE,NO	C,IE,NO	C,IE,NO	IE,NO	NO	NO	285.89		13.97
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:	NO	128.26	NO	NO	255.99	NO	882.21	NO	NO	164.41	0.83	NO	NO	19.38		IE,NO	IE,NO	NO	NO	IE,NO	NO	NO	285.89		13.97
In bulk	NO	95.32	NO	NO	221.72	NO	606.00	NO	NO	162.84	0.83	NO	NO	19.38		IE	IE	NO	NO	IE	NO	NO	285.89		13.97
In products (6)	NO	32.94	NO	NO	34.27	NO	276.21	NO	NO	1.56	NO	NO	NO	NO		NO	NO	NO	NO	NO	NO	NO	NO		NO
Export:	IE,NE	IE,NE	NO	NO	IE,NE	NO	IE,NE	IE,NE	NO	IE,NE	IE,NO	NO	NO	NO		IE,NO	IE,NO	IE,NO	IE,NO	NO	NO	NO	NO		NO
In bulk	IE	IE	NO	NO	IE	NO	IE	IE	NO	IE	IE	NO	NO	NO		IE	IE	IE	IE	NO	NO	NO	NO		NO
In products (6)	NE	NE	NO	NO	NE	NO	NE	NE	NO	NE	NO	NO	NO	NO		NO	NO	NO	NO	NO	NO	NO	NO		NO
Destroyed amount	C	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO		C	C	C	C	NO	NO	NO	NO		C
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))	10.07	35.88	NA,NO	NA,NO	395.81	NA,NO	612.04	NA,NO	NA,NO	376.00	0.00	NA,NO	NA,NO	1.65	1 431.45	IE,NA,NO	IE,NA,NO	IE,NA,NO	NA,NO	IE,NA,NO	NA,NO	NA,NO	40.46	40.46	326.18
C. Metal Production	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO		NO	NO	NO	NO	NO	NO	NO	NO	NO	4.68
E. Production of Halocarbons and SF_6	NA,NO	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA,NO	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
F(a). Consumption of Halocarbons and SF_6	10.07	35.88	NO	NO	395.81	NO	612.04	NO	NO	376.00	0.00	NO	NO	1.65	1 431.45	IE,NO	IE,NO	IE,NO	NO	IE,NO	NO	NO	40.46	40.46	321.50
G. Other	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Ratio of Potential/Actual Emissions from Consumption of Halocarbons and SF_6																									
Actual emissions - F(a) (Gg CO_2 eq.)	10.07	35.88	NO	NO	395.81	NO	612.04	NO	NO	376.00	0.00	NO	NO	1.65	1 431.45	IE,NO	IE,NO	IE,NO	NO	IE,NO	NO	NO	40.46	40.46	321.50
Potential emissions - F(p)(8) (Gg CO_2 eq.)	C,IE,NE,NO	83.37	NO	NO	716.77	NO	1 146.88	IE,NE,NO	NO	624.75	2.41	NO	NO	19.38	2 593.55	C,IE,NO	C,IE,NO	C,IE,NO	C,IE,NO	IE,NO	NO	NO	285.89	285.89	333.85
Potential/Actual emissions ratio	C,IE,NE,NO	2.32	NO	NO	1.81	NO	1.87	IE,NE,NO	NO	1.66	2 000.00	NO	NO	11.74	1.81	C,IE,NO	C,IE,NO	C,IE,NO	C,IE,NO	IE,NO	NO	NO	7.07	7.07	1.04

(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 is Gg of CO_2 equivalent.

(2) Note that the units used in this table differ from those used in the rest of the Sectoral report tables, i.e. *t* instead of *Gg* .

(3) ODS: ozone-depleting substances

(4) Potential emissions of each chemical of halocarbons and SF_6 estimated using Tier 1a or Tier 1b of the IPCC Guidelines (Volume 3. Reference Manual, pp. 2.47-2.50). Where potential emission estimates are available in a disaggregated manner for the source categories F.1 to F.9, these should be reported in the NIR and a reference should be provided in the documentation box. Use table Summary 3 to indicate whether Tier 1a or 1b was used.

(5) Production refers to production of new chemicals. Recycled substances could be included here, but avoid double counting of emissions. An indication as to whether recycled substances are included should be provided in the documentation box to this table.

(6) Relevant only for Tier 1b

(7) Total actual emissions equal the sum of the actual emissions of each halocarbon and SF_6 from the source categories 2.C, 2.E, 2.F and 2.G as reported in sheet 1 of this table multiplied by the corresponding GWP values.

(8) Potential emissions of each halocarbon and SF_6 taken from row F(p) multiplied by the corresponding GWP values.

Note: As stated in the UNFCCC reporting guidelines, Parties should report actual emissions of HFCs, PFCs and SF_6 where data are available, providing disaggregated data by chemical and source category in units of mass and in CO_2 equivalent. Parties reporting actual emissions should also report potential emissions for the sources where the concept of potential emissions applies, for reasons of transparency and comparability. Gases with GWP values not yet agreed upon by the COP should be reported in Table 9 (b).

Documentation box:
• Parties should provide detailed explanations on the industrial processes sector in Chapter 4: Industrial processes (CRF sector 2) of the NIR. Use this documentation box to provide references to relevant sections of the NIR if any additional information and/or further details are needed to understand the content of this table.
• If estimates are reported under "2.G Other", use this documentation box to provide information regarding activities covered under this category and to provide reference to the section in the NIR where background information can be found.

TABLE 2(II).C SECTORAL BACKGROUND DATA FOR INDUSTRIAL PROCESSES
Metal Production
(Sheet 1 of 1)

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	ACTIVITY DATA		IMPLIED EMISSION FACTORS[2]			EMISSIONS					
			CF_4	C_2F_6	SF_6	CF_4		C_2F_6		SF_6	
						Emissions[3]	Recovery[4]	Emissions[3]	Recovery[4]	Emissions[3]	Recovery[4]
	Description[1]	(t)	(kg/t)			(t)					
C. PFCs and SF_6 from Metal Production						NO	NO	NO	NO	0.20	NO
PFCs from Aluminium Production	Aluminium production [kt]	NO	NO	NO		NO	NO	NO	NO		
SF_6 used in Aluminium and Magnesium Foundries										0.20	NO
Aluminium Foundries	cast Aluminium [t]	C			C					0.00	NO
Magnesium Foundries	cast Magnesium [t]	3 600.00			0.05					0.19	NO

(1) Specify the activity data used as shown in the examples in parentheses.

(2) The implied emission factors (IEFs) are estimated on the basis of gross emissions as follows: IEF = (emissions + amounts recovered, oxidized, destroyed or transformed) / activity data.

(3) Final emissions (after subtracting the amounts of emission recovery, oxidation, destruction or transformation).

(4) Amounts of emission recovery, oxidation, destruction or transformation.

Documentation box:
• Parties should provide detailed explanations on the industrial processes sector in Chapter 4: Industrial processes (CRF sector 2) of the NIR. Use this documentation box to provide references to relevant sections of the NIR if any additional information and/or further details are needed to understand the content of this table.
• Where only aggregate figures for activity data are provided, e.g. due to reasons of confidentiality (see footnote 1 to table 2(II)), a note indicating this should be provided in this documentation box.
• Where applying Tier 1b and country-specific methods, specify any other relevant activity data used in this documentation box, including a reference to the section of the NIR where more detailed information can be found.
• Use this documentation box for providing clarification on emission recovery, oxidation, destruction and/or transformation, and provide a reference to the section of the NIR where more detailed information can be found .

TABLE 2(II).E SECTORAL BACKGROUND DATA FOR INDUSTRIAL PROCESSES
Production of Halocarbons and SF_6
(Sheet 1 of 1)

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	ACTIVITY DATA		IMPLIED EMISSION FACTORS[2]	EMISSIONS	
	Description[1]	(t)	(kg/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	NO	NO	NO
Other *(specify activity and chemical)*					
2. Fugitive Emissions *(specify activity and chemical)*					
HFCs				NA	
HFC-23				NA	
HFC-32				NA	
HFC-41				NA	
HFC-43-10-mee				NA	
HFC-125				NA	
HFC-134				NA	
HFC-134a				NA	
HFC-152a				NA	
HFC-143				NA	
HFC-143a				NA	
HFC-227ea				NA	
HFC-236fa				NA	
HFC-245ca				NA	
Unspecified mix of HFCs				NA	
PFCs				NA	
CF4				NA	
C2F6				NA	
C3F8				NA	
C4F10				NA	
c-C4F8				NA	
C5F12				NA	
C6F14				NA	
Unspecified mix of PFCs				NA	
SF6				NA	
3. Other *(specify activity and chemical)*					
HFCs				NA	
HFC-23				NA	
HFC-32				NA	
HFC-41				NA	
HFC-43-10-mee				NA	
HFC-125				NA	
HFC-134				NA	
HFC-134a				NA	
HFC-152a				NA	
HFC-143				NA	
HFC-143a				NA	
HFC-227ea				NA	
HFC-236fa				NA	
HFC-245ca				NA	
Unspecified mix of HFCs				NA	
PFCs				NA	
CF4				NA	
C2F6				NA	
C3F8				NA	
C4F10				NA	
c-C4F8				NA	
C5F12				NA	
C6F14				NA	
Unspecified mix of PFCs				NA	
SF6				NA	

(1) Specify the activity data used as shown in the examples within parentheses.
(2) The implied emission factors (IEFs) are estimated on the basis of gross emissions as follows: IEF = (emissions + amounts recovered, oxidized, destroyed or transformed) / activity data
(3) Final emissions are to be reported (after subtracting the amounts of emission recovery, oxidation, destruction or transformation).
(4) Amounts of emission recovery, oxidation, destruction or transformation

Documentation box:
• Parties should provide detailed explanations on the industrial processes sector in Chapter 4: Industrial processes (CRF sector 2) of the NIR. Use this documentation box to provide references to relevant sections of the NIR if any additional information and/or further details
• Where only aggregate figures for activity data are provided, e.g. due to reasons of confidentiality (see footnote 1 to table 2(II)), a note indicating this should be provided in this documentation box.
• Where applying Tier 2 and country-specific methods, specify any other relevant activity data used in this documentation box, including a reference to the section of the NIR where more detailed information can be found.
• Use this documentation box for providing clarification on emission recovery, oxidation, destruction and/or transformation, and provide a reference to the section of the NIR where more detailed information can be found

TABLE 2(II).F SECTORAL BACKGROUND DATA FOR INDUSTRIAL PROCESSES
Consumption of Halocarbons and SF_6
(Sheet 1 of 2)

Inventory 2012
Submission 2014 v1.4
AUSTRIA

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	ACTIVITY DATA *Amount of fluid*			IMPLIED EMISSION FACTORS			EMISSIONS		
	Filled into new manufactured products	In operating systems (average annual stocks)	Remaining in products at decommissioning	Product manufacturing factor	Product life factor	Disposal loss factor	From manufacturing	From stocks	From disposal
	(t)			(% per annum)			(t)		
1. Refrigeration[1]									
Air Conditioning Equipment									
Domestic Refrigeration *(please specify chemical)* [1]									
HFC-134a	NO	5.05	0.38	NA	0.30	30.00	NO	0.02	0.11
Commercial Refrigeration									
C3F8	IE	IE	IE	NA	NA	NA	IE	IE	IE
HFC-125	73.97	609.81	39.24	0.20	15.23	30.00	0.15	92.88	11.77
HFC-134a	77.16	775.13	88.76	0.19	15.87	30.00	0.14	122.99	26.63
HFC-143a	65.84	472.61	33.36	0.18	14.34	30.00	0.12	67.78	10.01
HFC-152a	NO	NO	NO	NA	NA	NA	NO	NO	NO
HFC-23	IE	IE	IE	NA	NA	NA	IE	IE	IE
HFC-32	30.02	209.91	11.01	0.20	16.92	30.00	0.06	35.53	3.30
Transport Refrigeration									
HFC-125	2.03	25.83	0.23	NA	29.00	30.00	NO	7.49	0.07
HFC-134a	NO	3.09	1.11	NA	29.00	30.00	NO	0.90	0.33
HFC-143a	1.56	24.20	0.22	NA	29.00	30.00	NO	7.02	0.07
HFC-152a	NO	NO	NO	NA	29.00	30.00	NO	NO	NO
HFC-32	0.71	5.35	0.03	NA	29.00	30.00	NO	1.55	0.01
Industrial Refrigeration									
HFC-125	9.67	92.34	9.18	0.20	7.31	30.00	0.02	6.75	2.75
HFC-134a	10.24	57.92	3.51	0.20	7.72	30.00	0.02	4.47	1.05
HFC-143a	9.08	83.42	7.93	0.20	7.26	30.00	0.02	6.05	2.38
HFC-152a	NO	NO	NO	NA	NA	NA	NO	NO	NO
HFC-32	1.99	21.75	2.46	1.20	7.48	30.00	0.02	1.63	0.74
Stationary Air-Conditioning									
HFC-125	60.29	330.87	13.73	0.03	4.64	30.00	0.02	15.35	4.12
HFC-134a	84.08	650.30	50.03	0.04	6.80	30.00	0.04	44.25	15.01
HFC-143a	3.80	54.81	5.77	0.10	6.88	30.00	0.00	3.77	1.73
HFC-152a	NO	NO	NO	NA	NA	NA	NO	NO	NO
HFC-32	55.65	284.45	1.24	0.02	4.21	30.00	0.01	11.98	0.37
Mobile Air-Conditioning									
HFC-134a	105.55	1 861.49	135.30	0.68	10.19	30.06	0.71	189.64	40.67
2. Foam Blowing[1]									
Hard Foam									
HFC-134a	NO	1 591.56	NO	NA	0.60	NA	NO	9.53	NO
HFC-152a	NO	NO	NO	NO	NA	NA	NO	NO	NO
Soft Foam									
HFC-134a	NO	NO	NO	NO	NO	NO	NO	NO	NO
HFC-152a	NO	NO	NO	NO	NO	NO	NO	NO	NO

[1] Under each of the listed source categories, specify the chemical consumed (*e.g. HFC-32)* as indicated under category Domestic Refrigeration; use one row per chemical.

Note: This table provides for reporting of the activity data and emission factors used to calculate actual emissions from consumption of halocarbons and SF_6 using the "bottom-up approach" (based on the total stock of equipment and estimated emission rates from this equipment). Some Parties may prefer to estimate actual emissions following the alternative "top-down approach" (based on annual sales of equipment and/or gas). Those Parties should indicate the activity data used and provide any other information needed to understand the content of the table in the documentation box at the end of sheet 2 to this table, including a reference to the section of the NIR where further details can be found. Those Parties should provide the following data in the NIR:

1. the amount of fluid used to fill new products,
2. the amount of fluid used to service existing products,
3. the amount of fluid originally used to fill retiring products (the total nameplate capacity of retiring products),
4. the product lifetime, and
5. the growth rate of product sales, if this has been used to calculate the amount of fluid originally used to fill retiring products.

In the NIR, Parties may provide alternative formats for reporting equivalent information with a similar level of detail.

TABLE 2(II).F SECTORAL BACKGROUND DATA FOR INDUSTRIAL PROCESSES
Consumption of Halocarbons and SF_6
(Sheet 2 of 2)

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	ACTIVITY DATA *Amount of fluid*			IMPLIED EMISSION FACTORS			EMISSIONS		
	Filled into new manufactured products	In operating systems (average annual stocks)	Remaining in products at decommissioning	Product manufacturing factor	Product life factor	Disposal loss factor	From manufacturing	From stocks	From disposal
	(t)			(% per annum)			(t)		
3. Fire Extinguishers *(please specify chemical)* [(1)]									
C4F10	NO	NO	NO	NO	NO	NO	NO	NO	NO
HFC-227ea	0.83	37.48	NO	0.05	NA	NA	0.00	NO	NO
HFC-23	NO	63.26	0.26	0.05	1.36	1.00	NO	0.86	0.00
4. Aerosols [(1)]									
Metered Dose Inhalers									
HFC-134a	NO	14.27	NO	NA	100.00	NA	NO	14.27	NO
Other									
HFC-134a	NA	NO	NO	NA	NA	NA	NO	NO	NO
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	13.97	NO	NO	12.52	NA	NA	1.75	NO	NO
Unspecified mix of HFCs	19 375.20	NO	NO	8.52	NA	NA	1 650.87	NO	NO
Unspecified mix of PFCs	285 891.00	NO	NO	14.15	NA	NA	40 456.78	NO	NO
8. Electrical Equipment[(1)]									
SF6	14.33	221.92	0.26	1.00	0.54	2.00	0.14	1.21	0.01
9. Other *(please specify)* [(1)]									
Double glaze windows									
SF6	NO	185.93	8.16	NO	1.15	100.00	NO	2.14	8.16
Research and other use									
C3F8	NO	NO	NO	NA	NA	NA	NO	NO	NO
SF6	NO	0.77	NO	NA	6.02	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 reporting equivalent information

TABLE 3 SECTORAL REPORT FOR SOLVENT AND OTHER PRODUCT USE
(Sheet 1 of 1)

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	CO_2	N_2O	NMVOC
	(Gg)		
Total Solvent and Other Product Use	189.00	0.47	79.16
A. Paint Application	59.09		22.22
B. Degreasing and Dry Cleaning	28.75	NA	10.87
C. Chemical Products, Manufacture and Processing	12.67		6.72
D. Other	88.50	0.47	39.35
1. Use of N_2O for Anaesthesia		0.07	
2. N_2O from Fire Extinguishers		NO	
3. N_2O from Aerosol Cans		0.40	
4. Other Use of N_2O		NO	
5. Other *(as specified in table 3.A-D)*	88.50	NA	39.35
Other non-specified	88.50	NA	39.35

Note: The quantity of carbon released in the form of NMVOCs should be accounted for in both the NMVOC and the CO_2 columns. The quantites of NMVOCs should be converted into CO_2 equivalent emissions before being added to the CO_2 amounts in the CO_2 column.

Documentation box:
• Parties should provide detailed explanations about the Solvent and Other Product Use sector in Chapter 5: Solvent and Other Product Use (CRF sector 3) of the NIR. Use this documentation box to provide references to relevant sections of the NIR if any additional information and/or further details are needed to understand the content of this table.
• The IPCC Guidelines do not provide methodologies for the calculation of emissions of N_2O from Solvent and Other Product Use. If reporting such data, Parties should provide in the NIR additional information (activity data and emission factors) used to derive these estimates, and provide in this documentation box a reference to the section of the NIR where this information can be found.

TABLE 3.A-D SECTORAL BACKGROUND DATA FOR SOLVENT AND OTHER PRODUCT USE
(Sheet 1 of 1)

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	ACTIVITY DATA		IMPLIED EMISSION FACTORS [1]	
	Description	(kt)	CO_2 (t/t)	N_2O (t/t)
A. Paint Application	Solvents used [kt]	51.14	1.16	
B. Degreasing and Dry Cleaning	Solvents used [kt]	19.64	1.46	NA
C. Chemical Products, Manufacture and Processing	Solvents used [kt]	13.20	0.96	
D. Other				
1. Use of N_2O for Anaesthesia	Use of N2O for Anaesthesia [kt]	0.08		0.82
2. N_2O from Fire Extinguishers	N2O from Fire Extinguishers	NO		NO
3. N_2O from Aerosol Cans	N2O from Aerosol Cans	NA		NA
4. Other Use of N_2O	(specify)	NO		NO
5. Other *(please specify)* [2]				
Other non-specified	Solvents used [kt]	53.22	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)

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	CH_4	N_2O	NO_x	CO	NMVOC
	(Gg)				
Total Agriculture	**167.92**	12.82	5.66	0.36	1.70
A. Enteric Fermentation	152.03				
1. Cattle [(1)]	142.14				
Option A:					
Dairy Cattle	62.25				
Non-Dairy Cattle	79.89				
Option B:					
Mature Dairy Cattle					
Mature Non-Dairy Cattle					
Young Cattle					
2. Buffalo	NO				
3. Sheep	2.92				
4. Goats	0.37				
5. Camels and Llamas	NO				
6. Horses	1.47				
7. Mules and Asses	IE				
8. Swine	4.47				
9. Poultry	0.28				
10. Other *(as specified in table 4.A)*	0.38				
Deer	0.38				
B. Manure Management	15.44	2.96			NA,NO
1. Cattle [(1)]	10.68				
Option A:					
Dairy Cattle	4.79				
Non-Dairy Cattle	5.88				
Option B:					
Mature Dairy Cattle					
Mature Non-Dairy Cattle					
Young Cattle					
2. Buffalo	NO				
3. Sheep	0.07				
4. Goats	0.01				
5. Camels and Llamas	NO				
6. Horses	0.11				
7. Mules and Asses	IE				
8. Swine	3.50				
9. Poultry	1.06				
10. Other livestock *(as specified in table 4.B(a))*	0.01				
Deer	0.01				

Note: All footnotes for this table are given at the end of the table on sheet 2.

TABLE 4 SECTORAL REPORT FOR AGRICULTURE
(Sheet 2 of 2)

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	CH_4	N_2O	NO_x	CO	NMVOC
	(Gg)				
B. Manure Management (continued)					
11. Anaerobic Lagoons		NO			NO
12. Liquid Systems		0.09			NA
13. Solid Storage and Dry Lot		2.19			NA
14. Other AWMS		0.68			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)]	0.42	9.86			1.63
1. Direct Soil Emissions	0.42	5.83			1.63
2. Pasture, Range and Paddock Manure [(3)]		0.30			NA
3. Indirect Emissions	NA	3.72			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	0.02	0.00	0.01	0.36	0.07
1 . Cereals	0.01	0.00	0.01	0.16	0.02
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	0.20	0.05
Vine	0.02	0.00	0.00	0.20	0.05
G. Other *(please specify)*	**NA**	**NA**	**5.65**	**NA**	**NA**
NOX from livestock and fertilizers	NA	NA	5.65	NA	NA

(1) The sum for cattle would be calculated on the basis of entries made under either option A (dairy and non-dairy cattle) or option B (mature dairy cattle, mature non-dairy cattle and young cattle).

(2) See footnote 4 to Summary 1.A of this common reporting format. Parties which choose to report CO_2 emissions and removals from agricultural soils under 4.D Agricultural Soils of the sector Agriculture should report the amount (in Gg) of these emissions or removals in table Summary 1.A of the CRF. References to additional information (activity data, emissions factors) reported in the NIR should be provided in the documentation box to table 4.D. In line with the corresponding table in the IPCC Guidelines (i.e. IPCC Sectoral Report for Agriculture), this table does not include provisions for reporting CO_2 estimates.

(3) Direct N_2O emissions from pasture, range and paddock manure are to be reported in the "4.D Agricultural Soils" category. All other N_2O emissions from animal manure are to be reported in the "4.B Manure Management" category. See also chapter 4.4 of the IPCC good practice guidance report.

Note: The IPCC Guidelines do not provide methodologies for the calculation of CH_4 emissions and CH_4 and N_2O removals from agricultural soils, or CO_2 emissions from prescribed burning of savannas and field burning of agricultural residues. Parties that have estimated such emissions should provide, in the NIR, additional information (activity data and emission factors) used to derive these estimates and include a reference to the section of the NIR in the documentation box of the corresponding Sectoral background data tables.

Documentation box:

- Parties should provide detailed explanations on the agriculture sector in Chapter 6: Agriculture (CRF sector 4) of the NIR. Use this documentation box to provide references to relevant sections of the NIR if any additional information and/or further details are needed to understand the content of this table.
- If estimates are reported under "4.G Other", use this documentation box to provide information regarding activities covered under this category and to provide reference to the section in the NIR where background information can be found.

4.A Dairy Cattle/2012:Daily milk yield: annual milk production divided by 365 days.
4.B Mules and Asses/2012:"4.A.7. Mules and Asses" are included in "4.A.6. Horses".
4.B Swine/2012: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)

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	ACTIVITY DATA AND OTHER RELATED INFORMATION			IMPLIED EMISSION FACTORS [3]
	Population size [1] (1000s)	Average gross energy intake (GE) (MJ/head/day)	Average CH_4 conversion rate (Y_m) [2] (%)	CH_4 (kg CH_4/head/yr)
1. Cattle	1 955.62			72.69
Option A:				
Dairy Cattle [4]	523.37	302.26	6.00	118.95
Non-Dairy Cattle	1 432.25	141.74	6.00	55.78
Option B:				
Mature Dairy Cattle				
Mature Non-Dairy Cattle				
Young Cattle				
2. Buffalo	NO	NO	NO	NO
3. Sheep	364.65	20.00	6.00	8.00
4. Goats	73.21	14.00	5.00	5.00
5. Camels and Llamas	NO	NO	NO	NO
6. Horses	81.64	110.00	2.50	18.00
7. Mules and Asses	IE	IE	IE	IE
8. Swine	2 983.16	38.00	0.60	1.50
9. Poultry	14 644.41	1.80	0.16	0.02
10. Other *(please specify)*				
Deer	47.58	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-year estimates (b) parameters relevant to the application of IPCC good practice guidance.
4.A Dairy Cattle/2012:Daily milk yield: annual milk production divided by 365 days.

Additional information (only for those livestock types for which Tier 2 was used) [a]

Disaggregated list of animals [b] Indicators:		Dairy Cattle	Non-Dairy Cattle	Mature Dairy Cattle	Mature Non-Dairy Cattle	Young Cattle	Buffalo	Sheep	Goats	Camels and Llamas	Horses	Mules and Asses	Swine	Poultry	Other *(specify)*	Deer
Weight	(kg)	700.00	421.17				NO	NA	NA	NO	NA	NA	NA	NA		NA
Feeding situation [c]		Stall/Pasture	Stall/Pastur				NO	NA	NA	NO	NA	NA	NA	NA		NA
Milk yield	(kg/day)	17.58	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	15.61	0.00	0.00	0.00	NO	NA	NA	NO	NA	NA	NA	NA		NA
Digestibility of feed	(%)	70.50	73.03	0.00	0.00	0.00	NO	NA	NA	NO	NA	NA	NA	NA		NA

[a] See also Tables A-1 and A-2 of the IPCC Guidelines (Volume 3. Reference Manual, pp. 4.31-4.34). These data are relevant if Parties do not have data on average feed intake.
[b] Disaggregate to the split actually used. Add columns to the table if necessary.
[c] Specify feeding situation as pasture, stall fed, confined, open range, etc.

TABLE 4.B(a) SECTORAL BACKGROUND DATA FOR AGRICULTURE
CH_4 Emissions from Manure Management
(Sheet 1 of 2)

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	ACTIVITY DATA AND OTHER RELATED INFORMATION							IMPLIED EMISSION FACTORS [4]
	Population size (1000s)	Allocation by climate region [1] Cool (%)	Temperate (%)	Warm (%)	Typical animal mass (average) (kg)	VS[2] daily excretion (average) (kg dm/head/day)	CH_4 producing potential (Bo)[2] (average) (m^3 CH_4/kg VS)	CH_4 (kg CH_4/head/yr)
1. Cattle	1 955.62							5.46
Option A:								
Dairy Cattle [3]	523.37	100.00	NO	NO	700.00	4.30	0.24	9.16
Non-Dairy Cattle	1 432.25	100.00	NO	NO	421.17	1.93	0.17	4.11
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	364.65	100.00	NO	NO	NA	NA	NA	0.19
4. Goats	73.21	100.00	NO	NO	NA	NA	NA	0.12
5. Camels and Llamas	NO	NO	NO	NO	NO	NO	NO	NO
6. Horses	81.64	100.00	NO	NO	NA	NA	NA	1.39
7. Mules and Asses	IE	IE	NO	NO	NA	NA	NA	IE
8. Swine	2 983.16	100.00	NO	NO	82.00	0.27	0.45	1.17
9. Poultry	14 644.41	100.00	NO	NO	NA	NA	NA	0.07
10. Other livestock *(please specify)*								
Deer	47.58	100.00	NO	NO	NA	NA	NA	0.19

[1] Climate regions are defined in terms of annual average temperature as follows: Cool = less than 15°C; Temperate = 15 - 25°C inclusive; and Warm = greater than 25°C (see table 4.2 of the IPCC Guidelines (Volume 3, Reference Manual, p. 4.8)).

[2] VS = Volatile Solids; Bo = maximum methane producing capacity for manure IPCC Guidelines (Volume 3, Reference Manual, p.4.23 and p.4.15); dm = dry matter. Provide average values for VS and Bo where original calculations were made at a more disaggregated level of these livestock categories.

[3] Including data on dairy heifers, if available.

[4] The implied emission factors will not be calculated until the corresponding emission estimates are entered directly into table 4.

Documentation box:

• Parties should provide detailed explanations on the Agriculture sector in Chapter 6: Agriculture (CRF sector 4) of the NIR. Use this documentation box to provide references to relevant sections of the NIR if any additional information and further details are needed to understand the content of this table.

• Indicate in this documentation box whether the activity data used are one-year estimates or three-year averages.

• Provide a reference to the relevant section in the NIR, in particular with regard to:

(a) disaggregation of livestock population (e.g. according to the classification recommended in the IPCC good practice guidance), including information on whether these data are one-year estimates or three-year averages.
(b) parameters relevant to the application of IPCC good practice guidance;
(c) information on how the MCFs are derived, if relevant data could not be provided in the additional information box.

4.B Mules and Asses/2012:"4.A.7. Mules and Asses" are included in "4.A.6. Horses".

4.B Swine/2012: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.

Additional information (for Tier 2) [(a)]

Animal category	Indicator	Climate region	Animal waste management system						
			Anaerobic lagoon	Liquid system	Daily spread	Solid storage	Dry lot	Pasture range paddock	Other
Dairy Cattle	Allocation (%)	Cool	NO	32.20	NO	49.04	NO	2.91	15.85
		Temperate	NO	NO	NO	NO	NO	NO	NO
		Warm	NO	NO	NO	NO	NO	NO	NO
	MCF[(b)]	Cool	NO	8.72	NO	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	NO	24.45	NO	42.95	NO	6.32	26.28
		Temperate	NO	NO	NO	NO	NO	NO	NO
		Warm	NO	NO	NO	NO	NO	NO	NO
	MCF[(b)]	Cool	NO	8.46	NO	1.00	NO	1.00	9.90
		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	NO	NO	NO	50.00	NO	50.00	NO
		Temperate	NO	NO	NO	NO	NO	NO	NO
		Warm	NO	NO	NO	NO	NO	NO	NO
	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	NO	NO	NO	50.00	NO	50.00	NO
		Temperate	NO	NO	NO	NO	NO	NO	NO
		Warm	NO	NO	NO	NO	NO	NO	NO
	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	NO	NO	NO	80.00	NO	20.00	NO
		Temperate	NO	NO	NO	NO	NO	NO	NO
		Warm	NO	NO	NO	NO	NO	NO	NO
	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	NO	NO	NO	IE	NO	IE	NO
		Temperate	NO	NO	NO	NO	NO	NO	NO
		Warm	NO	NO	NO	NO	NO	NO	NO
	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
Swine	Allocation (%)	Cool	NO	75.24	NO	7.18	NO	NO	17.58
		Temperate	NO	NO	NO	NO	NO	NO	NO
		Warm	NO	NO	NO	NO	NO	NO	NO
	MCF[(b)]	Cool	NO	3.39	NO	1.00	NO	1.00	7.82
		Temperate	NO	NO	NO	NO	NO	NO	NO
		Warm	NO	NO	NO	NO	NO	NO	NO
Poultry	Allocation (%)	Cool	NO	3.42	NO	89.83	NO	NO	6.76
		Temperate	NO	NO	NO	NO	NO	NO	NO
		Warm	NO	NO	NO	NO	NO	NO	NO
	MCF[(b)]	Cool	NA	NA	NA	NA	NA	NA	NA
		Temperate	NA	NA	NA	NA	NA	NA	NA
		Warm	NA	NA	NA	NA	NA	NA	NA
Other livestock *(please specify)*	Allocation (%)	Cool							
		Temperate							
		Warm							
	MCF[(b)]	Cool							
		Temperate							
		Warm							

[(a)] The information required in this table may not be directly applicable to country-specific methods developed for MCF calculations. In such cases, information on MCF derivation should be described in the NIR and references to the relevant sections of the NIR should be provided in the documentation box.

[(b)] MCF = Methane Conversion Factor (IPCC Guidelines, (Volume 3. Reference Manual, p. 4.9)). If another climate region categorization is used, replace the entries in the cells with the climate regions for which the MCFs are specified.

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	ACTIVITY DATA AND OTHER RELATED INFORMATION							
	Population size	Nitrogen excretion	Nitrogen excretion per animal waste management system (AWMS) (kg N/yr)					
	(1000s)	(kg N/head/yr)	Anaerobic lagoon	Liquid system	Daily spread	Solid storage and dry lot	Pasture range and paddock	Other
Cattle	1 955.62		NO	33 089 720.73	NO	54 186 035.82	5 712 629.01	25 722 871.02
Option A:								
Dairy Cattle	523.37	100.26	NO	16 894 343.16	NO	25 733 884.19	1 526 994.06	8 318 801.27
Non-Dairy Cattle	1 432.25	46.25	NO	16 195 377.57	NO	28 452 151.63	4 185 634.95	17 404 069.75
Option B:								
Mature Dairy Cattle								
Mature Non-Dairy Cattle								
Young Cattle								
Sheep	364.65	13.10	NO	NO	NO	2 388 424.75	2 388 424.75	NO
Swine	2 983.16	9.48	NO	21 270 120.97	NO	2 030 346.13	NO	4 970 497.91
Poultry	14 644.41	0.55	NO	274 482.47	NO	7 218 372.01	NO	543 088.28
Buffalo	NO	NO	NO	NO	NO	NO	NO	NO
Goats	73.21	12.30	NO	NO	NO	450 253.80	450 253.80	NO
Camels and Llamas	NO	NO	NO	NO	NO	NO	NO	NO
Horses	81.64	47.90	NO	NO	NO	3 128 329.84	782 082.46	NO
Mules and Asses	IE	IE	NO	NO	NO	IE	IE	NO
Other livestock *(please specify)*								
Deer	47.58	13.10	NO	NO	NO	311 616.25	311 616.25	NO
Total per AWMS			NO	54 634 324.17	NO	69 713 378.59	9 645 006.27	31 236 457.21

IMPLIED EMISSION FACTORS [(1)]	
Emission factor per animal waste management system	
(kg N_2O-N/kg N)	
Anaerobic lagoon	NO
Liquid system	0.00
Solid storage and dry lot	0.02
Other AWMS	0.01

[(1)] The implied emission factor will not be calculated until the emissions are entered directly into table 4

Documentation box:

• Parties should provide detailed explanations on the Agriculture sector in Chapter 6: Agriculture (CRF sector 4) of the NIR. Use this documentation box to provide references to relevant sections of the NIR if any additional information and/or further details are needed to understand the content of this table.

• Indicate in this documentation box whether the activity data used are one-year estimates or three-year averages.

• Provide a reference to the relevant section in the NIR, in particular with regard to:

(a) disaggregation of livestock population (e.g. according to the classification recommended in the IPCC good practice guidance), including information on whether these data are one-year estimates or three-year averages.

(b) information on other AWMS, if reported.

4.B Swine/2012: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 cate

TABLE 4.C SECTORAL BACKGROUND DATA FOR AGRICULTURE
Rice Cultivation
(Sheet 1 of 1)

Inventory 2012
Submission 2014 v1.4
AUSTRIA

GREENHOUSE GAS SOURCE AND SINK CATEGORIES		ACTIVITY DATA AND OTHER RELATED INFORMATION			IMPLIED EMISSION FACTOR (1)	EMISSIONS
		Harvested area (2)	Organic amendments added(3)		CH_4	CH_4
		(10^9 m^2/yr)	type	(t/ha)	(g/m^2)	(Gg)
1. Irrigated						NO
Continuously Flooded		NO	(specify type)	NO	NO	NO
Intermittently Flooded	Single Aeration	NO	(specify type)	NO	NO	NO
	Multiple Aeration	NO	(specify type)	NO	NO	NO
2. Rainfed						NO
Flood Prone		NO	(specify type)	NO	NO	NO
Drought Prone		NO	(specify type)	NO	NO	NO
3. Deep Water						NO
Water Depth 50-100 cm		NO	(specify type)	NO	NO	NO
Water Depth > 100 cm		NO	(specify type)	NO	NO	NO
4. Other *(please specify)*		NO				NO
Other non-specified		NO	(specify type)	NO	NO	NO
Upland Rice(4)		NO				
Total (4)		NO				

(1) The implied emission factor implicitly takes account of all relevant corrections for continuously flooded fields without organic amendment, the correction for the organic amendments and the effect of different soil characteristics, if considered in the calculation of methane emissions.

(2) Harvested area is the cultivated area multiplied by the number of cropping seasons per year.

(3) Specify dry weight or wet weight for organic amendments in the documentation box.

(4) These rows are included to allow comparison with international statistics. Methane emissions from upland rice are assumed to be zero.

Documentation box:

• Parties should provide detailed explanations on the Agriculture sector in Chapter 6: Agriculture (CRF sector 4) of the NIR. Use this documentation box to provide references to relevant sections of the NIR if any additional information and/or further details are needed to understand the content of this table.

• When disaggregating by more than one region within a country, and/or by growing season, provide additional information on disaggregation and related data in the NIR and provide a reference to the relevant section in the NIR.

• Where available, provide activity data and scaling factors by soil type and rice cultivar in the NIR.

TABLE 4.D SECTORAL BACKGROUND DATA FOR AGRICULTURE
Agricultural Soils
(Sheet 1 of 2)

Inventory 2012

Submission 2014 v1.4

AUSTRIA

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	ACTIVITY DATA AND OTHER RELATED INFORMATION		IMPLIED EMISSION FACTORS	EMISSIONS
	Description	Value kg N/yr	kg N_2O-N/kg N [(2)]	N_2O (Gg)
1. Direct Soil Emissions	**N input to soils**			5.83
1. Synthetic Fertilizers	Nitrogen input from application of synthetic fertilizers	102 975 572.00	0.01	2.02
2. Animal Manure Applied to Soils	Nitrogen input from manure applied to soils	109 610 254.58	0.01	2.15
3. N-fixing Crops	Nitrogen fixed by N-fixing crops	23 331 000.00	0.01	0.46
4. Crop Residue	Nitrogen in crop residues returned to soils	59 524 505.97	0.01	1.17
5. Cultivation of Histosols [(2)]	Area of cultivated organic soils (ha/yr)	NO	NO	NO
6. Other direct emissions *(please specify)*				0.03
Sewage Sludge Spreading	(specify)	1 326 701.70	0.01	0.03
2. Pasture, Range and Paddock Manure	**N excretion on pasture range and paddock**	9 645 006.27	0.02	0.30
3. Indirect Emissions				3.72
1. Atmospheric Deposition	Volatized N from fertilizers, animal manures and other	49 436 194.24	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	74 998 797.14	0.02	2.95
4. Other *(please specify)*				NA

(1) To convert from N_2O-N to N_2O emissions, multiply by 44/28. Note that for cultivation of Histosols the unit of the IEF is kg N_2O-N/ha.

Documentation box:

• Parties should provide detailed explanations on the Agriculture sector in Chapter 6: Agriculture (CRF sector 4) of the NIR. Use this documentation box to provide references to relevant sections of the NIR if any additional information and/or further details are needed to understand the content of this table.

• Provide a reference to the relevant section in the NIR, in particular with regard to:

(a) Background information on CH_4 emissions from agricultural soils, if accounted for under the Agriculture sector;

(b) Disaggregated values for $Frac_{GRAZ}$ according to animal type, and for $Frac_{BURN}$ according to crop types;

(c) Full list of assumptions and fractions used.

TABLE 4.D SECTORAL BACKGROUND DATA FOR AGRICULTURE

Agricultural Soils[1]

(Sheet 2 of 2)

Additional information

Fraction [(a)]	Description	Value
$Frac_{BURN}$	Fraction of crop residue burned	0.00
$Frac_{FUEL}$	Fraction of livestock N excretion in excrements burned for fuel	0.00
$Frac_{GASF}$	Fraction of synthetic fertilizer N applied to soils that volatilizes as NH_3 and NOx	0.04
$Frac_{GASM}$	Fraction of livestock N excretion that volatilizes as NH_3 and NOx	0.27
$Frac_{GRAZ}$	Fraction of livestock N excreted and deposited onto soil during grazing	0.06
$Frac_{LEACH}$	Fraction of N input to soils that is lost through leaching and run-off	0.30
$Frac_{NCRBF}$	Fraction of total above-ground biomass of N-fixing crop that is N	0.03
$Frac_{NCRO}$	Fraction of residue dry biomass that is N	0.01
$Frac_{R}$	Fraction of total above-ground crop biomass that is removed from the field as a crop product	0.34
Other fractions *(please specify)*		NO

[(a)] Use the definitions for fractions as specified in the IPCC Guidelines (Volume 3. Reference Manual, pp. 4.92-4.113) as elaborated by the IPCC good practice guidance (pp. 4.54-4.74).

TABLE 4.E SECTORAL BACKGROUND DATA FOR AGRICULTURE
Prescribed Burning of Savannas
(Sheet 1 of 1)

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	ACTIVITY DATA AND OTHER RELATED INFORMATION					IMPLIED EMISSION FACTORS		EMISSIONS	
	Area of savanna burned	Average above-ground biomass density	Fraction of savanna burned	Biomass burned	Nitrogen fraction in biomass	CH_4	N_2O	CH_4	N_2O
	(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 2012
Submission 2014 v1.4
AUSTRIA

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	ACTIVITY DATA AND OTHER RELATED INFORMATION								IMPLIED EMISSION FACTORS		EMISSIONS	
	Crop production	Residue/ Crop ratio	Dry matter (dm) fraction of residue	Fraction burned in fields	Fraction oxidized	Total biomass burned	C fraction of residue	N-C ratio in biomass residues	CH_4	N_2O	CH_4	N_2O
	(t)					(Gg dm)			(kg/t dm)		(Gg)	
1. Cereals											0.01	0.00
Wheat	1 275 497.70	1.00	0.86	0.00	0.90	1.40	0.49	0.01	2.91	0.06	0.00	0.00
Barley	662 465.84	1.10	0.86	0.00	0.90	0.80	0.46	0.01	2.74	0.05	0.00	0.00
Maize	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
Oats	93 491.38	1.50	0.86	0.00	0.90	0.15	0.49	0.01	2.91	0.06	0.00	0.00
Rye	204 697.35	1.40	0.86	0.00	0.90	0.32	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 *(please specify)*											NA	NA
2. Pulses											NA,NO	NA,NO
Dry bean	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
Peas	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
Soybeans	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
Other *(please specify)*											NA	NA
3 Tubers and Roots											NA,NO	NA,NO
Potatoes	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
Other *(please specify)*											NA	NA
4 Sugar Cane	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
5 Other *(please specify)*											0.02	0.00
Vine	NA	NA	0.80	NA	NA	2.80	NA	NA	6.03	0.06	0.02	0.00

Documentation box:
Parties should provide detailed explanations on the Agriculture sector in Chapter 6: Agriculture (CRF sector 4) of the NIR. Use this documentation box to provide references to relevant sections of the NIR if any additional information and/or further details are needed to understand the content of this table.

TABLE 5 SECTORAL REPORT FOR LAND USE, LAND-USE CHANGE AND FORESTRY
(Sheet 1 of 1)

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	Net CO_2 emissions/removals[1], [2]	CH_4 [2]	N_2O [2]	NO_x	CO	NMVOC
	(Gg)					
Total Land-Use Categories	**-3 863.83**	**0.01**	**0.08**	**IE,NA,NE**	**IE,NA,NE**	**NA,NE**
A. Forest Land	**-4 487.24**	**0.01**	**0.00**	**NE**	**NE**	**NE**
1. Forest Land remaining Forest Land	-2 608.44	0.01	0.00	NE	NE	NE
2. Land converted to Forest Land	-1 878.80	NO	NO	NE	NE	NE
B. Cropland	**224.99**	**IE,NA,NO**	**0.08**	**IE**	**IE**	**NE**
1. Cropland remaining Cropland	43.34	IE,NA	IE,NA	IE	IE	NE
2. Land converted to Cropland	181.65	NO	0.08	IE	IE	NE
C. Grassland	**41.24**	**NO**	**NO**	**IE**	**IE**	**NE**
1. Grassland remaining Grassland	1.66	NO	NO	IE	IE	NE
2. Land converted to Grassland	39.58	NO	NO	IE	IE	NE
D. Wetlands	**74.84**	**NO**	**NO**	**NA**	**NA**	**NA**
1. Wetlands remaining Wetlands [3]	NE,NO	NO	NO	NA	NA	NA
2. Land converted to Wetlands	74.84	NO	NO	NA	NA	NA
E. Settlements	**87.95**	**NA,NO**	**NA,NO**	**NA**	**NA**	**NA**
1. Settlements remaining Settlements [3]	NE,NO	NA	NA	NA	NA	NA
2. Land converted to Settlements	87.95	NA	NA	NA	NA	NA
F. Other Land	**194.38**	**NA,NO**	**NA,NO**	**NA**	**NA**	**NA**
1. Other Land remaining Other Land [4]						
2. Land converted to Other Land	194.38	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	548.38	NA	0.00	NA	NA	NA
Grassland converted to other Land-Use Categories	-308.89	NO	0.08	NA	NA	NA

(1) According to the Revised 1996 IPCC Guidelines, for the purposes of reporting, the signs for removals are always negative (-) and for emissions positive (+).

(2) For each land-use category and sub-category, this table sums net CO_2 emissions and removals shown in tables 5.A to 5.F, and the CO_2, CH_4 and N_2O emissions showing in tables 5(I) to 5(V).

(3) Parties may decide not to prepare estimates for these categories contained in appendices 3a.3 and 3a.4 of the IPCC good practice guidance for LULUCF, although they may do so if they wish.

(4) This land-use category is to allow the total of identified land area to match the national area.

(5) The total for category 5.G Other includes items specified only under category 5.G in this table as well as sources and sinks specified in category 5.G in tables 5(I) to 5(V).

(6) Parties may decide not to prepare estimates for this category contained in appendix 3a.1 of the IPCC good practice guidance for LULUCF, although they may do so if they wish and report in this row.

(7) These items are listed for information only and will not be added to the totals, because they are already included in subcategories 5.A.2 to 5.F.2.

Documentation box:

• Parties should provide detailed explanations on the Land Use, Land-Use Change and Forestry sector in Chapter 7: Land Use, Land-Use Change and Forestry (CRF sector 5) of the NIR. Use this documentation box to provide references to relevant sections of the NIR if any additional information and/or further details are needed to understand the content of this table.

• If estimates are reported under 5.G Other, use this documentation box to provide information regarding activities covered under this category and to provide reference to the section in the NIR where background information can be found.

5.B Cropland/2012:no comment.

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		4 013.00	NA,NO	2.35	-2.01	0.34	0.11	-0.14	NO	9 432.14	-8 063.55	1 368.59	428.76	-573.56	NO	-4 487.24
1. Forest Land remaining Forest Land		3 851.27	NA,NO	2.38	-2.07	0.31	0.06	-0.18	NO	9 153.62	-7 978.69	1 174.93	227.69	-691.23	NO	-2 608.44
	Coniferous	2 411.99	NA	2.75	-2.63	0.12	0.07	-0.29	NO	6 623.77	-6 336.33	287.44	170.62	-691.23	NO	854.95
	Deciduous	928.71	NA	2.72	-1.77	0.96	0.06	IE	NO	2 529.85	-1 642.36	887.49	57.07	IE	NO	-3 463.39
	Forest not in yield	510.57	NO	NA	NA	NA	NA	NO	NO	NA	NA	NA	NA	NO	NO	NA,NO
2. Land converted to Forest Land[10]		161.73	NO	1.72	-0.52	1.20	1.24	0.73	NO	278.52	-84.86	193.66	201.08	117.66	NO	-1 878.80
2.1 Cropland converted to Forest Land		14.43	NO	1.80	-0.56	1.24	1.34	1.16	NO	25.90	-8.07	17.83	19.30	16.75	NO	-197.59
	Total	14.43	NO	1.80	-0.56	1.24	1.34	1.16	NO	25.90	-8.07	17.83	19.30	16.75	NO	-197.59
2.2 Grassland converted to Forest Land		84.90	NO	1.74	-0.53	1.21	1.27	-0.71	NO	147.62	-45.22	102.40	108.16	-60.39	NO	-550.65
	Total	84.90	NO	1.74	-0.53	1.21	1.27	-0.71	NO	147.62	-45.22	102.40	108.16	-60.39	NO	-550.65
2.3 Wetlands converted to Forest Land		10.01	NO	1.77	-0.55	1.22	0.80	NO	NO	17.72	-5.48	12.24	8.04	NO	NO	-74.35
	Total	10.01	NO	1.77	-0.55	1.22	0.80	NO	NO	17.72	-5.48	12.24	8.04	NO	NO	-74.35
2.4 Settlements converted to Forest Land		8.78	NO	1.83	-0.57	1.25	1.26	3.36	NO	16.05	-5.04	11.00	11.11	29.53	NO	-189.36
	Total	8.78	NO	1.83	-0.57	1.25	1.26	3.36	NO	16.05	-5.04	11.00	11.11	29.53	NO	-189.36
2.5 Other Land converted to Forest Land		43.62	NO	1.63	-0.48	1.15	1.25	3.02	NO	71.23	-21.05	50.18	54.46	131.77	NO	-866.85
	Total	43.62	NO	1.63	-0.48	1.15	1.25	3.02	NO	71.23	-21.05	50.18	54.46	131.77	NO	-866.85

[1] Land categories may be further divided according to climate zone, management system, soil type, vegetation type, tree species, ecological zone or national land classification.

[2] The total area of the subcategories, in accordance with the sub-division used, should be entered here. For lands converted to Forest Land report the cumulative area remaining in the category in the reporting year.

[3] Carbon stock gains and losses should be listed separately except in cases where, due to the methods used, it is technically impossible to separate information on gains and losses.

[4] The signs for estimates of gains in carbon stocks are positive (+) and of losses in carbon stocks are negative (-).

[5] Implied carbon-stock-change factors for mineral soils are calculated by dividing the net C stock change estimate for mineral soil by the difference between the area and the area of organic soil.

[6] When Parties are estimating fluxes for organic soils but cannot separate these fluxes from mineral soils, these fluxes should be reported under mineral soils.

[7] The value reported for organic soils is estimated as a flux. For consistency with other entries in this column, these fluxes should be expressed in the unit required in this column, i.e. in Gg C.

[8] According to the Revised 1996 IPCC Guidelines, for the purposes of reporting, the signs for removals are always negative (-) and for emissions positive (+). Net changes in carbon stocks are converted to CO_2 by multiplying C by 44/12 and changing the sign for net CO2 removals to be negative (-) and for net CO_2 emissions to be positive (+). Note that carbon stock changes in a single pool are not necessarily equal to emissions or removals, because some carbon stock changes result from carbon transfers among pools rather than exchanges with the atmosphere.

[9] Where Parties directly estimate emissions and removals rather than carbon stock changes, they may report emissions/removals directly in this column and use notation keys in the stock change columns.

[10] A Party may report aggregate estimates for all conversions of land to forest land when data are not available to report them separately. A Party should specify in the documentation box which types of land conversion are included. Separate estimates for grassland conversion should be provided in table 5 as an information item.

Documentation box:
Parties should provide detailed explanations on the Land Use, Land-Use Change and Forestry sector in Chapter 7: Land Use, Land-Use Change and Forestry (CRF sector 5) of the NIR. Use this documentation box to provide references to relevant sections of the NIR if any additional information and/or further details are needed to understand the content of this table.

TABLE 5.B SECTORAL BACKGROUND DATA FOR LAND USE, LAND-USE CHANGE AND FORESTRY
Cropland
(Sheet 1 of 1)

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		1 425.33	NO	0.13	-0.16	-0.03	0.00	0.01	NO	182.45	-227.71	-45.26	-1.94	9.56	NO	138.00
1. Cropland remaining Cropland		1 373.86	NO	0.11	-0.15	-0.04	NO	0.04	NO	154.78	-203.20	-48.42	NO	60.32	NO	-43.65
	Annual converted to p	15.94	NO	2.10	-0.38	1.72	NO	0.35	NO	33.47	-6.03	27.44	NO	5.58	NO	-121.05
	Annual remaining ann	1 345.00	NO	0.09	-0.11	-0.03	NO	0.04	NO	116.57	-152.39	-35.81	NO	59.27	NO	-86.00
	Perennial converted to	12.92	NO	0.37	-3.47	-3.10	NO	-0.35	NO	4.74	-44.78	-40.04	NO	-4.52	NO	163.40
2. Land converted to Croplanc[12]		51.47	NO	0.54	-0.48	0.06	-0.04	-0.99	NO	27.67	-24.51	3.16	-1.94	-50.76	NO	181.65
2.1 Forest Land converted to Cropland		3.48	NO	0.26	-1.25	-0.98	-0.56	-0.99	NO	0.91	-4.33	-3.43	-1.94	-3.45	NO	32.33
	Total	3.48	NO	0.26	-1.25	-0.98	-0.56	-0.99	NO	0.91	-4.33	-3.43	-1.94	-3.45	NO	32.33
2.2 Grassland converted to Cropland		47.99	NO	0.56	-0.42	0.14	NO	-0.99	NO	26.76	-20.18	6.58	NO	-47.31	NO	149.32
	Grassland converted t	46.04	NO	0.49	-0.42	0.07	NO	-1.00	NO	22.68	-19.36	3.32	NO	-46.04	NO	156.66
	Grassland converted t	1.94	NO	2.10	-0.42	1.68	NO	-0.65	NO	4.08	-0.82	3.27	NO	-1.26	NO	-7.34
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

[6] For category 5.B.1 Cropland remaining Cropland this column only includes changes in perennial woody bioma

[7] No reporting on dead organic matter pools is required for category 5.B.1. Cropland remaining Croplanc

[8] When Parties are estimating fluxes for organic soils but cannot separate these fluxes from mineral soils, these fluxes should be reported under mineral so

[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

[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$_2$ by multiplying C by 44/12 and changing the sign for net CO_2 removals to be negative (-) and for net CO_2 emissions to be positive (+). Note that carbon stock changes in a single pool are not necessarily equal to emissions or removals, because some carbon stock changes result from carbon transfers among pools rather than exchanges with the atmosphere.

[11] Where Parties directly estimate emissions and removals rather than carbon stock changes, they may report emissions/removals directly in this column and use notation keys in the stock change colu

[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 lan grassland conversion should be provided in table 5 as an information item.

Documentation box:
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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 [10] [11]
Land-Use Category	Sub-division [1]	Area[2] (kha)	Area of organic soil[2] (kha)	Carbon stock change in living biomass per area[3] [4]			Net carbon stock change in dead organic matter per area[4]	Net carbon stock change in soils per area [4]		Carbon stock change in living biomass[3], [4], [6]			Net carbon stock change in dead organic matter[4] [7]	Net carbon stock change in soils [4] [8]		
				Gains	Losses	Net change		Mineral soils[5]	Organic soils	Gains	Losses	Net change		Mineral soils	Organic soils[9]	
				(Mg C/ha)						(Gg C)						(Gg)
C. Total Grassland		1 790.20	12.95	0.01	-0.03	-0.02	-0.01	0.03	-0.25	15.61	-53.70	-38.09	-23.05	53.13	-3.24	41.24
1. Grassland remaining Grassland		1 733.05	12.95	NO	NO	NO	NO	0.00	-0.25	NO	NO	NO	NO	2.79	-3.24	1.66
	Total	1 733.05	12.95	NO	NO	NO	NO	0.00	-0.25	NO	NO	NO	NO	2.79	-3.24	1.66
2. Land converted to Grassland[12]		57.15	NO	0.27	-0.94	-0.67	-0.40	0.88	NO	15.61	-53.70	-38.09	-23.05	50.34	NO	39.58
2.1 Forest Land converted to Grassland		30.55	NO	0.26	-1.44	-1.18	-0.75	0.78	NO	7.92	-43.87	-35.95	-23.05	23.85	NO	128.88
	Total	30.55	NO	0.26	-1.44	-1.18	-0.75	0.78	NO	7.92	-43.87	-35.95	-23.05	23.85	NO	128.88
2.2 Cropland converted to Grassland		26.60	NO	0.29	-0.37	-0.08	NO	1.00	NO	7.69	-9.83	-2.14	NO	26.49	NO	-89.30
	Annual cropland conv	26.31	NO	0.29	-0.34	-0.05	NO	1.00	NO	7.61	-8.91	-1.30	NO	26.31	NO	-91.68
	Perennial cropland co	0.29	NO	0.29	-3.20	-2.91	NO	0.65	NO	0.08	-0.92	-0.84	NO	0.19	NO	2.38
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
[6] For category 5.C.1 Grassland remaining Grassland this column only includes changes in perennial woody bioma
[7] No reporting on dead organic matter pools is required for category 5.C.1 Grassland remaining Grasslanc
[8] When Parties are estimating fluxes for organic soils but cannot separate these fluxes from mineral soils, these fluxes should be reported under mineral so
[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
[10] According to the Revised 1996 IPCC Guidelines, for the purposes of reporting, the signs for removals are always negative (-) and for emissions positive (+). Net changes in carbon stocks are converted to CO_2 by multiplying C by 44/12 and changing the sign for net CO_2 removals to be negative (-) and for net CO_2 emissions to be positive (+). Note that carbon stock changes in a single pool are not necessarily equal to emissions or removals, because some carbon stock changes result from carbon transfers among pools rather than exchanges with the atmosphere.
[11] Where Parties directly estimate emissions and removals rather than carbon stock changes, they may report emissions/removals directly in this column and use notation keys in the stock change colu
[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 conversion should be provided in table 5 as an information item.

Documentation box:
Parties should provide detailed explanations on the Land Use, Land-Use Change and Forestry sector in Chapter 7: Land Use, Land-Use Change and Forestry (CRF sector 5) of the NIR. Use this documentation box to provide references to relevant sections of the NIR if any additional information and/or further details are needed to understand the content of this table.

TABLE 5.D SECTORAL BACKGROUND DATA FOR LAND USE, LAND-USE CHANGE AND FORESTRY
Wetlands
(Sheet 1 of 1)

GREENHOUSE GAS SOURCE AND SINK CATEGORIES		ACTIVITY DATA	IMPLIED CARBON-STOCK-CHANGE FACTORS					CHANGES IN CARBON STOCK					Net CO_2 emissions/ removals (5) (6)
Land-Use Category	Sub-division (1)	Area(2) (kha)	Carbon stock change in living biomass per area(3) (4)			Net carbon stock change in dead organic matter per area(4)	Net carbon stock change in soils per area (4)	Carbon stock change in living biomass(3) (4)			Net carbon stock change in dead organic matter(4)	Net carbon stock change in soils (4)	
			Gains	Losses	Net change			Gains	Losses	Net change			
			(Mg C/ha)					(Gg C)					(Gg)
D. Total Wetlands		148.10	0.00	-0.12	-0.11	-0.03	NE,NO	0.52	-17.10	-16.58	-3.83	NE,NO	74.84
1. Wetlands remaining Wetlands (7)		123.96	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE
	Total	123.96	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE
2. Land converted to Wetlands (8)		24.13	0.02	-0.71	-0.69	-0.16	NO	0.52	-17.10	-16.58	-3.83	NO	74.84
2.1 Forest Land converted to Wetlands		2.15	0.24	-4.69	-4.45	-1.78	NO	0.52	-10.07	-9.55	-3.83	NO	49.07
	Total	2.15	0.24	-4.69	-4.45	-1.78	NO	0.52	-10.07	-9.55	-3.83	NO	49.07
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		21.99	NO	-0.32	-0.32	NO	NO	NO	-7.03	-7.03	NO	NO	25.77
	Total	21.99	NO	-0.32	-0.32	NO	NO	NO	-7.03	-7.03	NO	NO	25.77
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 carbo stocks are converted to CO_2 by multiplying C by 44/12 and changing the sign for net CO_2 removals to be negative (-) and for net CO_2 emissions to be positive (+). Note that carbon stock changes in a single pool are not necessarily equal to emissions or removals, because some carbon stock changes result from carbon transfers among pools rather than exchanges with the atmosphere.

(6) Where Parties directly estimate emissions and removals rather than carbon stock changes, they may report emissions/removals directly in this column and use notation keys in the stock change columns.

(7) Parties may decide not to prepare estimates for this category contained in appendix 3a.3 of the IPCC good practice guidance for LULUCF, although they may do so if they wish.

(8) A Party may report aggregate estimates for all land conversions to wetlands, when data are not available to report them separately. A Party should specify in the documentation box which types of land conversion are included. Separate estimates for forest land and grassla conversion should be provided in table 5 as an information item.

Documentation box:

Parties should provide detailed explanations on the Land Use, Land-Use Change and Forestry in Chapter 7: Land Use, Land-Use Change and Forestry (CRF sector 5) of the NIR. Use this documentation box to provide references to relevant sections of the NIR if any additional information and/or further detai are needed to understand the content of this table.

TABLE 5.E SECTORAL BACKGROUND DATA FOR LAND USE, LAND-USE CHANGE AND FORESTRY
Settlements
(Sheet 1 of 1)

GREENHOUSE GAS SOURCE AND SINK CATEGORIES		ACTIVITY DATA	IMPLIED CARBON-STOCK-CHANGE FACTORS					CHANGES IN CARBON STOCK					Net CO_2 emissions/ removals [6] [7]
Land-Use Category	Sub-division [1]	Area [2] (kha)	Carbon stock change in living biomass per area [3] [4]			Net carbon stock change in dead organic matter per area [4]	Net carbon stock change in soils per area [4]	Carbon stock change in living biomass [3], [4], [5]			Net carbon stock change in dead organic matter [4]	Net carbon stock change in soils [4]	
			Gains	Losses	Net change			Gains	Losses	Net change			
			(Mg C/ha)					(Gg C)					(Gg)
E. Total Settlements		538.11	0.16	-0.08	0.09	-0.01	-0.12	88.61	-42.44	46.17	-4.41	-65.75	87.95
1. Settlements remaining Settlements [8]		393.93	NE	NE	NE	NO	NE	NE	NE	NE	NO	NE	NE,NO
	Total	393.93	NE	NE	NE	NO	NE	NE	NE	NE	NO	NE	NE,NO
2. Land converted to Settlements [9]		144.18	0.61	-0.29	0.32	-0.03	-0.46	88.61	-42.44	46.17	-4.41	-65.75	87.95
2.1 Forest Land converted to Settlements		9.52	0.26	-0.91	-0.65	-0.46	-3.18	2.50	-8.71	-6.21	-4.41	-30.29	150.01
	Total	9.52	0.26	-0.91	-0.65	-0.46	-3.18	2.50	-8.71	-6.21	-4.41	-30.29	150.01
2.2 Cropland converted to Settlements		99.19	0.65	-0.32	0.34	NO	NO	64.87	-31.48	33.39	NO	NO	-122.42
	Total	99.19	0.65	-0.32	0.34	NO	NO	64.87	-31.48	33.39	NO	NO	-122.42
2.3 Grassland converted to Settlements		35.46	0.60	-0.06	0.54	NO	-1.00	21.25	-2.25	19.00	NO	-35.46	60.35
	Total	35.46	0.60	-0.06	0.54	NO	-1.00	21.25	-2.25	19.00	NO	-35.46	60.35
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 CO_2 by multiplying C by 44/12 and changing the sign for net CO_2 removals to be negative (-) and for net CO_2 emissions to be positive (+). Note that carbon stock changes in a single pool are not necessarily equal to emissions or removals, because some carbon stock changes result from carbon transfers among pools rather than exchanges with the atmosphere.

(7) Where Parties directly estimate emissions and removals rather than carbon stock changes, they may report emissions/removals directly in this column and use notation keys in the stock change columns.

(8) Parties may decide not to prepare estimates for this category contained in appendix 3a.4 of the IPCC good practice guidance for LULUCF, although they may do so if they wish.

(9) A Party may report aggregate estimates for all land conversions to settlements, when data are not available to report them separately. A Party should specify in the documentation box which types of land conversion are included. Separate estimates for forest land and grassland conversion should be provided in table 5 as an information item.

Documentation box:
Parties should provide detailed explanations on the Land Use, Land-Use Change and Forestry sector in Chapter 7: Land Use, Land-Use Change and Forestry (CRF sector 5) of the NIR. Use this documentation box to provide references to relevant sections of the NIR if any additional information and/or further details are needed to understand the content of this table.

TABLE 5.F SECTORAL BACKGROUND DATA FOR LAND USE, LAND-USE CHANGE AND FORESTRY
Other land
(Sheet 1 of 1)

GREENHOUSE GAS SOURCE AND SINK CATEGORIES		ACTIVITY DATA	IMPLIED CARBON-STOCK-CHANGE FACTORS					CHANGES IN CARBON STOCK					Net CO_2 emissions/ removals[5] [6]
Land-Use Category	Sub-division [1]	Area[2] (kha)	Carbon stock change in living biomass per area[3] [4]			Net carbon stock change in dead organic matter per area[4]	Net carbon stock change in soils per area [4]	Carbon stock change in living biomass[3] [4]			Net carbon stock change in dead organic matter[4]	Net carbon stock change in soils [4]	
			Gains	Losses	Net change			Gains	Losses	Net change			
			(Mg C/ha)					(Gg C)					(Gg)
F. Total Other Land		472.27	0.02	-0.05	-0.03	-0.01	-0.07	10.63	-23.78	-13.14	-5.63	-34.24	194.38
1. Other Land remaining Other Land [7]		418.84											
2. Land converted to Other Land [8]		53.43	0.20	-0.44	-0.25	-0.11	-0.64	10.63	-23.78	-13.14	-5.63	-34.24	194.38
2.1 Forest Land converted to Other Land		11.67	0.26	-1.02	-0.76	-0.48	-3.16	3.05	-11.89	-8.83	-5.63	-36.83	188.08
	Total	11.67	0.26	-1.02	-0.76	-0.48	-3.16	3.05	-11.89	-8.83	-5.63	-36.83	188.08
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		41.76	0.18	-0.28	-0.10	NO	0.06	7.58	-11.89	-4.31	NO	2.59	6.31
	Total	41.76	0.18	-0.28	-0.10	NO	0.06	7.58	-11.89	-4.31	NO	2.59	6.31
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 carbo
stocks are converted to CO_2 by multiplying C by 44/12 and changing the sign for net CO_2 removals to be negative (-) and for net CO_2 emissions to be positive (+). Note that carbon stock
changes in a single pool are not necessarily equal to emissions or removals, because some carbon stock changes result from carbon transfers among pools rather than exchanges with the atmosphere.
[6] Where Parties directly estimate emissions and removals rather than carbon stock changes, they may report emissions/removals directly in this column and use notation keys in the stock change columns.
[7] This land-use category is to allow the total of identified land area to match the national area.
[8] A Party may report aggregate estimates for all land conversions to other land, when data are not available to report them separately. A Party should specify in the documentation box which types of land conversion are included. Separate estimates for forest land and grassla
conversion should be provided in table 5 as an information item.

Documentation box:
Parties should provide detailed explanations on the Land Use, Land-Use Change and Forestry sector in Chapter 7: Land Use, Land-Use Change and Forestry (CRF sector 5) of the NIR. Use this documentation box to provide references to relevant sections of the NIR if any additional information and/or further details are needed to understand the content of this table.

TABLE 5 (I) SECTORAL BACKGROUND DATA FOR LAND USE, LAND-USE CHANGE AND FORESTRY
Direct N_2O emissions from N fertilization[1] of Forest Land and Other
(Sheet 1 of 1)

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	ACTIVITY DATA	IMPLIED EMISSION FACTORS	EMISSIONS [4]
Land-Use Category [2]	Total amount of fertilizer applied	N_2O-N emissions per unit of fertilizer	N_2O
	(Gg N/yr)	(kg N_2O-N/kg N)[3]	(Gg)
Total for all Land Use Categories	**NO**	**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 N_2O emissions from fertilization are estimated using equations 3.2.17 and 3.2.18 of the IPCC good practice guidance for LULUCF based on the amounts of fertilizers applied to forest land.

(2) N_2O emissions from N fertilization of cropland and grassland are reported in the Agriculture sector; therefore only Forest Land is included in this table.

(3) In the calculation of the implied emission factor, N_2O emissions are converted to N_2O-N by multiplying by 28/44.

(4) Emissions are reported with a positive sign.

(5) If a Party is not able to separate the fertilizer applied to forest land from that applied to agriculture, it may report all N_2O emissions from fertilization in the Agriculture sector. This should be explicitly indicated in the documentation box.

(6) A Party may report aggregate estimates for all N fertilization on forest land in the category Forest Land remaining Forest Land when data are not available to report Forest Land remaining Forest Land and Land converted to Forest Land 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-CO_2 emissions from drainage of soils and wetlands[1]

(Sheet 1 of 1)

GREENHOUSE GAS SOURCE AND SINK CATEGORIES		ACTIVITY DATA	IMPLIED EMISSION FACTORS		EMISSIONS [5]	
Land-Use Category [2]	Sub-division [3]	Area (kha)	N_2O-N per area [4] (kg N_2O-N/ha)	CH_4 per area (kg CH_4/ha)	N_2O (Gg)	CH_4
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) N_2O emissions from drained cropland and grassland soils are covered in the Agriculture tables of the CRF under Cultivation of Histosols.

(3) A Party should report further disaggregations of drained soils corresponding to the methods used. Tier 1 disaggregates soils into "nutrient rich" and "nutrient poor" areas, whereas higher-tier methods can further disaggregate into different peatland types, soil

(4) In the calculation of the implied emission factor, N_2O emissions are converted to N_2O-N by multiplying by 28/44.

(5) Emissions are reported with a positive sign.

(6) In table 5, these emissions will be added to 5.A.1 Forest Land remaining Forest Land.

(7) In table 5, these emissions will be added to 5.D.2 Land converted to Wetlands.

Documentation box:
Parties should provide detailed explanations on the Land Use, Land-Use Change and Forestry sector in Chapter 7: Land Use, Land-Use Change and Forestry (CRF sector 5) of the NIR. Use this documentation box to provide references to relevant sections of the NIR if any additional information and/or further details are needed to understand the content of this table.

TABLE 5 (III) SECTORAL BACKGROUND DATA FOR LAND USE, LAND-USE CHANGE AND FORESTRY

N_2O emissions from disturbance associated with land-use conversion to cropland [1]

(Sheet 1 of 1)

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	ACTIVITY DATA	IMPLIED EMISSION FACTORS	EMISSIONS [4]
Land-Use Category [2]	Land area converted	N_2O-N emissions per area converted[3]	N_2O
	(kha)	(kg N_2O-N/ha)	(Gg)
Total all Land-Use Categories [5]	**51.47**	**1.00**	**0.08**
B. Cropland	**51.47**	**1.00**	**0.08**
2. Lands converted to Cropland [6]	51.47	1.00	0.08
Organic Soils	NO	NO	NO
Mineral Soils	51.47	1.00	0.08
2.1 Forest Land converted to Cropland	3.48	0.65	0.00
Organic Soils	NO	NO	NO
Mineral Soils	3.48	0.65	0.00
2.2 Grassland converted to Cropland	47.99	1.03	0.08
Organic Soils	NO	NO	NO
Mineral Soils	47.99	1.03	0.08
2.3 Wetlands converted to Cropland [7]	NO	NO	NO
Organic Soils	NO	NO	NO
Mineral Soils	NO	NO	NO
2.5 Other Land converted to Cropland	NO	NO	NO
Organic Soils	NO	NO	NO
Mineral Soils	NO	NO	NO
G. Other *(please specify)*			

[1] Methodologies for N_2O emissions from disturbance associated with land-use conversion are based on equations 3.3.14 and 3.3.15 of the IPCC good practice guidance for LULUCF. N_2O emissions from fertilization in the preceding land use and new land use should not be reported.

[2] According to the IPCC good practice guidance for LULUCF, N_2O emissions from disturbance of soils are only relevant for land conversions to cropland. N_2O emissions from Cropland remaining Cropland are included in the Agriculture sector of the good practice guidance. The good practice guidance provides methodologies only for mineral soils.

[3] In the calculation of the implied emission factor, N_2O emissions are converted to N_2O-N by multiplying by 28/44

[4] Emissions are reported with a positive sign.

[5] Parties can separate between organic and mineral soils, if they have data available.

[6] If activity data cannot be disaggregated to all initial land uses, Parties may report some initial land uses aggregated under Other Land converted to Cropland (indicate in the documentation box what this category includes).

[7] Parties should avoid double counting with N_2O emissions from drainage and from cultivation of organic soils reported in Agriculture under Cultivation of Histosols

Documentation box:

Parties should provide detailed explanations on the Land Use, Land-Use Change and Forestry sector in Chapter 7: Land Use, Land-Use Change and Forestry (CRF Sector 5) of the NIR. Use this documentation box to provide references to relevant sections of the NIR if any additional information and/or further details are needed to understand the content of this table.

CO_2 emissions from agricultural lime application [1]

(Sheet 1 of 1)

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	ACTIVITY DATA	IMPLIED EMISSION FACTORS	EMISSIONS [3]
Land-Use Category	Total amount of lime applied (Mg/yr)	CO_2-C per unit of lime [2] (Mg CO_2-C /Mg)	CO_2 (Gg)
Total all Land-Use Categories [4], [5], [6]	**197 701.56**	**0.12**	**86.99**
B. Cropland [6] [7]	**197 701.56**	**0.12**	**86.99**
Limestone $CaCO_3$	197 701.56	0.12	86.99
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] CO_2 emissions from agricultural lime application are addressed in equations 3.3.6 and 3.4.11 of the IPCC good practice guidance for LULUCF.
[2] The implied emission factor is expressed in unit of carbon to faciliate comparison with published emission factors.
[3] Emissions are reported with a positive sign.
[4] If Parties are not able to separate liming application for different land-use categories, they should include liming for all land-use categories in the category 5.G Othe
[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 categor
[6] A Party may report aggregate estimates for total lime applications when data are not available for limestone and dolomite.
[7] In table 5, these CO_2 emissions will be added to 5.B.1 Cropland remaining Cropland.
[8] In table 5, these CO_2 emissions will be added to 5.C.1 Grassland remaining Grassland.
[9] If a Party has data broken down to limestone and dolomite at national level, it can report these data under 5.G Other.

Documentation box:
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TABLE 5 (V) SECTORAL BACKGROUND DATA FOR LAND USE, LAND-USE CHANGE AND FORESTRY

Biomass Burning [1]

(Sheet 1 of 1)

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	ACTIVITY DATA			IMPLIED EMISSION FACTOR			EMISSIONS [5]		
	Description[3]	Unit	Values	CO_2	CH_4	N_2O	CO_2 [4]	CH_4	N_2O
Land-Use Category[2]		(ha or kg dm)		(Mg/activity data unit)			(Gg)		
Total for Land-Use Categories	**Area burned**	**ha**	**55.00**	**IE,NA,NO**	**0.14**	**0.00**	**IE,NA,NO**	**0.01**	**0.00**
A. Forest Land	**Area burned**	**ha**	**55.00**	**IE,NO**	**0.14**	**0.00**	**IE,NO**	**0.01**	**0.00**
1. Forest land remaining Forest Land	Area burned	ha	55.00	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	55.00	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**	**IE,NA,NO**	**IE,NA,NO**	**IE,NA,NO**	**IE,NA,NO**	**IE,NA,NO**	**IE,NA,NO**	**IE,NA,NO**
1. Cropland remaining Cropland[6]	Area burned	ha	IE,NA	IE,NA	IE,NA	IE,NA	IE,NA	IE,NA	IE,NA
Controlled Burning	Area burned	ha	IE	IE	IE	IE	IE	IE	IE
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 CO_2 emissions from biomass burning are not already included in tables 5.A - 5.F, they should be reported here. This should be clearly documented in the documentation box and in the NIR. Double counting should be avoided. Parties that include all carbon stock changes in the carbon stock tables (5.A, 5.B, 5.C, 5.D, 5.E and 5.F), should report IE (included elsewhere) in this column.
[5] Emissions are reported with a positive sign.
[6] In-situ above-ground woody biomass burning is reported here. Agricultural residue burning is reported in the Agriculture sector.
[7] Includes only emissions from controlled biomass burning on grasslands outside the tropics (prescribed savanna burning is reported under the Agriculture sector).
[8] Parties may decide not to prepare estimates for these categories contained in appendices 3a.2, 3a.3 and 3a.4 of the IPCC good practice guidance for LULUCF, although they may do so if they wish.
[9] This land-use category is to allow the total of identified land area to match the national area.

Documentation box:
Parties should provide detailed explanations on the Land Use, Land-Use Change and Forestry sector in Chapter 7: Land Use, Land-Use Change and Forestry (CRF sector 5) of the NIR. Use this documentation box to provide references to relevant sections of the NIR if any additional information and/ further details are needed to understand the content of this table.

TABLE 6 SECTORAL REPORT FOR WASTE
(Sheet 1 of 1)

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GREENHOUSE GAS SOURCE AND SINK CATEGORIES	CO_2 [(1)]	CH_4	N_2O	NO_x	CO	NMVOC	SO_2
	(Gg)						
Total Waste	**2.03**	**60.90**	**1.21**	**0.01**	**4.04**	**0.05**	**0.01**
A. Solid Waste Disposal on Land	**NA,NO**	**57.19**		**NA,NO**	**4.03**	**0.05**	
1. Managed Waste Disposal on Land	NA	57.19		NA	4.03	0.05	
2. Unmanaged Waste Disposal Sites	NO	NO		NO	NO	NO	
3. Other *(as specified in table 6.A)*	NA	NA		NA	NA	NA	
B. Waste Water Handling		**1.11**	**0.86**	**NA**	**NA**	**NA**	
1. Industrial Wastewater		NA	0.19	NA	NA	NA	
2. Domestic and Commercial Waste Water		1.11	0.67	NA	NA	NA	
3. Other *(as specified in table 6.B)*		NA	NA	NA	NA	NA	
C. Waste Incineration	**2.03**	**0.00**	**0.00**	**0.01**	**0.01**	**0.00**	**0.01**
D. Other *(please specify)*	**NA**	**2.59**	**0.35**	**NA**	**NA**	**NA**	**NA**
Compost production	NA	2.59	0.35	NA	NA	NA	NA

(1) CO_2 emissions from source categories Solid waste disposal on land and Waste incineration should only be included if they derive from non-biological or inorganic waste sources.

Documentation box:
• Parties should provide detailed explanations on the waste sector in Chapter 8: Waste (CRF sector 6) of the NIR. Use this documentation box to provide references to relevant sections of the NIR if any additional information and/or further details are needed to understand the content of this table.
• If estimates are reported under "6.D Other", use this documentation box to provide information regarding activities covered under this category and to provide reference to the section in the NIR where background information can be found.

TABLE 6.A SECTORAL BACKGROUND DATA FOR WASTE
Solid Waste Disposal
(Sheet 1 of 1)

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	ACTIVITY DATA AND OTHER RELATED INFORMATION			IMPLIED EMISSION FACTOR		EMISSIONS		
	Annual MSW at the SWDS	MCF	DOC degraded	CH_4 (1)	CO_2	CH_4		CO_2 (4)
						Emissions (2)	Recovery (3)	
	(Gg)		%	(t /t MSW)		(Gg)		
1 Managed Waste Disposal on Land	166.26	1.00	0.16	0.39	NA	57.19	7.20	NA
2 Unmanaged Waste Disposal Sites	NO	NO	NO	NO	NO	NO	NO	NO
a. Deep (>5 m)	NO	NO	NO	NO	NO	NO	NO	NO
b. Shallow (<5 m)	NO	NO	NO	NO	NO	NO	NO	NO
3 Other *(please specify)*						NA	NA	NA

Additional information

Description	Value
Total population (1000s)[(a)]	**8 426.31**
Urban population (1000s)[(a)]	5 729.89
Waste generation rate (kg/capita/day)	0.05
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)]	63.00

Note: MSW - Municipal Solid Waste, SWDS - Solid Waste Disposal Site, MCF - Methane Correction Factor, DOC - Degradable Organic Carbon (IPCC Guidelines (Volume 3. Reference Manual, section 6.2.4)).
MSW includes household waste, yard/garden waste, commercial/market waste and organic industrial solid waste. MSW should not include inorganic industrial waste such as construction or demolition materials.

(1) The CH_4 implied emission factor (IEF) is calculated on the basis of gross CH_4 emissions, as follows: IEF = (CH_4 emissions + CH_4 recovered)/annual MSW at the SWDS.
(2) Actual emissions (after recovery)
(3) CH_4 recovered and flared or utilized.
(4) Under Solid Waste Disposal, CO_2 emissions should be reported only when the disposed waste is combusted at the disposal site as a management practice. CO_2 emissions from non-biogenic wastes are included in the total emissions, whereas the CO_2 emissions from biogenic wastes are not included in the total emissions.

(a) Specify whether total or urban population is used and the rationale for doing so.
(b) See IPCC Guidelines (Volume 3. Reference Manual, p. 6.9)
(c) Only for Parties using Tier 2 methods

TABLE 6.C SECTORAL BACKGROUND DATA FOR WASTE
Waste Incineration
(Sheet 1 of 1)

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	ACTIVITY DATA	IMPLIED EMISSION FACTOR			EMISSIONS		
	Amount of incinerated wastes	CO_2	CH_4	N_2O	CO_2 (1)	CH_4	N_2O
	(Gg)	(kg/t waste)			(Gg)		
Waste Incineration	1.00				2.03	0.00	0.00
a. Biogenic (1)	NA	NA	NA	NA	NA	NA	NA
b. Other (non-biogenic - *please specify*) (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, CO_2 emissions should be reported only when the disposed waste is combusted at the disposal site as a management practice. CO_2 emissions from non-biogenic wastes are included in the total emissions, while the CO_2 emissions from biogenic wastes are not included in the total emissions.
(2) Enter under this source category all types of non-biogenic wastes, such as plastic

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 guida page 5.23).

Documentation box:
- Parties should provide detailed explanations on the waste sector in Chapter 8: Waste (CRF sector 6) of the NIR. Use this documentation box to provide references to relevant sections of the NIR if any additional information and/or further details are
- Parties that use country-specific models should provide a reference in the documentation box to the relevant section in the NIR where these models are described, and fill in only the relevant cells of tables 6.A and 6.C.
- Provide a reference to the relevant section in the NIR, in particular with regard to:
  (a) A population size (total or urban population) used in the calculations and the rationale for doing so;
  (b) The composition of landfilled waste;
  (c) In relation to the amount of incinerated wastes (specify whether the reported data relate to wet or dry matter).

TABLE 6.B SECTORAL BACKGROUND DATA FOR WASTE

Waste Water Handling

(Sheet 1 of 2)

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	ACTIVITY DATA AND RELATED INFORMATION[1]	IMPLIED EMISSION FACTOR		EMISSIONS		
	Total organic product	CH_4 [2]	N_2O [3]	CH_4 Emissions [4]	CH_4 Recovery [5]	N_2O [3]
	(Gg DC[1]/yr)	(kg/kg DC)		(Gg)		
1. Industrial Waste Water				NA	NA	0.19
a. Waste Water	510.00	NA	0.00	NA	NA	0.19
b. Sludge	NA	NA	NA	NA	NA	NA
2. Domestic and Commercial Wastewater				1.11	NA	0.67
a. Waste Water	369.07	0.00	NA	1.11	NA	NA
b. Sludge	NA	NA	NA	NA	NA	NA
3. Other *(please specify)* [6]				NA	NA	NA

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	ACTIVITY DATA AND OTHER RELATED INFORMATION			IMPLIED EMISSION FACTOR	EMISSIONS
	Population (1000s)	Protein consumption (kg/person/yr)	N fraction (kg N/kg protein)	N_2O (kg N_2O-N/kg sewage N produced)	N_2O (Gg)
N_2O from human sewage [3]	8 426.31	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 CH_4 implied emission factor (IEF) is calculated on the basis of gross CH_4 emissions, as follows: IEF = (CH_4 emissions + CH_4 recovered or flared) / total organic product.

(3) Parties using methods other than those from the IPCC for estimating N_2O emissions from human sewage or waste-water treatment should provide aggregate data in this table.

(4) Actual emissions (after recovery).

(5) CH_4 recovered and flared or utilized.

(6) Use the cells below to specify each activity covered under "6.B.3 Other". Note that under each reported activity, data for waste water and sludge are to be reported separately.

Documentation box:
- Parties should provide detailed explanations on the Waste sector in Chapter 8: Waste (CRF sector 6) of the NIR. Use this documentation box to provide references to relevant sections of the NIR if any additional information and/or further details are needed to understand the content of this table.
- Regarding the estimates for N_2O from human sewage, specify whether total or urban population is used in the calculations and the rationale for doing so. Provide explanation in the documentation box.
- Parties using methods other than those from the IPCC for estimating N_2O emissions from human sewage or waste-water treatment should provide, in the NIR, corresponding information on methods, activity data and emission factors used, and should provide a reference to the relevant section of the NIR in this documentation box.

TABLE 6.B SECTORAL BACKGROUND DATA FOR WASTE
Waste Water Handling
(Sheet 2 of 2)

Additional information

	Domestic	Industrial
Total waste water (m^3):	1 111 589.65	1 050 000 000.00
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)

GREENHOUSE GAS SOURCE AND SINK CATEGORIES		Net CO_2 emissions/removals	CH_4	N_2O	HFCs[1]		PFCs[1]		SF_6		NO_x	CO	NMVOC	SO_2
					P	A	P	A	P	A				
		(Gg)			CO_2 equivalent (Gg)						(Gg)			
Total National Emissions and Removals		**63 869.64**	**252.68**	**16.93**	**2 593.55**	**1 431.45**	**285.89**	**40.46**	**0.01**	**0.01**	**178.26**	**607.21**	**135.54**	**17.23**
1. Energy		**58 534.31**	**22.99**	**2.18**							**171.25**	**579.15**	**49.77**	**16.00**
A. Fuel Combustion	Reference Approach[2]	60 582.86												
	Sectoral Approach[2]	58 297.14	11.36	2.18							171.25	579.15	47.86	15.75
1. Energy Industries		12 324.99	0.50	0.36							14.37	5.94	0.89	2.86
2. Manufacturing Industries and Construction		15 409.01	0.64	0.51							32.27	150.10	2.17	10.76
3. Transport		21 418.45	0.61	0.66							104.08	132.28	13.30	0.20
4. Other Sectors		9 097.29	9.60	0.64							20.44	290.55	31.48	1.93
5. Other		47.40	0.00	0.00							0.08	0.28	0.02	0.01
B. Fugitive Emissions from Fuels		237.17	11.63	IE,NA							IE,NA	IE,NA	1.90	0.25
1. Solid Fuels		IE,NA,NO	0.04	NA							NA	NA	NA,NO	NA
2. Oil and Natural Gas		237.17	11.58	IE,NA							IE,NA	IE,NA	1.90	0.25
2. Industrial Processes		**9 008.12**	**0.87**	**0.17**	**2 593.55**	**1 431.45**	**285.89**	**40.46**	**0.01**	**0.01**	**1.35**	**23.66**	**4.86**	**1.22**
A. Mineral Products		2 946.15	NA	NA							NA	9.78	IE,NA	NA
B. Chemical Industry		587.78	0.87	0.17	NO	NO	NO	NO	NO	NO	0.41	11.09	1.32	0.77
C. Metal Production		5 474.20	0.00	NA				NO		0.00	0.10	2.18	0.43	0.45
D. Other Production[3]		NA									0.83	0.60	3.10	NA
E. Production of Halocarbons and SF_6						NA,NO		NA		NA				
F. Consumption of Halocarbons and SF_6					2 593.55	1 431.45	285.89	40.46	0.01	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.

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	Net CO_2 emissions/removals	CH_4	N_2O	HFCs [1]		PFCs [1]		SF_6		NO_x	CO	NMVOC	SO_2
				P	A	P	A	P	A				
	(Gg)			CO_2 equivalent (Gg)						(Gg)			
3. Solvent and Other Product Use	**189.00**		**0.47**							**NA**	**NA**	**79.16**	**NA**
4. Agriculture		**167.92**	**12.82**							**5.66**	**0.36**	**1.70**	**0.00**
A. Enteric Fermentation		152.03											
B. Manure Management		15.44	2.96									NA,NO	
C. Rice Cultivation		NO										NO	
D. Agricultural Soils[4]		0.42	9.86									1.63	
E. Prescribed Burning of Savannas		NO	NO							NO	NO	NO	
F. Field Burning of Agricultural Residues		0.02	0.00							0.01	0.36	0.07	
G. Other		NA	NA							5.65	NA	NA	0.00
5. Land Use, Land-Use Change and Forestry	[5] **-3 863.83**	**0.01**	**0.08**							**IE,NA,NE**	**IE,NA,NE**	**NA,NE**	**NA**
A. Forest Land	[5] -4 487.24	0.01	0.00							NE	NE	NE	
B. Cropland	[5] 224.99	IE,NA,NO	0.08							IE	IE	NE	
C. Grassland	[5] 41.24	NO	NO							IE	IE	NE	
D. Wetlands	[5] 74.84	NO	NO							NA	NA	NA	
E. Settlements	[5] 87.95	NA,NO	NA,NO							NA	NA	NA	
F. Other Land	[5] 194.38	NA,NO	NA,NO							NA	NA	NA	
G. Other	[5] NE	NA	NA							NA	NA	NA	NA
6. Waste	**2.03**	**60.90**	**1.21**							**0.01**	**4.04**	**0.05**	**0.01**
A. Solid Waste Disposal on Land	[6] NA,NO	57.19								NA,NO	4.03	0.05	
B. Waste-water Handling		1.11	0.86							NA	NA	NA	
C. Waste Incineration	[6] 2.03	0.00	0.00							0.01	0.01	0.00	0.01
D. Other	NA	2.59	0.35							NA	NA	NA	NA
7. Other *(please specify)* [7]	**NA**	**NA**	**NA**	**NA**	**NA**	**NA**	**NA**	**NA**	**NA**	**NA**	**NA**	**NA**	**NA**

Note: All footnotes for this table are given at the end of the table on sheet 3.

SUMMARY 1.A SUMMARY REPORT FOR NATIONAL GREENHOUSE GAS INVENTORIES (IPCC TABLE 7A) (Sheet 3 of 3)

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	Net CO_2 emissions/removals	CH_4	N_2O	HFCs		PFCs		SF_6		NO_x	CO	NMVOC	SO_2
				P	A	P	A	P	A				
	(Gg)			CO_2 equivalent (Gg)						(Gg)			
Memo Items: [8]													
International Bunkers	**2 118.29**	**0.05**	**0.09**							**9.22**	**2.91**	**0.90**	**0.67**
Aviation	2 072.66	0.04	0.07							8.71	2.47	0.90	0.66
Marine	45.63	0.00	0.02							0.51	0.44	NA	0.02
Multilateral Operations	**NO**	**NO**	**NO**							**NO**	**NO**	**NO**	**NO**
CO_2 Emissions from Biomass	**25 166.69**												

(1) The emissions of HFCs and PFCs are to be expressed as CO_2 equivalent emissions. Data on disaggregated emissions of HFCs and PFCs are to be provided in Table 2(II) of this common reporting format.

(2) For verification purposes, countries are asked to report the results of their calculations using the Reference approach and to explain any differences with the Sectoral approach in the documentation box to Table 1.A.(c). For estimating national total emissions, the results from the Sectoral approach should be used, where possible.

(3) Other Production includes Pulp and Paper and Food and Drink Production.

(4) Parties which previously reported CO_2 from soils in the Agriculture sector should note this in the NIR.

(5) For the purposes of reporting, the signs for removals are always negative (-) and for emissions positive (+).

(6) CO_2 from source categories Solid Waste Disposal on Land and Waste Incineration should only be included if it stems from non-biogenic or inorganic waste streams. Only emissions from Waste Incineration Without Energy Recovery are to be reported in the Waste sector, whereas emissions from Incineration With Energy Recovery are to be reported in the Energy sector.

(7) If reporting any country-specific source category under sector "7. Other", detailed explanations should be provided in Chapter 9: Other (CRF sector 7) of the NIR

(8) Countries are asked to report emissions from international aviation and marine bunkers and multilateral operations, as well as CO_2 emissions from biomass, under Memo Items. These emissions should not be included in the national total emissions from the energy sector. Amounts of biomass used as fuel are included in the national energy consumption but the corresponding CO_2 emissions are not included in the national total as it is assumed that the biomass is produced in a sustainable manner. If the biomass is harvested at an unsustainable rate, net CO_2 emissions are accounted for as a loss of biomass stocks in the Land Use, Land-use Change and Forestry sector.

SUMMARY 1.B SHORT SUMMARY REPORT FOR NATIONAL GREENHOUSE GAS INVENTORIES (IPCC TABLE 7B)
(Sheet 1 of 1)

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	Net CO_2 emisions/removals	CH_4	N_2O	HFCs[1]		PFCs[1]		SF_6		NO_x	CO	NMVOC	SO_2
				P	A	P	A	P	A				
	(Gg)			CO_2 equivalent (Gg)						(Gg)			
Total National Emissions and Removals	**63 869.64**	**252.68**	**16.93**	**2 593.55**	**1 431.45**	**285.89**	**40.46**	**0.01**	**0.01**	**178.26**	**607.21**	**135.54**	**17.23**
1. Energy	**58 534.31**	**22.99**	**2.18**							**171.25**	**579.15**	**49.77**	**16.00**
A. Fuel Combustion — Reference Approach[2]	60 582.86												
Sectoral Approach[2]	58 297.14	11.36	2.18							171.25	579.15	47.86	15.75
B. Fugitive Emissions from Fuels	237.17	11.63	IE,NA							IE,NA	IE,NA	1.90	0.25
2. Industrial Processes	**9 008.12**	**0.87**	**0.17**	**2 593.55**	**1 431.45**	**285.89**	**40.46**	**0.01**	**0.01**	**1.35**	**23.66**	**4.86**	**1.22**
3. Solvent and Other Product Use	**189.00**		**0.47**							**NA**	**NA**	**79.16**	**NA**
4. Agriculture [3]		**167.92**	**12.82**							**5.66**	**0.36**	**1.70**	**0.00**
5. Land Use, Land-Use Change and Forestry	[4] **-3 863.83**	**0.01**	**0.08**							**IE,NA,NE**	**IE,NA,NE**	**NA,NE**	**NA**
6. Waste	**2.03**	**60.90**	**1.21**							**0.01**	**4.04**	**0.05**	**0.01**
7. Other	**NA**	**NA**	**NA**	**NA**	**NA**	**NA**	**NA**	**NA**	**NA**	**NA**	**NA**	**NA**	**NA**
Memo Items: [5]													
International Bunkers	**2 118.29**	**0.05**	**0.09**							**9.22**	**2.91**	**0.90**	**0.67**
Aviation	2 072.66	0.04	0.07							8.71	2.47	0.90	0.66
Marine	45.63	0.00	0.02							0.51	0.44	NA	0.02
Multilateral Operations	**NO**	**NO**	**NO**							**NO**	**NO**	**NO**	**NO**
CO_2 Emissions from Biomass	**25 166.69**												

Note: A = Actual emissions based on Tier 2 approach of the IPCC Guidelines.
P = Potential emissions based on Tier 1 approach of the IPCC Guidelines.

(1) The emissions of HFCs and PFCs are to be expressed as CO_2 equivalent emissions. Data on disaggregated emissions of HFCs and PFCs are to be provided in Table 2(II) of this common reporting format.

(2) For verification purposes, countries are asked to report the results of their calculations using the Reference approach and to explain any differences with the Sectoral approach in the documentation box to Table 1.A.(c). For estimating national total emissions, the result from the Sectoral approach should be used, where possible.

(3) Parties which previously reported CO_2 from soils in the Agriculture sector should note this in the NIR.

(4) For the purposes of reporting, the signs for removals are always negative (-) and for emissions positive (+).

(5) Countries are asked to report emissions from international aviation and marine bunkers and multilateral operations, as well as CO_2 emissions from biomass, under Memo Items. These emissions should not be included in the national total emissions from the energy sector. Amounts of biomass used as fuel are included in the national energy consumption but the corresponding CO_2 emissions are not included in the national total as it is assumed that the biomass is produced in a sustainable manner. If the biomass is harvested at an unsustainable rate, net CO_2 emissions are accounted for as a loss of biomass stocks in the Land Use, Land-use Change and Forestry sector.

SUMMARY 2 SUMMARY REPORT FOR CO_2 EQUIVALENT EMISSIONS
(Sheet 1 of 1)

Inventory 2012
Submission 2014 v1.4
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GREENHOUSE GAS SOURCE AND SINK CATEGORIES	CO_2 [(1)]	CH_4	N_2O	HFCs [(2)]	PFCs [(2)]	SF_6 [(2)]	Total
	CO_2 equivalent (Gg)						
Total (Net Emissions) [(1)]	**63 869.64**	**5 306.34**	**5 246.78**	**1 431.45**	**40.46**	**326.18**	**76 220.84**
1. Energy	**58 534.31**	**482.75**	**674.47**				**59 691.53**
A. Fuel Combustion (Sectoral Approach)	58 297.14	238.58	674.47				59 210.19
1. Energy Industries	12 324.99	10.49	111.42				12 446.90
2. Manufacturing Industries and Construction	15 409.01	13.53	158.06				15 580.60
3. Transport	21 418.45	12.85	204.52				21 635.83
4. Other Sectors	9 097.29	201.67	199.48				9 498.45
5. Other	47.40	0.03	0.98				48.41
B. Fugitive Emissions from Fuels	237.17	244.17	IE,NA				481.35
1. Solid Fuels	IE,NA,NO	0.90	NA				0.90
2. Oil and Natural Gas	237.17	243.28	IE,NA				480.45
2. Industrial Processes	**9 008.12**	**18.33**	**52.70**	**1 431.45**	**40.46**	**326.18**	**10 877.24**
A. Mineral Products	2 946.15	NA	NA				2 946.15
B. Chemical Industry	587.78	18.24	52.70	NO	NO	NO	658.72
C. Metal Production	5 474.20	0.08	NA	NO	NO	4.68	5 478.96
D. Other Production	NA						NA
E. Production of Halocarbons and SF_6				NA,NO	NA	NA	NA,NO
F. Consumption of Halocarbons and SF_6 [(2)]				1 431.45	40.46	321.50	1 793.40
G. Other	NA	NA	NA	NA	NA	NA	NA
3. Solvent and Other Product Use	**189.00**		**145.56**				**334.56**
4. Agriculture		**3 526.24**	**3 972.79**				**7 499.03**
A. Enteric Fermentation		3 192.73					3 192.73
B. Manure Management		324.15	917.41				1 241.56
C. Rice Cultivation		NO					NO
D. Agricultural Soils [(3)]		8.84	3 055.28				3 064.12
E. Prescribed Burning of Savannas		NO	NO				NO
F. Field Burning of Agricultural Residues		0.52	0.10				0.62
G. Other		NA	NA				NA
5. Land Use, Land-Use Change and Forestry [(1)]	**-3 863.83**	**0.16**	**25.15**				**-3 838.52**
A. Forest Land	-4 487.24	0.16	0.04				-4 487.04
B. Cropland	224.99	IE,NA,NO	25.11				250.10
C. Grassland	41.24	NO	NO				41.24
D. Wetlands	74.84	NO	NO				74.84
E. Settlements	87.95	NA,NO	NA,NO				87.95
F. Other Land	194.38	NA,NO	NA,NO				194.38
G. Other	NE	NA	NA				NA,NE
6. Waste	**2.03**	**1 278.85**	**376.12**				**1 657.00**
A. Solid Waste Disposal on Land	NA,NO	1 201.09					1 201.09
B. Waste-water Handling		23.32	266.14				289.45
C. Waste Incineration	2.03	0.00	0.01				2.04
D. Other	NA	54.45	109.98				164.43
7. Other *(as specified in Summary 1.A)*	**NA**	**NA**	**NA**	**NA**	**NA**	**NA**	**NA**

Memo Items: [(4)]							
International Bunkers	2 118.29	0.98	26.50				2 145.77
Aviation	2 072.66	0.94	21.62				2 095.21
Marine	45.63	0.04	4.89				50.55
Multilateral Operations	**NO**	**NO**	**NO**				**NO**
CO_2 Emissions from Biomass	**25 166.69**						**25 166.69**

Total CO_2 Equivalent Emissions without Land Use, Land-Use Change and Forestry	80 059.36
Total CO_2 Equivalent Emissions with Land Use, Land-Use Change and Forestry	76 220.84

(1) For CO_2 from Land Use, Land-use Change and Forestry the net emissions/removals are to be reported. For the purposes of reporting, the signs for removals are always negative (-) and for emissions positive (+).

(2) Actual emissions should be included in the national totals. If no actual emissions were reported, potential emissions should be included.

(3) Parties which previously reported CO_2 from soils in the Agriculture sector should note this in the NIR.

(4) See footnote 8 to table Summary 1.A.

SUMMARY 3 SUMMARY REPORT FOR METHODS AND EMISSION FACTORS USED
(Sheet 1 of 2)

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	CO_2		CH_4		N_2O		HFCs		PFCs		SF_6	
	Method applied	Emission factor	Method applied	Emission factor	Method applied	Emission factor	Method applied	Emission factor	Method applied	Emission factor	Method applied	Emission factor
1. Energy	**CS,T2,T3**	**CS,D,PS**	**CS,T1,T2,T3**	**CR,CS,D,PS**	**CS,T1,T2,T3**	**CR,CS,D**						
A. Fuel Combustion	CS,T2,T3	CS,D,PS	CS,T1,T2,T3	CR,CS,D	CS,T1,T2,T3	CR,CS,D						
1. Energy Industries	T2	CS,PS	T2	CS	T2	CS						
2. Manufacturing Industries and Construction	T2	CS,D,PS	T2	CS	T2	CS						
3. Transport	CS,T2,T3	CS	CS,T1,T2,T3	CR,CS,D	CS,T1,T2,T3	CR,CS,D						
4. Other Sectors	T2	CS,D	T2	CS	T2	CS						
5. Other	T2	CS	T2	CS	T2	CS						
B. Fugitive Emissions from Fuels	CS,T2	CS,D,PS	CS,T1,T2,T3	CS,D,PS	NA	NA						
1. Solid Fuels	NA	NA	T1	D	NA	NA						
2. Oil and Natural Gas	CS,T2	CS,D,PS	CS,T1,T2,T3	CS,D,PS	NA	NA						
2. Industrial Processes	**CS,T1,T2,T3**	**CS,D,PS**	**CR,CS,T1**	**CS,PS**	**CS**	**PS**	**CS**	**CS**	**CS**	**CS**	**CS,T1**	**CS,D**
A. Mineral Products	CS,T1,T3	CS,D,PS	NA	NA	NA	NA						
B. Chemical Industry	CS,T2,T3	CS,PS	CS	PS	CS	PS	NA	NA	NA	NA	NA	NA
C. Metal Production	CS,T1,T2	D,PS	CR,T1	CS,PS	NA	NA	NA	NA	NA	NA	T1	D
D. Other Production	NA	NA										
E. Production of Halocarbons and SF_6							NA	NA	NA	NA	NA	NA
F. Consumption of Halocarbons and SF_6							CS	CS	CS	CS	CS	CS
G. Other	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA

Use the following notation keys to specify the method applied:

D (IPCC default) — **T1a, T1b, T1c** (IPCC Tier 1a, Tier 1b and Tier 1c, respectively) — **CR** (CORINAIR)
RA (Reference Approach) — **T2** (IPCC Tier 2) — **CS** (Country Specific)
T1 (IPCC Tier 1) — **T3** (IPCC Tier 3) — **OTH** (Other)

If using more than one method within one source category, list all the relevant methods. Explanations regarding country-specific methods, other methods or any modifications to the default IPCC methods, as well as informatic

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.

SUMMARY 3 SUMMARY REPORT FOR METHODS AND EMISSION FACTORS USED
(Sheet 2 of 2)

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	CO_2		CH_4		N_2O		HFCs		PFCs		SF_6	
	Method applied	Emission factor	Method applied	Emission factor	Method applied	Emission factor	Method applied	Emission factor	Method applied	Emission factor	Method applied	Emission factor
3. Solvent and Other Product Use	**CR,CS**	**CS**			**CS**	**D**						
4. Agriculture			**CS,D,T1,T2**	**CS,D**	**CS,D,T1,T1a,T1b,T2**	**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	CS,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,T3	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 different methods per source

Use the following notation keys to specify the emission factor used:

D (IPCC default) — **CS** (Country Specific) — **OTH** (Other)
CR (CORINAIR) — **PS** (Plant Specific)

Where a mix of emission factors has been used, list all the methods in the relevant cells and give further explanations in the documentation box. Also use the documentation box to explain the use of notation OTH.

Documentation box:

• Parties should provide the full information on methodological issues, such as methods and emission factors used, in the relevant sections of Chapters 3 to 9 (see section 2.2 of each of Chapters 3 - 9) of the NIR. Use this documentation box to provide references to relevant sections of the NIR if any additional information and further details are needed to understand the content of this table.

• Where a mix of methods/emission factors has been used within one source category, use this documentation box to specify those methods/emission factors for the various sub-sources where they have been applied.

• Where the notation OTH (Other) has been entered in this table, use this documentation box to specify those other methods/emission factors.

TABLE 7 SUMMARY OVERVIEW FOR KEY CATEGORIES
(Sheet 1 of 1)

KEY CATEGORIES OF EMISSIONS AND REMOVALS	Gas	Criteria used for key source identification			Key category excluding LULUCF [1]	Key category including LULUCF [1]	Comments [1]
		L	T	Q			
Specify key categories according to the national level of disaggregation used:							
1 A 1 a gaseous	CO2	x	x		x	x	
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	
1 A 1 b liquid	CO2	x	x		x	x	
1 A 1 c gaseous	CO2	x			x	x	
1 A 2 a gaseous	CO2	x	x		x	x	
1 A 2 a liquid	CO2	x			x	x	
1 A 2 a solid	CO2	x	x		x	x	
1 A 2 b gaseous	CO2	x	x		x	x	
1 A 2 c gaseous	CO2	x	x		x	x	
1 A 2 c other	CO2	x	x		x	x	
1 A 2 d gaseous	CO2	x	x		x	x	
1 A 2 d liquid	CO2		x		x	x	
1 A 2 d solid	CO2	x			x	x	
1 A 2 e gaseous	CO2	x	x		x	x	
1 A 2 e liquid	CO2		x		x	x	
1 A 2 f gaseous	CO2	x	x		x	x	
1 A 2 f liquid	CO2	x	x		x	x	
1 A 2 f other	CO2	x	x		x	x	
1 A 2 f solid	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 a gaseous	CO2	x	x		x	x	
1 A 4 a liquid	CO2	x	x		x	x	
1 A 4 a other	CO2		x		x	x	
1 A 4 b biomass	CH4		x		x	x	
1 A 4 b gaseous	CO2	x	x		x	x	
1 A 4 b liquid	CO2	x	x		x	x	
1 A 4 b solid	CO2		x		x	x	
1 A 4 c liquid	CO2	x	x		x	x	
1 B 2 a Oil	CO2		x		x		
2 A 1 Cement Production	CO2	x	x		x	x	
2 A 2 Lime Production	CO2	x	x		x	x	
2 A 3 Limestone and Dolomite Use	CO2	x			x	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 Refrigeration and Air Conditioning Equipment	HFC	x	x		x	x	
2 F 9 Other Sources of SF6	SF6	x	x		x	x	
3 D Other	N2O		x		x		
4 A 1 Cattle	CH4	x	x		x	x	
4 B 1 Cattle	CH4	x			x	x	
4 B 1 Cattle	N2O	x			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	
5 A 1 Forest land remaining forest land	CO2	x	x			x	
5 A 2 Land converted to forest land	CO2	x	x			x	
5 B 1 Cropland remaining Cropland	CO2		x			x	
5 C 2 Land converted to grassland	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; Q = Qualitative assessment.
[1] The term "key categories" refers to both the key source categories as addressed in the IPCC good practice guidance and the key categories as addressed in the IPCC good practice guidance for LULUCF.
[2] For estimating key categories Parties may chose the disaggregation level presented as an example in table 7.1 of the IPCC good practice guidance (page 7.6) and table 5.4.1 (page 5.31) of the IPCC good practice guidance for LULUCF, the level used in table Summary 1.A of the common reporting format or any other disaggregation level that the Party used to determine its key categories.

Documentation box:
Parties should provide the full information on methodologies used for identifying key categories and the quantitative results from the level and trend assessments (according to tables 7.1–7.3 of the IPCC good practice guidance and tables 5.4.1–5.4.3 of the IPCC good practice guidance for LULUCF) in Annex 1 to the NIR.

TABLE 8(a) RECALCULATION - RECALCULATED DATA
(Sheet 1 of 2)

Recalculated year: Inventory 2012
Submission 2014 v1.4
AUSTRIA

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	CO_2						CH_4						N_2O					
	Previous submission	Latest submission	Difference	Difference[(1)]	Impact of recalculation on total emissions excluding LULUCF [(2)]	Impact of recalculation on total emissions including LULUCF[(3)]	Previous submission	Latest submission	Difference	Difference[(1)]	Impact of recalculation on total emissions excluding LULUCF [(2)]	Impact of recalculation on total emissions including LULUCF[(3)]	Previous submission	Latest submission	Difference	Difference[(1)]	Impact of recalculation on total emissions excluding LULUCF [(2)]	Impact of recalculation on total emissions including LULUCF[(3)]
	CO_2 equivalent (Gg)			(%)			CO_2 equivalent (Gg)			(%)			CO_2 equivalent (Gg)			(%)		
Total National Emissions and Removals		**63 869.64**						5 306.34						5 246.78				
1. Energy		**58 534.31**						482.75						674.47				
1.A. Fuel Combustion Activities		58 297.14						238.58						674.47				
1.A.1. Energy Industries		12 324.99						10.49						111.42				
1.A.2. Manufacturing Industries and Construction		15 409.01						13.53						158.06				
1.A.3. Transport		21 418.45						12.85						204.52				
1.A.4. Other Sectors		9 097.29						201.67						199.48				
1.A.5. Other		47.40						0.03						0.98				
1.B. Fugitive Emissions from Fuels		237.17						244.17						IE,NA				
1.B.1. Solid fuel		IE,NA,NO						0.90						NA				
1.B.2. Oil and Natural Gas		237.17						243.28						IE,NA				
2. Industrial Processes		**9 008.12**						**18.33**						**52.70**				
2.A. Mineral Products		2 946.15						NA						NA				
2.B. Chemical Industry		587.78						18.24						52.70				
2.C. Metal Production		5 474.20						0.08						NA				
2.D. Other Production		NA																
2.G. Other		NA						NA						NA				
3. Solvent and Other Product Use		**189.00**												**145.56**				
4. Agriculture								**3 526.24**						**3 972.79**				
4.A. Enteric Fermentation								3 192.73										
4.B. Manure Management								324.15						917.41				
4.C. Rice Cultivation								NO										
4.D. Agricultural Soils [(4)]								8.84						3 055.28				
4.E. Prescribed Burning of Savannas								NO						NO				
4.F. Field Burning of Agricultural Residues								0.52						0.10				
4.G. Other								NA						NA				
5. Land Use, Land-Use Change and Forestry (net) [(5)]		**-3 863.83**						0.16						25.15				
5.A. Forest Land		-4 487.24						0.16						0.04				
5.B. Cropland		224.99						IE,NA,NO						25.11				
5.C. Grassland		41.24						NO						NO				
5.D. Wetlands		74.84						NO						NO				
5.E. Settlements		87.95						NA,NO						NA,NO				
5.F. Other Land		194.38						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.

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	CO_2						CH_4						N_2O					
	Previous submission	Latest submission	Difference	Difference[(1)]	Impact of recalculation on total emissions excluding LULUCF [(2)]	Impact of recalculation on total emissions including LULUCF[(3)]	Previous submission	Latest submission	Difference	Difference[(1)]	Impact of recalculation on total emissions excluding LULUCF [(2)]	Impact of recalculation on total emissions including LULUCF[(3)]	Previous submission	Latest submission	Difference	Difference[(1)]	Impact of recalculation on total emissions excluding LULUCF [(2)]	Impact of recalculation on total emissions including LULUCF[(3)]
	CO_2 equivalent (Gg)			(%)			CO_2 equivalent (Gg)			(%)			CO_2 equivalent (Gg)			(%)		
6. Waste		**2.03**						1 278.85						376.12				
6.A. Solid Waste Disposal on Land		NA,NO						1 201.09										
6.B. Waste-water Handling								23.32						266.14				
6.C. Waste Incineration		2.03						0.00						0.01				
6.D. Other		NA						54.45						109.98				
7. Other *(as specified in Summary 1.A)*		NA						NA						NA				
Memo Items:																		
International Bunkers		**2 118.29**						**0.98**						**26.50**				
Multilateral Operations		**NO**						**NO**						**NO**				
CO_2 Emissions from Biomass		**25 166.69**																

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		**1 431.45**						**40.46**						**326.18**				
2.C.3. Aluminium Production								NO										
2.E. Production of Halocarbons and SF_6		NA,NO						NA						NA				
2.F. Consumption of Halocarbons and SF_6		1 431.45						40.46						321.50				
2.G. Other		NA						NA						NA				
Potential Emissions from Consumption of HFCs/PFCs and SF_6		**2 593.55**						**285.89**						**333.85**				

	Previous submission	Latest submission	Difference	Difference[(1)]
	CO_2 equivalent (Gg)			(%)
Total CO_2 Equivalent Emissions with Land Use, Land-Use Change and Forestry		76 220.84		
Total CO_2 Equivalent Emissions without Land Use, Land-Use Change and Forestry		80 059.36		

(1) Estimate the percentage change due to recalculation with respect to the previous submission (percentage change = 100 x [(LS-PS)/PS], where LS = latest submission and PS = previous submission. All cases of recalculation of the estimate of the source/sink category should be addressed and explained in table 8(b).

(2) Total emissions refer to total aggregate GHG emissions expressed in terms of CO_2 equivalent, excluding GHGs from the LULUCF sector. The impact of the recalculation on the total emissions is calculated as follows: impact of recalculation (%) = 100 x [(source (LS) - source (PS))/total emissions (LS)], where LS = latest submission, PS = previous submission.

(3) Total emissions refer to total aggregate GHG emissions expressed in terms of CO_2 equivalent, including GHGs from the LULUCF sector. The impact of the recalculation on the total emissions is calculated as follows: impact of recalculation (%) = 100 x [(source (LS) - source (PS))/total emissions (LS)], where LS = latest submission, PS = previous submission.

(4) Parties which previously reported CO_2 from soils in the Agriculture sector should note this in the NIR.

(5) Net CO_2 emissions/removals to be reported.

Documentation box:

Parties should provide detailed information on recalculations in Chapter 10: Recalculations and Improvements, and in the relevant sections of Chapters 3 to 9 (see section 2.5 of each of Chapters 3 - 9) of the NIR. Use this documentation box to provide references to relevant sections of the NIR if any additional information and further details are needed to understand the content of this table.

TABLE 8(b) RECALCULATION - EXPLANATORY INFORMATION
(Sheet 1 of 1)

Specify the sector and source/sink category[1] where changes in estimates have occurred:		GHG	RECALCULATION DUE TO				
			CHANGES IN:			Addition/removal/ reallocation of source/sink categories	Other changes in data (e.g. statistical or editorial changes, correction of errors)
			Methods [2]	Emission factors [2]	Activity data [2]		

[1] Enter the identification code of the source/sink category (e.g. 1.B.1) in the first column and the name of the category (e.g. Fugitive Emissions from Solid Fuels) in the second column of the table. Note that the source categories entered in this table should match those used in table 8(a).

[2] Explain changes in methods, emission factors and activity data that have resulted in recalculation of the estimate of the source/sink as indicated in table 8(a). Include changes in the assumptions and coefficients in the Methods column.

Documentation box:

Parties should provide the full information on recalculations in Chapter 10: Recalculations and Improvements, and in the relevant sections of Chapters 3 to 9 (see section 2.5 of each of Chapters 3 to 9) of the NIR. Use this documentation box to provide references to relevant sections of the NIR if any additional information and further details are needed to understand the content of this table. References should point particularly to the sections of the NIR in which justifications of the changes as to improvements in the accuracy, completeness and consistency of the inventory are reported.

TABLE 9(a) COMPLETENESS - INFORMATION ON NOTATION KEYS
(Sheet 1 of 1)

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 LULUCF.

Sources and sinks reported elsewhere (IE)[3]				
GHG	**Source/sink category**	**Allocation as per IPCC Guidelines**	**Allocation used by the Party**	**Explanation**
Carbon	Deciduous	5.A.1 Forest Land remaining Forest Land - Mineral soils - Decidous.	ng Forest Land - Mineral soils - Coniferous.	Included in coniferous.
CH4	3.1.A.2.2 Post-Mining Activities	1 B 1 A 2 Coal Surface Mines/ Post Mining Activities	A 2 Coal Surface Mines/ Mining Activities	Emissions from mining and post-mining activities are reported together.
CH4	1.B.2.A.1 Exploration	1 B 2 A 1 Oil Exploration	1 B 2 A 2 Oil Production	oduction 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	oduction 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	oduction fields are reported here (total figures are reported from the Association of Oil Industry).
CH4	B.2.B.2 Production / Processing	1 B 2 B 2 Natural Gas Production/Processing	1 B 2 A 2 Oil Production	oduction fields are reported here (total figures are reported from the Association of Oil Industry).
CH4	1.B.2.C.1.1 Oil			The emission declaration of the refinery includes all emissions from all sources.
CH4	1.B.2.C.1.2 Gas			The emission declaration of the refinery includes all emissions from all sources.
CH4	1.B.2.C.1.3 Combined			The emission declaration of the refinery includes all emissions from all sources.
CH4	1.B.2.C.2.1 Oil			The emission declaration of the refinery includes all emissions from all sources.
CH4	1.B.2.C.2.2 Gas			The emission declaration of the refinery includes all emissions from all sources.
CH4	1.B.2.C.2.3 Combined			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	ons from 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	ons from all activities of integrated iron and steel plants are reported under 1 A 2 a Iron and Steel.
CH4	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.
CH4	1.AA.3.B Road Transportation	1.A.3.b - gaseous fuels (CNG)	1.A.3.b - gasoline	Included in gasoline.
CH4	1.AA.3.B Road Transportation	1A3b LPG	1A3b Gasoline	Included in gasoline.
CH4	Military use	1.A.5.b - biomass (biofuels).	1.A.5.b - diesel and gasoline.	Included in gasoline.
CH4	1 Cropland remaining Cropland	5.B.1 Cropland remaining Cropland - Biomass burning.	Included in 4.F Agricultural field burning.	
CO2	3.1.A.2.2 Post-Mining Activities	1 B 1 A 2 Coal Surface Mines/ Post Mining Activities	A 2 Coal Surface Mines/ Mining Activities	Emissions from mining and post-mining activities are reported together.
CO2	1.B.2.A.1 Exploration	1 B 2 A 1 Oil Exploration	1 B 2 A 2 Oil Production	oduction 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	oduction fields are reported here (total figures are reported from the Association of Oil Industry).
CO2	1.B.2.C.1.1 Oil			The emission declaration of the refinery includes all emissions from all sources.
CO2	1.B.2.C.1.2 Gas			The emission declaration of the refinery includes all emissions from all sources.
CO2	1.B.2.C.1.3 Combined			The emission declaration of the refinery includes all emissions from all sources.
CO2	1.B.2.C.2.1 Oil			The emission declaration of the refinery includes all emissions from all sources.
CO2	1.B.2.C.2.2 Gas			The emission declaration of the refinery includes all emissions from all sources.
CO2	1.B.2.C.2.3 Combined			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	sector (subcategory 1 A 2 c), that's why CO2 emissions of soda ash production is reported as "IE".
CO2	2.A.4.1 Soda Ash Production	2 A 4 1 Soda Ash Production	1 A 2 c Chemicals	sector (subcategory 1 A 2 c), that's why CO2 emissions of soda ash production is reported as "IE".
CO2	2.A.5 Asphalt Roofing	2 A 5 Asphalt Roofing	3 Solvent Use	from 2A5 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	from 2A5 Asphalt Roofing and 2A6 Road Paving with Asphalt are included in the Solvent Sector.
CO2	est Land remaining Forest Land	5 A 1 Widfires	Forest Land remaining Forest land	arbon stock change due to wildfires at forest land is included in figures of table 5.A Sektor 5.A.1.
CO2	1 Cropland remaining Cropland	5 B Cropland / lime application / Dolomite	5 B Cropland / lime application / Limestone	Emissions from dolomite liming include emissions from limestone liming
CO2	1 Cropland remaining Cropland	5.B.1 Cropland remaining Cropland - Biomass burning.	n the harvest of 'perennial cropland' in 5.B.1	
CO2	Grassland remaining Grassland	5 C Grassland / lime application	5 B Cropland / lime application / Limestone	Emissions from cropland dolomite liming include emissions from grassland liming.
CO2	Grassland remaining Grassland	5 C Grassland / lime application	5 B Cropland / lime application / Limestone	Emissions from cropland dolomite liming include emissions from grassland liming.
N2O	1.B.2.A.1 Exploration	1 B 2 A 1 Oil Exploration	1 B 2 A 2 Oil Production	oduction fields are reported here (total figures are reported from the Association of Oil Industry).
N2O	1.B.2.C.2.1 Oil			The emission declaration of the refinery includes all emissions from all sources.
N2O	1.B.2.C.2.2 Gas			The emission declaration of the refinery includes all emissions from all sources.
N2O	1.B.2.C.2.3 Combined			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	Included in gasoline.
N2O	1.AA.3.B Road Transportation	1A3b LPG	1A3b Gasoline	Included in gasoline.
N2O	Military use	1.A.5.b - biomass (biofuels)	1.A.5.b - diesel and gasoline.	Included in gasoline.
N2O	1 Cropland remaining Cropland	5.B.1 Cropland remaining Cropland - Biomass burning.	Included in 4.F Agricultural field burning.	

(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 GASES
(Sheet 1 of 1)

Additional GHG emissions reported[1]						
GHG	Source category	Emissions (Gg)	Estimated GWP value (100-year horizon)	Emissions CO_2 equivalent (Gg)	Reference to the source of GWP value	Explanation
HFC-245fa	Hard Foam	0.00	950.00	1.96	l Panel on Climate Change	CHF2CH2CF3
HFC-365mfc	Hard Foam	0.00	890.00	1.85	l 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
CO_2
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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**	**57 963.29**	**53 065.22**	**53 465.94**	**53 537.93**	**56 355.11**	**60 112.29**	**59 299.54**	**59 256.24**	**58 045.51**
A. Fuel Combustion (Sectoral Approach)	54 069.60	57 852.20	52 945.09	53 353.81	53 410.30	56 227.96	60 041.15	59 178.92	59 114.30	57 874.86
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	12 685.38	13 074.35	11 948.10	12 247.73	13 237.16	13 489.03	13 704.07	15 241.16	13 991.72	13 217.08
3. Transport	13 771.40	15 234.53	15 208.62	15 341.65	15 391.00	15 675.07	17 232.78	16 251.57	18 351.92	17 825.01
4. Other Sectors	13 785.55	14 883.76	14 439.82	14 258.96	12 979.22	14 112.67	15 260.86	13 774.42	13 725.57	14 264.23
5. Other	35.00	37.09	33.67	39.41	41.56	32.55	38.89	37.08	42.39	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	**7 539.87**	**7 381.88**	**6 838.98**	**6 819.64**	**7 157.74**	**7 368.01**	**7 068.54**	**7 659.46**	**7 301.98**	**7 125.64**
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	540.72	561.44	527.57	566.67	523.92	563.62	571.72	565.15	560.44	565.56
C. Metal Production	3 724.96	3 688.72	3 158.74	3 165.48	3 431.94	3 941.84	3 721.65	4 119.24	3 919.62	3 752.71
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)	**-9 898.16**	**-15 620.11**	**-10 826.84**	**-11 273.59**	**-10 205.22**	**-11 503.58**	**-8 473.65**	**-17 213.63**	**-15 394.31**	**-18 309.99**
A. Forest Land	-10 930.15	-16 659.55	-11 896.23	-12 368.63	-11 303.94	-12 295.86	-9 274.47	-18 024.03	-16 207.42	-19 124.37
B. Cropland	33.56	33.57	56.05	73.83	79.91	94.84	110.94	128.06	138.23	141.51
C. Grassland	321.74	316.68	311.69	306.86	306.83	139.73	141.44	143.19	144.99	144.81
D. Wetlands	42.08	42.03	41.98	41.93	41.93	35.81	35.81	35.81	35.81	35.80
E. Settlements	183.66	187.43	191.18	195.00	193.22	143.58	138.90	134.22	129.54	127.63
F. Other Land	450.94	459.73	468.50	477.41	476.83	378.32	373.72	369.13	364.54	364.64
G. Other	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE
6. Waste	**26.89**	**23.40**	**10.86**	**10.60**	**10.65**	**10.97**	**11.30**	**11.62**	**11.94**	**12.26**
A. Solid Waste Disposal on Land	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO
B. Waste-water Handling										
C. Waste Incineration	26.89	23.40	10.86	10.60	10.65	10.97	11.30	11.62	11.94	12.26
D. Other	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
7. Other ***(as specified in Summary 1.A)***	**NA**	**NA**	**NA**	**NA**	**NA**	**NA**	**NA**	**NA**	**NA**	**NA**
Total CO_2 emissions including net CO_2 from LULUCF	**52 119.58**	**49 981.95**	**49 273.37**	**49 208.58**	**50 671.87**	**52 420.46**	**58 891.64**	**49 948.86**	**51 349.68**	**47 033.19**
Total CO_2 emissions excluding net CO_2 from LULUCF	**62 017.75**	**65 602.05**	**60 100.21**	**60 482.17**	**60 877.09**	**63 924.04**	**67 365.30**	**67 162.49**	**66 743.98**	**65 343.17**
Memo Items:										
International Bunkers	**924.70**	**1 027.57**	**1 110.20**	**1 173.64**	**1 228.45**	**1 375.60**	**1 515.79**	**1 573.72**	**1 630.79**	**1 593.64**
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	38.72	33.70	32.77	33.66	42.80	48.17	49.37	48.15	52.58	51.98
Multilateral Operations	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
CO_2 Emissions from Biomass	9 927.77	10 814.86	10 576.17	11 145.84	10 753.83	11 454.01	12 189.91	11 755.98	11 548.23	13 213.80

Note: All footnotes for this table are given at the end of the table on sheet 5

TABLE 10 EMISSION TRENDS
CO_2
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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	**58 032.82**	**62 130.16**	**63 271.67**	**69 378.28**	**69 825.43**	**70 484.56**	**67 301.85**	**64 218.32**	**63 661.29**	**59 375.06**
A. Fuel Combustion (Sectoral Approach)	57 868.17	61 947.30	63 104.51	69 145.12	69 615.28	70 279.40	67 069.69	63 981.16	63 449.13	59 109.90
1. Energy Industries	12 221.05	13 825.71	13 473.50	16 287.24	16 324.94	16 222.82	15 075.33	13 836.44	13 631.65	12 598.18
2. Manufacturing Industries and Construction	13 890.90	13 747.09	14 088.79	14 730.61	15 128.37	16 160.98	15 877.85	15 664.63	15 932.21	14 229.15
3. Transport	18 620.84	20 109.47	22 008.29	23 858.14	24 379.03	24 675.47	23 398.05	23 572.40	22 317.08	21 524.34
4. Other Sectors	13 094.59	14 223.67	13 492.02	14 226.67	13 739.92	13 176.57	12 674.42	10 863.07	11 523.02	10 712.52
5. Other	40.80	41.36	41.91	42.47	43.03	43.57	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	**7 755.15**	**7 682.79**	**8 245.55**	**8 189.19**	**8 202.68**	**8 683.13**	**9 070.35**	**9 525.56**	**9 926.42**	**8 035.18**
A. Mineral Products	2 965.71	2 983.49	3 089.32	3 076.21	3 172.18	3 132.87	3 290.69	3 517.56	3 531.12	2 915.82
B. Chemical Industry	568.74	521.83	529.68	570.53	565.18	534.90	566.26	504.57	567.51	522.61
C. Metal Production	4 220.70	4 177.48	4 626.55	4 542.46	4 465.32	5 015.35	5 213.40	5 503.43	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)	**-15 249.97**	**-17 179.66**	**-11 114.67**	**-1 102.04**	**-6 160.92**	**-7 643.66**	**-1 827.15**	**-771.84**	**116.36**	**-3 928.27**
A. Forest Land	-16 033.88	-17 984.86	-12 232.56	-2 244.30	-7 328.50	-8 782.88	-2 970.76	-1 945.09	-1 052.77	-4 604.63
B. Cropland	149.91	157.93	177.40	188.39	209.14	204.97	211.23	229.58	230.10	239.73
C. Grassland	144.61	144.54	352.57	348.52	350.14	352.53	351.68	354.17	355.05	49.23
D. Wetlands	35.80	35.80	47.28	47.27	47.30	37.17	39.32	51.30	48.93	68.78
E. Settlements	87.41	99.22	204.39	220.21	230.65	221.72	226.02	230.32	234.61	101.29
F. Other Land	366.17	367.71	336.26	337.86	330.35	322.83	315.36	307.90	300.43	217.33
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 CO_2 emissions including net CO_2 from LULUCF	**50 742.89**	**52 849.65**	**60 632.96**	**76 698.95**	**72 068.30**	**71 749.28**	**74 805.94**	**73 208.24**	**73 920.85**	**63 639.49**
Total CO_2 emissions excluding net CO_2 from LULUCF	**65 992.86**	**70 029.31**	**71 747.63**	**77 800.99**	**78 229.22**	**79 392.94**	**76 633.08**	**73 980.07**	**73 804.48**	**67 567.76**
Memo Items:										
International Bunkers	**1 752.24**	**1 711.16**	**1 608.21**	**1 506.68**	**1 789.05**	**2 021.80**	**2 100.87**	**2 231.18**	**2 232.59**	**1 935.67**
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	56.66	59.88	67.36	53.71	64.12	61.97	51.99	55.38	50.62	42.27
Multilateral Operations	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
CO_2 Emissions from Biomass	12 477.53	13 552.81	12 508.81	12 985.42	13 152.82	16 553.92	17 540.02	19 358.15	20 828.33	21 578.09

Note: All footnotes for this table are given at the end of the table on sheet 5

TABLE 10 EMISSION TRENDS
CO_2
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GREENHOUSE GAS SOURCE AND SINK CATEGORIES	2010	2011	2012	Change from base to latest reported year
	(Gg)	(Gg)	(Gg)	%
1. Energy	**63 189.29**	**60 849.99**	**58 534.31**	**8.05**
A. Fuel Combustion (Sectoral Approach)	62 952.12	60 616.82	58 297.14	7.82
1. Energy Industries	13 946.65	13 723.18	12 324.99	-10.64
2. Manufacturing Industries and Construction	15 773.52	15 553.81	15 409.01	21.47
3. Transport	22 190.92	21 510.60	21 418.45	55.53
4. Other Sectors	10 994.76	9 782.39	9 097.29	-34.01
5. Other	46.27	46.83	47.40	35.40
B. Fugitive Emissions from Fuels	237.17	233.17	237.17	132.32
1. Solid Fuels	IE,NA,NO	IE,NA,NO	IE,NA,NO	0.00
2. Oil and Natural Gas	237.17	233.17	237.17	132.32
2. Industrial Processes	**8 997.90**	**9 328.47**	**9 008.12**	**19.47**
A. Mineral Products	2 935.73	3 029.59	2 946.15	-10.02
B. Chemical Industry	581.37	605.41	587.78	8.70
C. Metal Production	5 480.81	5 693.47	5 474.20	46.96
D. Other Production	NA	NA	NA	0.00
E. Production of Halocarbons and SF_6				
F. Consumption of Halocarbons and SF_6				
G. Other	NA	NA	NA	0.00
3. Solvent and Other Product Use	176.89	173.21	189.00	-32.33
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)	**-3 916.88**	**-3 895.38**	**-3 863.83**	**-60.96**
A. Forest Land	-4 565.50	-4 526.37	-4 487.24	-58.95
B. Cropland	223.00	223.33	224.99	570.37
C. Grassland	45.69	43.46	41.24	-87.18
D. Wetlands	73.40	69.77	74.84	77.85
E. Settlements	96.84	92.39	87.95	-52.12
F. Other Land	209.68	202.03	194.38	-56.89
G. Other	NE	NE	NE	0.00
6. Waste	**2.03**	**2.03**	**2.03**	**-92.45**
A. Solid Waste Disposal on Land	NA,NO	NA,NO	NA,NO	0.00
B. Waste-water Handling				
C. Waste Incineration	2.03	2.03	2.03	-92.45
D. Other	NA	NA	NA	0.00
7. Other *(as specified in Summary 1.A)*	**NA**	**NA**	**NA**	**0.00**
Total CO_2 emissions including net CO_2 from LULUCF	**68 449.24**	**66 458.32**	**63 869.64**	**22.54**
Total CO_2 emissions excluding net CO_2 from LULUCF	**72 366.12**	**70 353.70**	**67 733.47**	**9.22**
Memo Items:				
International Bunkers	**2 100.05**	**2 212.86**	**2 118.29**	**129.08**
Aviation	2 049.55	2 168.44	2 072.66	133.94
Marine	50.50	44.42	45.63	17.83
Multilateral Operations	NO	NO	NO	0.00
CO_2 Emissions from Biomass	24 126.35	23 522.49	25 166.69	153.50

Note: All footnotes for this table are given at the end of the table on sheet 5.

TABLE 10 EMISSION TRENDS
CH_4
(Part 1 of 3)

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	33.23	35.46	34.46	34.29	31.77	32.76	33.30	28.50	28.19	28.36
A. Fuel Combustion (Sectoral Approach)	22.06	23.96	22.12	21.79	20.04	20.50	21.23	16.64	16.10	16.10
1. Energy Industries	0.21	0.23	0.20	0.21	0.20	0.21	0.22	0.23	0.23	0.21
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	18.44	19.95	18.17	17.84	16.15	16.81	17.81	13.50	13.03	13.36
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	11.17	11.50	12.34	12.50	11.73	12.26	12.07	11.86	12.09	12.26
1. Solid Fuels	0.55	0.48	0.40	0.39	0.32	0.31	0.27	0.27	0.28	0.27
2. Oil and Natural Gas	10.61	11.03	11.93	12.11	11.40	11.95	11.80	11.59	11.82	11.99
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	**199.63**	**196.68**	**188.75**	**188.92**	**188.82**	**192.07**	**188.84**	**185.59**	**184.22**	**182.09**
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	20.52	20.18	19.61	19.70	19.46	19.50	19.03	18.77	18.65	17.93
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	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. 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 1.A)*	**NA**	**NA**	**NA**	**NA**	**NA**	**NA**	**NA**	**NA**	**NA**	**NA**
Total CH_4 emissions including CH_4 from LULUCF	**396.80**	**395.47**	**382.02**	**379.65**	**368.48**	**364.38**	**353.79**	**339.01**	**332.32**	**324.93**
Total CH_4 emissions excluding CH_4 from LULUCF	**396.77**	**395.46**	**382.01**	**379.63**	**368.47**	**364.38**	**353.78**	**339.00**	**332.31**	**324.93**
Memo Items:										
International Bunkers	0.02	0.02	0.02	0.02	0.02	0.02	0.03	0.03	0.03	0.03
Aviation	0.01	0.02	0.02	0.02	0.02	0.02	0.02	0.03	0.03	0.03
Marine	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Multilateral Operations	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
CO_2 Emissions from Biomass										

Note: All footnotes for this table are given at the end of the table on sheet 5.

TABLE 10 EMISSION TRENDS
CH_4
(Part 2 of 3)

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	27.60	27.74	26.42	26.31	25.04	24.42	23.58	23.03	22.49	22.04
A. Fuel Combustion (Sectoral Approach)	15.17	15.28	14.10	13.83	13.19	13.35	12.19	11.57	11.70	11.04
1. Energy Industries	0.20	0.23	0.24	0.28	0.31	0.30	0.34	0.35	0.37	0.40
2. Manufacturing Industries and Construction	0.45	0.46	0.47	0.53	0.58	0.61	0.61	0.61	0.65	0.64
3. Transport	1.92	1.80	1.76	1.67	1.50	1.33	1.16	1.02	0.86	0.77
4. Other Sectors	12.60	12.78	11.63	11.35	10.80	11.11	10.08	9.58	9.82	9.22
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	12.43	12.46	12.32	12.48	11.86	11.06	11.39	11.46	10.79	11.00
1. Solid Fuels	0.30	0.29	0.33	0.28	0.08	0.04	0.04	0.04	0.04	0.04
2. Oil and Natural Gas	12.14	12.17	11.99	12.20	11.77	11.03	11.35	11.43	10.75	10.96
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	**180.66**	**178.33**	**174.49**	**172.72**	**172.36**	**170.30**	**169.65**	**170.34**	**169.66**	**171.82**
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	17.46	17.37	16.87	16.56	16.23	16.15	15.97	16.03	15.69	15.87
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	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. 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**	**80.46**	**73.98**
A. Solid Waste Disposal on Land	105.05	101.08	101.64	103.62	96.84	91.00	86.63	81.16	76.65	70.24
B. Waste-water Handling	2.68	2.43	2.18	1.95	1.79	1.64	1.48	1.39	1.29	1.20
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 1.A)*	**NA**	**NA**	**NA**	**NA**	**NA**	**NA**	**NA**	**NA**	**NA**	**NA**
Total CH_4 emissions including CH_4 from LULUCF	**317.94**	**311.67**	**307.05**	**307.06**	**298.91**	**290.45**	**284.72**	**279.36**	**273.50**	**268.69**
Total CH_4 emissions excluding CH_4 from LULUCF	**317.94**	**311.67**	**307.02**	**307.03**	**298.91**	**290.45**	**284.71**	**279.36**	**273.49**	**268.68**
Memo Items:										
International Bunkers	0.03	0.03	0.04	0.04	0.05	0.04	0.04	0.05	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
CO_2 Emissions from Biomass										

Note: All footnotes for this table are given at the end of the table on sheet 5.

TABLE 10 EMISSION TRENDS
CH_4
(Part 3 of 3)

Inventory 2012
Submission 2014 v1.4
AUSTRIA

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	2010	2011	2012	Change from base to latest reported year
	(Gg)	(Gg)	(Gg)	%
1. Energy	23.37	21.91	22.99	-30.82
A. Fuel Combustion (Sectoral Approach)	12.01	10.67	11.36	-48.51
1. Energy Industries	0.44	0.48	0.50	136.33
2. Manufacturing Industries and Construction	0.65	0.67	0.64	89.85
3. Transport	0.70	0.63	0.61	-80.07
4. Other Sectors	10.22	8.89	9.60	-47.92
5. Other	0.00	0.00	0.00	30.06
B. Fugitive Emissions from Fuels	11.36	11.25	11.63	4.11
1. Solid Fuels	0.04	0.04	0.04	-92.31
2. Oil and Natural Gas	11.32	11.21	11.58	9.15
2. Industrial Processes	**0.87**	**0.88**	**0.87**	**23.56**
A. Mineral Products	NA	NA	NA	0.00
B. Chemical Industry	0.87	0.87	0.87	23.38
C. Metal Production	0.00	0.00	0.00	80.45
D. Other Production				
E. Production of Halocarbons and SF_6				
F. Consumption of Halocarbons and SF_6				
G. Other	NA	NA	NA	0.00
3. Solvent and Other Product Use				
4. Agriculture	**171.47**	**169.17**	**167.92**	**-15.89**
A. Enteric Fermentation	155.06	153.08	152.03	-14.94
B. Manure Management	15.91	15.62	15.44	-24.77
C. Rice Cultivation	NO	NO	NO	0.00
D. Agricultural Soils	0.46	0.44	0.42	28.25
E. Prescribed Burning of Savannas	NO	NO	NO	0.00
F. Field Burning of Agricultural Residues	0.04	0.03	0.02	-56.59
G. Other	NA	NA	NA	0.00
5. Land Use, Land-Use Change and Forestry	**0.01**	**0.01**	**0.01**	**-72.50**
A. Forest Land	0.01	0.01	0.01	-72.50
B. Cropland	IE,NA,NO	IE,NA,NO	IE,NA,NO	0.00
C. Grassland	NO	NO	NO	0.00
D. Wetlands	NO	NO	NO	0.00
E. Settlements	NA,NO	NA,NO	NA,NO	0.00
F. Other Land	NA,NO	NA,NO	NA,NO	0.00
G. Other	NA	NA	NA	0.00
6. Waste	**69.16**	**64.88**	**60.90**	**-62.68**
A. Solid Waste Disposal on Land	65.52	61.25	57.19	-63.76
B. Waste-water Handling	1.10	1.11	1.11	-77.11
C. Waste Incineration	0.00	0.00	0.00	-98.41
D. Other	2.53	2.52	2.59	398.27
7. Other ***(as specified in Summary 1.A)***	**NA**	**NA**	**NA**	**0.00**
Total CH_4 emissions including CH_4 from LULUCF	**264.87**	**256.84**	**252.68**	**-36.32**
Total CH_4 emissions excluding CH_4 from LULUCF	**264.86**	**256.84**	**252.68**	**-36.32**
Memo Items:				
International Bunkers	0.04	0.05	0.05	183.29
Aviation	0.04	0.05	0.04	208.04
Marine	0.00	0.00	0.00	-3.64
Multilateral Operations	NO	NO	NO	0.00
CO_2 Emissions from Biomass				

Note: All footnotes for this table are given at the end of the table on sheet 5.

TABLE 10 EMISSION TRENDS
N_2O
(Part 1 of 3)

Inventory 2012
Submission 2014 v1.4
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**	**2.35**
A. Fuel Combustion (Sectoral Approach)	1.79	2.00	1.97	2.04	2.06	2.13	2.24	2.20	2.32	2.35
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	0.37	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	0.76	0.81	0.79	0.79	0.75	0.78	0.83	0.81	0.80	0.82
5. Other	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
B. Fugitive Emissions from Fuels	IE,NA	IE,NA	IE,NA	IE,NA	IE,NA	IE,NA	IE,NA	IE,NA	IE,NA	IE,NA
1. Solid Fuels	NA	NA	NA	NA	NA	NA	NA	NA	NA	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	3.01	3.01	2.93	2.96	2.98	3.08	3.04	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	**0.07**	**0.07**	**0.07**	**0.06**	**0.06**	**0.06**	**0.06**	**0.06**	**0.06**	**0.06**
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	0.07	0.07	0.06	0.06	0.06	0.06	0.06	0.06	0.06	0.06
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 1.A)***	**NA**	**NA**	**NA**	**NA**	**NA**	**NA**	**NA**	**NA**	**NA**	**NA**
Total N_2O emissions including N_2O from LULUCF	**20.06**	**21.13**	**19.85**	**19.29**	**20.84**	**21.37**	**20.28**	**20.38**	**20.77**	**20.69**
Total N_2O emissions excluding N_2O from LULUCF	**19.99**	**21.06**	**19.79**	**19.23**	**20.78**	**21.31**	**20.22**	**20.32**	**20.71**	**20.63**
Memo Items:										
International Bunkers	**0.04**	**0.05**	**0.05**	**0.05**	**0.06**	**0.06**	**0.07**	**0.07**	**0.07**	**0.07**
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	0.02	0.02	0.02	0.02	0.02	0.02
Multilateral Operations	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
CO_2 Emissions from Biomass										

Note: All footnotes for this table are given at the end of the table on sheet 5.

TABLE 10 EMISSION TRENDS
N_2O
(Part 2 of 3)

Inventory 2012
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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**	**2.48**	**2.56**	**2.55**	**2.66**	**2.56**	**2.50**	**2.44**	**2.29**
A. Fuel Combustion (Sectoral Approach)	2.36	2.45	2.48	2.56	2.55	2.66	2.56	2.50	2.44	2.29
1. Energy Industries	0.16	0.19	0.19	0.22	0.24	0.27	0.29	0.31	0.33	0.32
2. Manufacturing Industries and Construction	0.43	0.43	0.40	0.42	0.43	0.50	0.51	0.52	0.52	0.49
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	0.73	0.68
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	NA	NA	NA	NA	NA	NA	NA	NA	NA	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**	**12.68**	**12.37**	**12.39**	**12.54**	**12.71**	**13.19**	**12.99**
A. Enteric Fermentation										
B. Manure Management	2.99	2.98	2.94	2.95	2.95	2.93	2.93	2.96	2.96	3.00
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	**0.06**	**0.06**	**0.06**	**0.06**	**0.06**	**0.06**	**0.06**	**0.07**	**0.08**	**0.08**
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	0.06	0.06	0.06	0.06	0.06	0.06	0.06	0.07	0.08	0.08
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**	**1.18**	**1.19**
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	0.84
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 N_2O emissions including N_2O from LULUCF	**20.35**	**19.99**	**19.99**	**19.76**	**17.51**	**17.64**	**17.75**	**17.84**	**18.44**	**17.55**
Total N_2O emissions excluding N_2O from LULUCF	**20.29**	**19.93**	**19.93**	**19.70**	**17.45**	**17.58**	**17.69**	**17.77**	**18.37**	**17.48**
Memo Items:										
International Bunkers	**0.08**	**0.08**	**0.08**	**0.07**	**0.08**	**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	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02
Multilateral Operations	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
CO_2 Emissions from Biomass										

Note: All footnotes for this table are given at the end of the table on sheet 5.

TABLE 10 EMISSION TRENDS
N_2O
(Part 3 of 3)

Inventory 2012
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GREENHOUSE GAS SOURCE AND SINK CATEGORIES	2010	2011	2012	Change from base to latest reported year
	(Gg)	(Gg)	(Gg)	%
1. Energy	**2.34**	**2.23**	**2.18**	**21.37**
A. Fuel Combustion (Sectoral Approach)	2.34	2.23	2.18	21.37
1. Energy Industries	0.39	0.38	0.36	141.72
2. Manufacturing Industries and Construction	0.50	0.50	0.51	94.80
3. Transport	0.75	0.69	0.66	5.84
4. Other Sectors	0.70	0.65	0.64	-14.89
5. Other	0.00	0.00	0.00	12.76
B. Fugitive Emissions from Fuels	IE,NA	IE,NA	IE,NA	0.00
1. Solid Fuels	NA	NA	NA	0.00
2. Oil and Natural Gas	IE,NA	IE,NA	IE,NA	0.00
2. Industrial Processes	**0.20**	**0.15**	**0.17**	**-94.22**
A. Mineral Products	NA	NA	NA	0.00
B. Chemical Industry	0.20	0.15	0.17	-94.22
C. Metal Production	NA	NA	NA	0.00
D. Other Production				
E. Production of Halocarbons and SF_6				
F. Consumption of Halocarbons and SF_6				
G. Other	NA	NA	NA	0.00
3. Solvent and Other Product Use	0.48	0.47	0.47	-37.39
4. Agriculture	**12.48**	**12.99**	**12.82**	**-8.97**
A. Enteric Fermentation				
B. Manure Management	3.01	2.98	2.96	-1.78
C. Rice Cultivation				
D. Agricultural Soils	9.46	10.01	9.86	-10.93
E. Prescribed Burning of Savannas	NO	NO	NO	0.00
F. Field Burning of Agricultural Residues	0.00	0.00	0.00	-64.51
G. Other	NA	NA	NA	0.00
5. Land Use, Land-Use Change and Forestry	**0.08**	**0.08**	**0.08**	**23.56**
A. Forest Land	0.00	0.00	0.00	-72.50
B. Cropland	0.08	0.08	0.08	24.20
C. Grassland	NO	NO	NO	0.00
D. Wetlands	NO	NO	NO	0.00
E. Settlements	NA,NO	NA,NO	NA,NO	0.00
F. Other Land	NA,NO	NA,NO	NA,NO	0.00
G. Other	NA	NA	NA	0.00
6. Waste	**1.20**	**1.20**	**1.21**	**182.21**
A. Solid Waste Disposal on Land				
B. Waste-water Handling	0.85	0.85	0.86	143.05
C. Waste Incineration	0.00	0.00	0.00	-95.78
D. Other	0.35	0.35	0.35	365.08
7. Other *(as specified in Summary 1.A)*	**NA**	**NA**	**NA**	**0.00**
Total N_2O emissions including N_2O from LULUCF	**16.78**	**17.12**	**16.93**	**-15.62**
Total N_2O emissions excluding N_2O from LULUCF	**16.70**	**17.04**	**16.84**	**-15.75**
Memo Items:				
International Bunkers	**0.09**	**0.09**	**0.09**	**92.57**
Aviation	0.07	0.07	0.07	125.72
Marine	0.02	0.02	0.02	16.71
Multilateral Operations	NO	NO	NO	0.00
CO_2 Emissions from Biomass				

Note: All footnotes for this table are given at the end of the table on sheet 5.

TABLE 10 EMISSION TRENDS
HFCs, PFCs and SF_6
(Part 1 of 3)

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	Base year (1990) (Gg)	1991 (Gg)	1992 (Gg)	1993 (Gg)	1994 (Gg)	1995 (Gg)	1996 (Gg)	1997 (Gg)	1998 (Gg)	1999 (Gg)
Emissions of HFCs[(3)] - (Gg CO_2 equivalent)	**22.55**	**24.73**	**26.51**	**237.01**	**260.33**	**339.64**	**392.57**	**460.99**	**555.40**	**632.48**
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	0.00	0.00	0.00	0.00	0.01	0.01	0.02
HFC-134	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO
HFC-134a	0.02	0.02	0.02	0.17	0.18	0.23	0.26	0.30	0.35	0.38
HFC-152a	NA,NO	NA,NO	NA,NO	0.07	0.08	0.08	0.09	0.10	0.10	0.10
HFC-143	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO
HFC-143a	NA,NO	NA,NO	NA,NO	0.00	0.00	0.00	0.00	0.01	0.01	0.02
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)	1.93	3.07	4.44	5.81	7.18	8.53	9.74	9.43	2.96	3.23
Emissions of PFCs[(3)] - (Gg CO_2 equivalent)	**1 022.65**	**1 030.48**	**439.81**	**52.57**	**58.30**	**68.39**	**65.92**	**96.48**	**44.40**	**64.19**
CF_4	0.14	0.14	0.05	IE,NA,NO	IE,NA,NO	IE,NA,NO	IE,NA,NO	IE,NA,NO	IE,NA,NO	IE,NA,NO
C_2F_6	0.01	0.01	0.00	IE,NA,NO	IE,NA,NO	IE,NA,NO	IE,NA,NO	IE,NA,NO	IE,NA,NO	IE,NA,NO
C_3F_8	IE,NA,NO	IE,NA,NO	IE,NA,NO	IE,NA,NO	IE,NA,NO	IE,NA,NO	IE,NA,NO	IE,NA,NO	IE,NA,NO	IE,NA,NO
C_4F_{10}	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO
c-C_4F_8	IE,NA,NO	IE,NA,NO	IE,NA,NO	IE,NA,NO	IE,NA,NO	IE,NA,NO	IE,NA,NO	IE,NA,NO	IE,NA,NO	IE,NA,NO
C_5F_{12}	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO
C_6F_{14}	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO
Unspecified mix of listed PFCs[(4)] - (Gg CO_2 equivalent)	29.05	36.89	44.73	52.57	58.30	68.39	65.92	96.48	44.40	64.19
Emissions of SF6[(3)] - (Gg CO_2 equivalent)	**493.37**	**643.82**	**687.97**	**779.93**	**970.88**	**1 153.20**	**1 233.69**	**1 138.81**	**911.84**	**708.98**
SF_6	0.02	0.03	0.03	0.03	0.04	0.05	0.05	0.05	0.04	0.03

Note: All footnotes for this table are given at the end of the table on sheet 5.

TABLE 10 EMISSION TRENDS
HFCs, PFCs and SF_6
(Part 2 of 3)

Inventory 2012
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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 CO_2 equivalent)	**646.82**	**773.86**	**874.78**	**952.51**	**1 020.17**	**997.37**	**1 004.15**	**1 042.65**	**1 082.02**	**1 134.26**
HFC-23	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
HFC-32	0.01	0.01	0.01	0.02	0.02	0.02	0.02	0.02	0.03	0.03
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	0.03	0.04	0.04	0.06	0.06	0.07	0.08	0.08	0.09	0.10
HFC-134	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO
HFC-134a	0.30	0.34	0.35	0.39	0.43	0.41	0.38	0.39	0.40	0.39
HFC-152a	0.60	0.61	0.95	0.64	0.43	0.20	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	0.02	0.03	0.04	0.05	0.05	0.06	0.06	0.07	0.07	0.08
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 CO_2 equivalent)	**67.46**	**90.03**	**83.46**	**102.20**	**125.49**	**125.04**	**136.94**	**183.72**	**167.13**	**28.64**
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_2F_6	IE,NA,NO	IE,NA,NO	IE,NA,NO	IE,NA,NO	IE,NA,NO	IE,NA,NO	IE,NA,NO	IE,NA,NO	IE,NA,NO	IE,NA,NO
C_3F_8	IE,NA,NO	IE,NA,NO	IE,NA,NO	IE,NA,NO	IE,NA,NO	IE,NA,NO	0.00	0.00	0.00	IE,NA,NO
C_4F_{10}	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO
$c-C_4F_8$	IE,NA,NO	IE,NA,NO	IE,NA,NO	IE,NA,NO	IE,NA,NO	IE,NA,NO	IE,NA,NO	IE,NA,NO	IE,NA,NO	IE,NA,NO
C_5F_{12}	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO
C_6F_{14}	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO
Unspecified mix of listed PFCs(4) - (Gg CO_2 equivalent)	67.46	90.03	83.46	102.20	125.49	125.04	135.50	182.55	166.39	28.64
Emissions of SF6(3) - (Gg CO_2 equivalent)	**602.25**	**659.69**	**642.89**	**575.58**	**507.07**	**517.12**	**474.88**	**384.22**	**390.87**	**357.54**
SF_6	0.03	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 SF_6
(Part 3 of 3)

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	2010	2011	2012	Change from base to latest reported year
	(Gg)	(Gg)	(Gg)	%
Emissions of HFCs[(3)] - (Gg CO_2 equivalent)	**1 285.65**	**1 349.00**	**1 431.45**	**6 247.88**
HFC-23	0.00	0.00	0.00	100.00
HFC-32	0.04	0.05	0.06	100.00
HFC-41	NA,NO	NA,NO	NA,NO	0.00
HFC-43-10mee	NA,NO	NA,NO	NA,NO	-100.00
HFC-125	0.12	0.13	0.14	100.00
HFC-134	NA,NO	NA,NO	NA,NO	0.00
HFC-134a	0.43	0.45	0.47	2 936.03
HFC-152a	0.13	NA,NO	NA,NO	0.00
HFC-143	NA,NO	NA,NO	NA,NO	0.00
HFC-143a	0.09	0.09	0.10	100.00
HFC-227ea	0.00	0.00	0.00	2 423.33
HFC-236fa	NA,NO	NA,NO	NA,NO	0.00
HFC-245ca	NA,NO	NA,NO	NA,NO	0.00
Unspecified mix of listed HFCs[(4)] - (Gg CO_2 equivalent)	1.62	1.63	1.65	-14.33
Emissions of PFCs[(3)] - (Gg CO_2 equivalent)	**63.93**	**60.07**	**40.46**	**-96.04**
CF_4	IE,NA,NO	IE,NA,NO	IE,NA,NO	-100.00
C_2F_6	IE,NA,NO	IE,NA,NO	IE,NA,NO	-100.00
C_3F_8	IE,NA,NO	IE,NA,NO	IE,NA,NO	0.00
C_4F_{10}	NA,NO	NA,NO	NA,NO	0.00
$c\text{-}C_4F_8$	IE,NA,NO	IE,NA,NO	IE,NA,NO	0.00
C_5F_{12}	NA,NO	NA,NO	NA,NO	0.00
C_6F_{14}	NA,NO	NA,NO	NA,NO	0.00
Unspecified mix of listed PFCs[(4)] - (Gg CO_2 equivalent)	63.93	60.07	40.46	39.26
Emissions of SF6[(3)] - (Gg CO_2 equivalent)	**351.50**	**321.53**	**326.18**	**-33.89**
SF_6	0.01	0.01	0.01	-33.89

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 2012
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GREENHOUSE GAS EMISSIONS	Base year (1990)	1991	1992	1993	1994	1995	1996	1997	1998	1999
	CO_2 equivalent (Gg)	CO_2 equivalent (Gg)	CO_2 equivalent (Gg)	CO_2 equivalent (Gg)	CO_2 equivalent (Gg)	CO_2 equivalent (Gg)	CO_2 equivalent (Gg)	CO_2 equivalent (Gg)	CO_2 equivalent (Gg)	CO_2 equivalent (Gg)
CO_2 emissions including net CO_2 from LULUCF	52 119.58	49 981.95	49 273.37	49 208.58	50 671.87	52 420.46	58 891.64	49 948.86	51 349.68	47 033.19
CO_2 emissions excluding net CO_2 from LULUCF	62 017.75	65 602.05	60 100.21	60 482.17	60 877.09	63 924.04	67 365.30	67 162.49	66 743.98	65 343.17
CH_4 emissions including CH_4 from LULUCF	8 332.70	8 304.78	8 022.50	7 972.55	7 738.03	7 652.02	7 429.52	7 119.15	6 978.73	6 823.60
CH_4 emissions excluding CH_4 from LULUCF	8 332.12	8 304.63	8 022.12	7 972.23	7 737.86	7 651.93	7 429.43	7 119.09	6 978.46	6 823.58
N_2O emissions including N_2O from LULUCF	6 218.28	6 549.57	6 154.32	5 980.31	6 460.88	6 626.03	6 287.31	6 319.20	6 438.08	6 412.83
N_2O emissions excluding N_2O from LULUCF	6 197.92	6 529.38	6 134.15	5 960.22	6 441.00	6 606.37	6 267.87	6 299.94	6 418.93	6 393.87
HFCs	22.55	24.73	26.51	237.01	260.33	339.64	392.57	460.99	555.40	632.48
PFCs	1 022.65	1 030.48	439.81	52.57	58.30	68.39	65.92	96.48	44.40	64.19
SF_6	493.37	643.82	687.97	779.93	970.88	1 153.20	1 233.69	1 138.81	911.84	708.98
Total (including LULUCF)	**68 209.13**	**66 535.33**	**64 604.49**	**64 230.94**	**66 160.29**	**68 259.73**	**74 300.64**	**65 083.50**	**66 278.12**	**61 675.27**
Total (excluding LULUCF)	**78 086.35**	**82 135.09**	**75 410.77**	**75 484.11**	**76 345.45**	**79 743.56**	**82 754.78**	**82 277.81**	**81 653.02**	**79 966.28**

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	55 425.27	59 328.01	54 400.84	54 818.29	54 844.64	57 703.82	61 505.05	60 579.98	60 567.66	59 368.36
2. Industrial Processes	10 005.29	10 022.82	8 844.74	8 782.55	9 287.45	9 800.84	9 649.57	10 233.17	9 725.80	9 469.35
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	8 556.71	8 746.36	8 283.60	8 049.85	8 555.85	8 719.98	8 245.83	8 223.61	8 227.18	8 104.83
5. Land Use, Land-Use Change and Forestry[5]	-9 877.23	-15 599.76	-10 806.28	-11 253.17	-10 185.16	-11 483.83	-8 454.13	-17 194.31	-15 374.90	-18 291.00
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]	**68 209.13**	**66 535.33**	**64 604.49**	**64 230.94**	**66 160.29**	**68 259.73**	**74 300.64**	**65 083.50**	**66 278.12**	**61 675.27**

[1] The column "Base year" should be filled in only by those Parties with economies in transition that use a base year different from 1990 in accordance with the relevant decisions of the COP. For these Parties, this different base year is used to calculate the percentage change in the final column of this table.

[2] Fill in net emissions/removals as reported in table Summary 1.A. For the purposes of reporting, the signs for removals are always negative (-) and for emissions positive (+).

[3] Enter actual emissions estimates. If only potential emissions estimates are available, these should be reported in this table and an indication for this be provided in the documentation box. Only in these rows are the emissions expressed as CO_2 equivalent emissions.

[4] In accordance with the UNFCCC reporting guidelines, HFC and PFC emissions should be reported for each relevant chemical. However, if it is not possible to report values for each chemical (i.e. mixtures, confidential data, lack of disaggregation), this row could be used for reporting aggregate figures for HFCs and PFCs, respectively. Note that the unit used for this row is Gg of CO_2 equivalent and that appropriate notation keys should be entered in the cells for the individual chemicals.
[5] Includes net CO_2, CH_4 and N_2O from LULUCF.

TABLE 10 EMISSION TRENDS
SUMMARY
(Part 2 of 3)

Inventory 2012
Submission 2014 v1.4
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	50 742.89	52 849.65	60 632.96	76 698.95	72 068.30	71 749.28	74 805.94	73 208.24	73 920.85	63 639.49
CO_2 emissions excluding net CO_2 from LULUCF	65 992.86	70 029.31	71 747.63	77 800.99	78 229.22	79 392.94	76 633.08	73 980.07	73 804.48	67 567.76
CH_4 emissions including CH_4 from LULUCF	6 676.80	6 545.08	6 447.95	6 448.19	6 277.06	6 099.52	5 979.06	5 866.66	5 743.52	5 642.51
CH_4 emissions excluding CH_4 from LULUCF	6 676.68	6 545.01	6 447.39	6 447.66	6 277.01	6 099.43	5 978.84	5 866.55	5 743.37	5 642.35
N_2O emissions including N_2O from LULUCF	6 309.79	6 195.53	6 198.19	6 124.34	5 428.61	5 467.34	5 502.34	5 531.53	5 717.50	5 441.14
N_2O emissions excluding N_2O from LULUCF	6 290.90	6 176.77	6 179.42	6 105.65	5 410.39	5 449.04	5 482.90	5 510.22	5 694.16	5 417.43
HFCs	646.82	773.86	874.78	952.51	1 020.17	997.37	1 004.15	1 042.65	1 082.02	1 134.26
PFCs	67.46	90.03	83.46	102.20	125.49	125.04	136.94	183.72	167.13	28.64
SF_6	602.25	659.69	642.89	575.58	507.07	517.12	474.88	384.22	390.87	357.54
Total (including LULUCF)	**65 046.00**	**67 113.84**	**74 880.22**	**90 901.77**	**85 426.69**	**84 955.67**	**87 903.30**	**86 217.01**	**87 021.88**	**76 243.58**
Total (excluding LULUCF)	**80 276.96**	**84 274.66**	**85 975.56**	**91 984.60**	**91 569.35**	**92 580.94**	**89 710.79**	**86 967.42**	**86 882.03**	**80 147.97**

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	59 343.60	63 473.31	64 594.65	70 725.45	71 143.15	71 821.10	68 589.60	65 477.86	64 888.46	60 548.85
2. Industrial Processes	10 037.96	10 006.96	10 668.71	10 717.51	10 151.01	10 612.62	10 985.76	11 425.20	11 910.88	9 738.75
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	7 912.11	7 865.46	7 763.42	7 557.19	7 453.77	7 415.93	7 451.60	7 516.97	7 652.61	7 633.61
5. Land Use, Land-Use Change and Forestry[(5)]	-15 230.97	-17 160.83	-11 095.34	-1 082.82	-6 142.66	-7 625.27	-1 807.49	-750.41	139.85	-3 904.39
6. Waste	2 558.17	2 504.11	2 521.70	2 566.02	2 447.19	2 344.70	2 268.81	2 159.06	2 062.84	1 927.59
7. Other	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Total (including LULUCF)[(5)]	**65 046.00**	**67 113.84**	**74 880.22**	**90 901.77**	**85 426.69**	**84 955.67**	**87 903.30**	**86 217.01**	**87 021.88**	**76 243.58**

[(1)] The column "Base year" should be filled in only by those Parties with economies in transition that use a base year different from 1990 in accordance with the relevant decisions of the COP. For these Parties, this different base year is used to calculate the percentage change in the final column of this table.

[(2)] Fill in net emissions/removals as reported in table Summary 1.A. For the purposes of reporting, the signs for removals are always negative (-) and for emissions positive (+).

[(3)] Enter actual emissions estimates. If only potential emissions estimates are available, these should be reported in this table and an indication for this be provided in the documentation box. Only in these rows are the emissions expressed as CO_2 equivalent emissions.

[(4)] In accordance with the UNFCCC reporting guidelines, HFC and PFC emissions should be reported for each relevant chemical. However, if it is not possible to report values for each chemical (i.e. mixtures, confidential data, lack of disaggregation), this row could be used for reporting aggregate figures for HFCs and PFCs, respectively. Note that the unit used for this row is Gg of CO_2 equivalent and that appropriate notation keys should be entered in the cells for the individual chemicals.

[(5)] Includes net CO_2, CH_4 and N_2O from LULUCF.

GREENHOUSE GAS EMISSIONS	2010	2011	2012	Change from base to latest reported year
	CO_2 equivalent (Gg)	CO_2 equivalent (Gg)	CO_2 equivalent (Gg)	(%)
CO_2 emissions including net CO_2 from LULUCF	68 449.24	66 458.32	63 869.64	22.54
CO_2 emissions excluding net CO_2 from LULUCF	72 366.12	70 353.70	67 733.47	9.22
CH_4 emissions including CH_4 from LULUCF	5 562.27	5 393.67	5 306.34	-36.32
CH_4 emissions excluding CH_4 from LULUCF	5 562.12	5 393.54	5 306.18	-36.32
N_2O emissions including N_2O from LULUCF	5 202.46	5 307.28	5 246.78	-15.62
N_2O emissions excluding N_2O from LULUCF	5 178.53	5 283.00	5 221.63	-15.75
HFCs	1 285.65	1 349.00	1 431.45	6 247.88
PFCs	63.93	60.07	40.46	-96.04
SF_6	351.50	321.53	326.18	-33.89
Total (including LULUCF)	**80 915.05**	**78 889.87**	**76 220.84**	**11.75**
Total (excluding LULUCF)	**84 807.85**	**82 760.84**	**80 059.36**	**2.53**

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	2010	2011	2012	Change from base to latest reported year
	CO_2 equivalent (Gg)	CO_2 equivalent (Gg)	CO_2 equivalent (Gg)	(%)
1. Energy	64 405.46	62 000.40	59 691.53	7.70
2. Industrial Processes	10 780.73	11 125.32	10 877.24	8.71
3. Solvent and Other Product Use	327.12	319.75	334.56	-34.63
4. Agriculture	7 468.13	7 578.42	7 499.03	-12.36
5. Land Use, Land-Use Change and Forestry (5)	-3 892.80	-3 870.97	-3 838.52	-61.14
6. Waste	1 826.42	1 736.95	1 657.00	-53.81
7. Other	NA	NA	NA	0.00
Total (including LULUCF)(5)	**80 915.05**	**78 889.87**	**76 220.84**	**11.75**

(1) The column "Base year" should be filled in only by those Parties with economies in transition that use a base year different from 1990 in accordance with the relevant decisions of the COP. For these Parties, this different base year is used to calculate the percentage change in the final column of this table.

(2) Fill in net emissions/removals as reported in table Summary 1.A. For the purposes of reporting, the signs for removals are always negative (-) and for emissions positive (+).

(3) Enter actual emissions estimates. If only potential emissions estimates are available, these should be reported in this table and an indication for this be provided in the documentation box. Only in these rows are the emissions expressed as CO_2 equivalent emissions.

(4) In accordance with the UNFCCC reporting guidelines, HFC and PFC emissions should be reported for each relevant chemical. However, if it is not possible to report values for each chemical (i.e. mixtures, confidential data, lack of disaggregation), this row could be used for reporting aggregate figures for HFCs and PFCs, respectively. Note that the unit used for this row is Gg of CO_2 equivalent and that appropriate notation keys should be entered in the cells for the individual chemicals.

(5) Includes net CO_2, CH_4 and N_2O from LULUCF.

Documentation box:
- Parties should provide detailed explanations on emissions trends in Chapter 2: Trends in Greenhouse Gas Emissions and, as appropriate, in the corresponding Chapters 3 - 9 of the NIR. Use this documentation box to provide references to relevant sections of the NIR if any additional information and further details are needed to understand the content of this table.
- Use the documentation box to provide explanations if potential emissions are reported.

ANNEX 9: CRF TABLES ART. 3.3 AND 3.4 KP ACTIVITIES FOR 2012

The full set of tables is submitted electronically together with this report.

- NIR-1
- NIR-2
- NIR-3
- 5(KP)
- 5(KP-I)A.1.1
- 5(KP-I)A.1.2
- 5(KP-I)A.1.3
- 5(KP-I)A.2.
- 5(KP-I)A.2.1
- 5(KP-I)B.1
- 5(KP-I)B.2
- 5(KP-I)B.3
- 5(KP-I)B.4
- 5(KP-II)1
- 5(KP-II)2
- 5(KP-II)3
- 5(KP-II)4
- 5(KP-II)5
- Accounting

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 to croplands	Liming	Biomass burning[4]		
							N_2O	N_2O	N_2O	CO_2	CO_2	CH_4	N_2O
Article 3.3 activities	Afforestation and Reforestation	R	R	R	R	R	NO			NO	NO	NO	NO
	Deforestation	R	R	R	R	R			R	R	NO	NO	NO
Article 3.4 activities	Forest Management	NA	NA	NA	NA	NA	NA	NA		NA	NA	NA	NA
	Cropland Management	NA	NA	NA	NA	NA			NA	NA	NA	NA	NA
	Grazing Land Management	NA	NA	NA	NA	NA				NA	NA	NA	NA
	Revegetation	NA	NA	NA	NA	NA				NA	NA	NA	NA

(1) Indicate R (reported), NR (not reported), IE (included elsewhere) or NO (not occurring), for each relevant activity under Article 3.3 or elected activity under Article 3.4. If changes in a carbon pool are not reported, it must be demonstrated in the NIR that this pool is not a net source of greenhouse gases. Indicate NA (not applicable) for each activity that is not elected under Article 3.4. Explanation about the use of notation keys should be provided in the text.

(2) Indicate R (reported), NE (not estimated), IE (included elsewhere) or NO (not occurring) for greenhouse gas sources reported, for each relevant activity under Article 3.3 or elected activity under Article 3.4. Indicate NA (not applicable) for each activity that is not elected under Article 3.4. Explanation about the use of notation keys should be provided in the text.

(3) N_2O emissions from fertilization for Cropland Management, Grazing Land Management and Revegetation should be reported in the Agriculture sector. If a Party is not able to separate fertilizer applied to Forest Land from Agriculture, it may report all N_2O emissions from fertilization in the Agriculture sector.

(4) If CO_2 emissions from biomass burning are not already included under changes in carbon stocks, they should be reported under biomass burning; this also includes the carbon component of CH_4. Parties that include CO_2 emissions from biomass burning in their carbon stock change estimates should report IE (included elsewhere)

Table NIR 1.1 Additional information
Selection of parameters for defining "Forest"under the Kyoto Protocol

Parameter	Range	Selected value
Minimum land area	0.05 - 1 ha	0.05
Minimum crown cover	10 - 30 %	30.00
Minimum height	2 - 5 m	2.00

Table NIR 2. LAND TRANSITION MATRIX

Areas and changes in areas between the previous and the current inventory year[(1), (2), (3)]

From previous inventory year \ To current inventory year		Article 3.3 activities: Afforestation and Reforestation	Article 3.3 activities: Deforestation	Article 3.4 activities: Forest Management (if elected)	Article 3.4 activities: Cropland Management (if elected)	Article 3.4 activities: Grazing Land Management (if elected)	Article 3.4 activities: Revegetation (if elected)	Other [(5)]	Total area at the beginning of the current inventory year[(6)]
		(kha)							
Article 3.3 activities	Afforestation and Reforestation	189.14	NO						189.14
	Deforestation		67.37						67.37
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)]		7.23	1.66	NA	NA	NA	NA	8 121.60	8 130.49
Total area at the end of the current inventory year		196.37	69.03	NA	NA	NA	NA	8 121.60	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, and which was deforested in the inventory year, should be reported in the cell in column of Deforestation and in the row of Forest Management.

(2) Some of the transitions in the matrix are not possible and the cells concerned have been shaded.

(3) In accordance with section 4.2.3.2 of the IPCC good practice guidance for LULUCF, the value of the reported area subject to the various activities under Article 3.3 and 3.4 for the inventory year should be that on 31 December of that year.

(4) Lands subject to Cropland Management, Grazing Land Management or Revegetation which, after 2008, are subject to activities other than those under Article 3.3 and 3.4, should still be tracked and reported under Cropland Management, Grazing Land Management or Revegetation, respectively.

(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)]

AUSTRIA
Inventory 2012
Submission 2014 v1.4

GREENHOUSE GAS SOURCE AND SINK ACTIVITIES	Net CO_2 emissions/ removals[(3), (4)]	CH_4 [(5)]	N_2O [(6)]	Net CO_2 equivalent emissions/removals
	(Gg)			
A. Article 3.3 activities				**-1 505.58**
A.1. Afforestation and Reforestation[(7)]	-2 051.86	NO	NO	-2 051.86
A.1.1. Units of land not harvested since the beginning of the commitment period	-2 051.86	NO	NO	-2 051.86
A.1.2. Units of land harvested since the beginning of the commitment period	NO	NO	NO	NO
A.2. Deforestation	545.17	NO	0.00	546.28
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/2012:Further information on the methodology is provided in the NIR chapters 10.2 (land-related information) and 10.3. (Activity specific information).

KP.A.1.2 Units of land harvested since the beginning of the commitment period/2012:Further information is provided in the NIR chapter 10.4.3.Austria reports NO for harvesting on AR are 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) All estimates in this table include emissions and removals from projects under Article 6 hosted by the reporting Party.

(2) If Cropland Management, Grazing Land Management and/or Revegetation are elected, this table and all relevant CRF tables should also be reported for the base year for these activities.

(3) According to the Revised 1996 IPCC Guidelines, for the purposes of reporting, the signs for removals are always negative (-) and for emissions positive (+). Net changes in carbon stocks

(4) CO_2 emissions from liming, biomass burning and drained organic soils, where applicable, are included in this column.

(5) CH_4 emissions reported here for Cropland Management, Grazing Land Management and Revegetation, if elected, include only emissions from biomass burning (with the exception of

(6) N_2O emissions reported here for Cropland Management, if elected, include only emissions from biomass burning (with the exception of savannah burning and agricultural residue burning which are reported in the Agriculture sector) and N_2O emissions from mineral soils from conversion to Cropland of lands other than Forest Land (Table 5(KP-II)3). Any other N_2O emissions from Agriculture should be reported in the Agriculture sector.

(7) As both Afforestation and Reforestation under Article 3.3 are subject to the same provisions specified in the annex to decision 16/CMP.1, they can be reported together.

TABLE 5(KP-I)A.1.1. SUPPLEMENTARY BACKGROUND DATA ON CARBON STOCK CHANGES AND NET CO_2 EMISSIONS AND REMOVALS FOR LAND USE, LAND-USE CHANGE AND FORESTRY ACTIVITIES UNDER THE KYOTO PROTOCOL

AUSTRIA
Inventory 2012
Submission 2014 v1.4

Article 3.3 activities: Afforestation and Reforestation [(1), (2)]

Units of land not harvested since the beginning of the commitment period

GEOGRAPHICAL LOCATION [(3)]	ACTIVITY DATA			IMPLIED CARBON STOCK CHANGE FACTORS [(7)]										Implied emission/ removal factor per area[(9)]	CHANGE IN CARBON STOCK [(7)]										Net CO_2 emissions/ removals [(9)]
Identification code	Subdivision[(4)]	Area subject to the activity	Area of organic soils[(8)]	Carbon stock change in above-ground biomass per area[(5), (6)]			Carbon stock change in below-ground biomass per area[(5), (6)]			Net carbon stock change in litter per area[(5)]	Net carbon stock change in dead wood per area[(5)]	Net carbon stock change in soils per area[(5)]			Carbon stock change in above-ground biomass[(5), (6)]			Carbon stock change in below-ground biomass[(5), (6)]			Net carbon stock change in litter [(5)]	Net carbon stock change in dead wood[(5)]	Net carbon stock change in soils[(5)]		
				Gains	Losses	Net change	Gains	Losses	Net change			Mineral soils	Organic soils		Gains	Losses	Net change	Gains	Losses	Net change			Mineral soils	Organic soils [(10)]	
		(kha)	(kha)	(Mg C/ha)										($Mg CO_2$/ha)	(Gg C)										($Gg CO_2$)
Total for activity A.1.1		**196.37**	**NO**	**1.41**	**-0.45**	**0.96**	**0.36**	**-0.10**	**0.26**	**1.01**	**0.02**	**0.60**	**NO**	**-10.45**	**276.47**	**-88.15**	**188.32**	**70.84**	**-18.85**	**51.99**	**198.50**	**3.13**	**117.66**	**NO**	**-2 051.86**
Austria		196.37	NO	1.41	-0.45	0.96	0.36	-0.10	0.26	1.01	0.02	0.60	NO	-10.45	276.47	-88.15	188.32	70.84	-18.85	51.99	198.50	3.13	117.66	NO	-2 051.86
	Cropland converted to	18.56	NO	1.46	-0.48	0.99	0.41	-0.10	0.31	1.03	0.02	0.90	NO	-11.89	27.15	-8.82	18.33	7.60	-1.89	5.72	19.07	0.30	16.75	NO	-220.61
	Grassland converted to	104.12	NO	1.42	-0.45	0.97	0.36	-0.10	0.26	1.03	0.02	-0.58	NO	-6.20	147.91	-47.37	100.54	37.47	-10.13	27.34	106.81	1.66	-60.39	NO	-645.18
	Other land converted to	50.95	NO	1.34	-0.42	0.92	0.34	-0.09	0.25	1.06	0.02	2.59	NO	-17.72	68.25	-21.20	47.04	17.39	-4.53	12.85	53.77	0.81	131.77	NO	-902.91
	Settlement converted to	11.07	NO	1.48	-0.48	1.00	0.37	-0.10	0.27	0.99	0.02	2.67	NO	-18.13	16.39	-5.36	11.04	4.14	-1.15	2.99	10.97	0.18	29.53	NO	-200.59
	Wetland converted to	11.68	NO	1.44	-0.46	0.97	0.36	-0.10	0.26	0.67	0.02	NO	NO	-7.07	16.76	-5.39	11.36	4.24	-1.15	3.09	7.88	0.19	NO	NO	-82.56

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 informati

(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 CO_2 by multiplying C by 44/12 and changing the sign for net CO_2 removals to be negative (-) and for net CO_2 emissions to be positive (+).

(10) The value reported here is an emission and not a carbon stock change.

TABLE 5(KP-I)A.1.2. SUPPLEMENTARY BACKGROUND DATA ON CARBON STOCK CHANGES AND NET CO_2 EMISSIONS AND REMOVALS FOR LAND USE, LAND-USE CHANGE AND FORESTRY ACTIVITIES UNDER THE KYOTO PROTOCOL

AUSTRIA
Inventory 2012
Submission 2014 v1.4

Article 3.3 activities: Afforestation and Reforestation [(1), (2)]

Units of land harvested since the beginning of the commitment period

GEOGRAPHICAL LOCATION [(3)]	ACTIVITY DATA			IMPLIED CARBON STOCK CHANGE FACTORS [(7)]										Implied emission/ removal factor per area[(9)]	CHANGE IN CARBON STOCK [(7)]										Net CO_2 emissions/ removals[(9)]
Identification code	Subdivision[(4)]	Area subject to the activity	Area of organic soils[(8)]	Carbon stock change in above-ground biomass per area[(5), (6)]			Carbon stock change in below-ground biomass per area[(5), (6)]			Net carbon stock change in litter per area[(5)]	Net carbon stock change in dead wood per area[(5)]	Net carbon stock change in soils per area[(5)]			Carbon stock change in above-ground biomass[(5), (6)]			Carbon stock change in below-ground biomass[(5), (6)]			Net carbon stock change in litter [(5)]	Net carbon stock change in dead wood[(5)]	Net carbon stock change in soils[(5)]		
				Gains	Losses	Net change	Gains	Losses	Net change			Mineral soils	Organic soils		Gains	Losses	Net change	Gains	Losses	Net change			Mineral soils	Organic soils [(10)]	
		(kha)	(kha)	(Mg C/ha)										(Mg CO_2/ha)	(Gg C)										(Gg CO_2)
Total for activity A.1.2		**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**
Austria		NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
	D-Area	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO

Documentation box

Parties should provide detailed explanation on the land use, land-use change and forestry sector in the relevant annex of the NIR: Supplementary information on LULUCF activities under the Kyoto Protocol. Use this documentation box to provide references to relevant sections of the NIR if any additional details are needed to understand the content of this table.

KP.A.1.2 D-Area/2012: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 c 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 CO_2 by multiplying C by 44/12 and changing the sign for net CO_2 removals to be negative (-) and for net CO_2 emissions to be positive (+).

(10) The value reported here is an emission and not a carbon stock change.

TABLE 5(KP-I)A.1.3. SUPPLEMENTARY BACKGROUND FOR LAND USE, LAND-USE CHANGE AND FORESTRY ACTIVITIES UNDER THE KYOTO PROTOCOL

AUSTRIA

Article 3.3 activities: Afforestation and Reforestation [(1), (2)]

Inventory 2012

Units of land otherwise subject to elected activities under Article 3.4 (information item)

Submission 2014 v1.4

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 CO_2 EMISSIONS AND REMOVALS FOR LAND USE, LAND-USE CHANGE AND FORESTRY ACTIVITIES UNDER THE KYOTO PROTOCOL
Article 3.3 activities: Deforestation[1]

AUSTRIA
Inventory 2012
Submission 2014 v1.4

GEOGRAPHICAL LOCATION[2]	ACTIVITY DATA			IMPLIED CARBON STOCK CHANGE FACTORS [6]										Implied emission/ removal factor per area[8]	CHANGE IN CARBON STOCK [6]										Net CO_2 emissions/ removals[8]
Identification code	Subdivision[3]	Area subject to the activity	Area of organic soils[7]	Carbon stock change in above ground biomass per area[4], [5]			Carbon stock change in below ground biomass per area[4], [5]			Net carbon stock change in litter per area[4]	Net carbon stock change in dead wood per area[4]	Net carbon stock change in soils per area[4]			Carbon stock change in above-ground biomass[4], [5]			Carbon stock change in below-ground biomass[4], [5]			Net carbon stock change in litter[4]	Net carbon stock change in dead wood[4]	Net carbon stock change in soils[4]		
				Gains	Losses	Net change	Gains	Losses	Net change			Mineral soils	Organic soils		Gains	Losses	Net change	Gains	Losses	Net change			Mineral soils	Organic soils [9]	
		(kha)	(kha)	(Mg C/ha)										(Mg CO_2/ha)	(Gg C)										(Gg CO_2)
Total for activity A.2.		**69.03**	**NO**	**0.21**	**-0.94**	**-0.73**	**0.05**	**-0.23**	**-0.18**	**-0.56**	**0.00**	**-0.68**	**NO**	**7.88**	**14.39**	**-64.77**	**-50.38**	**3.61**	**-15.96**	**-12.35**	**-38.83**	**0.02**	**-46.73**	**NO**	**543.71**
Austria		69.03	NO	0.21	-0.94	-0.73	0.05	-0.23	-0.18	-0.56	0.00	-0.68	NO	7.88	14.39	-64.77	-50.38	3.61	-15.96	-12.35	-38.83	0.02	-46.73	NO	543.71
	Forest Land converted to	4.20	NO	0.21	-0.85	-0.64	0.05	-0.21	-0.16	-0.46	0.00	-0.82	NO	7.62	0.88	-3.57	-2.69	0.22	-0.88	-0.66	-1.94	0.00	-3.45	NO	32.04
	Forest Land converted to	36.26	NO	0.21	-0.99	-0.78	0.05	-0.24	-0.19	-0.64	0.00	0.66	NO	3.49	7.55	-35.94	-28.39	1.89	-8.84	-6.95	-23.03	0.00	23.85	NO	126.60
	Forest Land converted to	14.86	NO	0.21	-0.67	-0.46	0.05	-0.17	-0.11	-0.38	0.00	-2.48	NO	12.57	3.11	-9.92	-6.81	0.79	-2.48	-1.69	-5.64	0.02	-36.83	NO	186.80
	Forest Land converted to	11.25	NO	0.21	-0.64	-0.43	0.05	-0.16	-0.11	-0.39	0.00	-2.69	NO	13.28	2.36	-7.19	-4.83	0.60	-1.80	-1.20	-4.42	0.02	-30.29	NO	149.32
	Forest Land converted to	2.45	NO	0.20	-3.33	-3.13	0.05	-0.80	-0.76	-1.56	-0.01	NO	NO	20.00	0.49	-8.15	-7.67	0.11	-1.96	-1.85	-3.81	-0.02	NO	NO	48.95

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/2012:Further information on the methodology is provided in the NIR chapters 10.2 (land-related information) and 10.3. (Activity specific informatic

(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

(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 subdivi:

(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 are

(8) According to the Revised 1996 IPCC Guidelines, for the purposes of reporting, the signs for removals are always negative (-) and for emissions positive (+). Net changes in carbon stocks are converted to CO_2 by multiplying C by 44/12 and changing the sign for net CO_2 removals to be negative (-) and for net CO_2 emissions to be positive (+)

(9) The value reported here is an emission and not a carbon stock change.

TABLE 5(KP-I)A.2.1. SUPPLEMENTARY BACKGROUND DATA FOR LAND USE, LAND-USE CHANGE AND FORESTRY ACTIVITIES UNDER THE KYOTO PROTOCOL

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**
Austria		NA

Documentation box
Parties should provide detailed explanation on the land use, land-use change and forestry sector in the relevant annex of the NIR: Supplementary information on LULUCF activities under the Kyoto Protocol. Use this documentation box to provide references to relevant sections of the NIR if any additional details are needed to understand the content of this table.

(1) Units of lands subject to Deforestation under Article 3.3 otherwise subject to elected activities under Article 3.4 are implicitly included under A.2. They are reported here for transparency and to fulfil the requirement of paragraph 6 (b) (ii) of the annex to decision 15/CMP.1.

(2) Geographical location refers to the boundaries of the areas that encompass units of land subject to Deforestation which would otherwise be included in land subject to elected activities under Article 3.4.

(3) Activity data may be further subdivided according to climate zone, management system, soil type, vegetation type, tree species, ecological zone, national 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 CO_2 EMISSIONS AND REMOVALS FOR LAND USE, LAND-USE CHANGE AND FORESTRY ACTIVITIES UNDER THE KYOTO PROTOCOL
Elected Article 3.4 activities: Forest Management[(1)]

AUSTRIA
Inventory 2012
Submission 2014 v1.4

GEOGRAPHICAL LOCATION[(2)]	ACTIVITY DATA			IMPLIED CARBON STOCK CHANGE FACTORS [(6)]										Implied emission/ removal factor per area[(8)]	CHANGE IN CARBON STOCK [(6)]										Net CO_2 emissions/ removals[(8)]
Identification code	Subdivision[(3)]	Area subject to the activity	Area of organic soils[(7)]	Carbon stock change in above-ground biomass per area [(4), (5)]			Carbon stock change in below-ground biomass per area [(4), (5)]			Net carbon stock change in litter per area[(4)]	Net carbon stock change in dead wood per area[(4)]	Net carbon stock change in soils per area[(4)]			Carbon stock change in above-ground biomass[(4), (5)]			Carbon stock change in below-ground biomass[(4), (5)]			Net carbon stock change in litter[(4)]	Net carbon stock change in dead wood[(4)]	Net carbon stock change in soils[(4)]		
				Gains	Losses	Net change	Gains	Losses	Net change			Mineral soils	Organic soils		Gains	Losses	Net change	Gains	Losses	Net change			Mineral soils	Organic soils [(9)]	
		(kha)	(kha)	(Mg C/ha)										(Mg CO_2/ha)	(Gg C)										(Gg CO_2)
Total for activity 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 encompass land subjec

(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" column and net losses should be

(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 $_2$ by multiplying C by 44/12 and changing the sign for net C_2 removals to be negative (-) and for net CO_2 emissions to be positive (+).

(9) The value reported here is an emission and not a carbon stock change.

TABLE 5(KP-I)B.2. SUPPLEMENTARY BACKGROUND DATA ON CARBON STOCK CHANGES AND NET CO_2 EMISSIONS AND REMOVALS FOR LAND USE, LAND-USE CHANGE AND FORESTRY ACTIVITIES UNDER THE KYOTO PROTOCOL
Elected Article 3.4 activities: Cropland Management[(1), (2)]

AUSTRIA
Inventory 2012
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GEOGRAPHICAL LOCATION[(3)]	ACTIVITY DATA			IMPLIED CARBON STOCK CHANGE FACTORS [(7)]										Implied emission/ removal factor per area[(10)]	CHANGE IN CARBON STOCK [(7)]										Net CO_2 emissions/ removals[(10)]
Identification code	Subdivision[(4)]	Area subject to the activity	Area of organic soils[(9)]	Carbon stock change in above-ground biomass per area [(5), (6)]			Carbon stock change in below-ground biomass per area [(5), (6)]			Net carbon stock change in litter per area[(5)]	Net carbon stock change in dead wood per area[(5)]	Net carbon stock change in soils per area[(5)]			Carbon stock change in above-ground biomass[(5), (6)]			Carbon stock change in below ground biomass [(5), (6)]			Net carbon stock change in litter[(5)]	Net carbon stock change in dead wood[(5)]	Net carbon stock change in soils[(5)]		
				Gains	Losses	Net change	Gains	Losses	Net change			Mineral soils	Organic soils		Gains	Losses	Net change	Gains	Losses	Net change			Mineral soils	Organic soils[(8)]	
		(kha)	(kha)	(Mg C/ha)										(Mg CO_2/ha)	(Gg C)										(Gg CO_2)
Total for activity B.2		**NA**	**NA**	**NA**	**NA**	**NA**	**NA**	**NA**	**NA**	**NA**	**NA**	**NA**	**NA**	**NA**	**NA**	**NA**	**NA**	**NA**	**NA**	**NA**	**NA**	**NA**	**NA**	**NA**	**NA**
Austria		NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA

Documentation box
Parties should provide detailed explanation on the land use, land-use change and forestry sector in the relevant annex of the NIR: Supplementary information on LULUCF activities under the Kyoto Protocol. Use this documentation box to provide references to relevant sections of the NIR if any additional details are needed to understand the content of this table.

(1) If Cropland Management has been elected, report here information on anthropogenic carbon stock change for the inventory year for all geographical locations that encompass land subject to Cropland Management under Article

(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 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 CO_2 by multiplying C by 44/12 and changing the sign for net CO_2 removals to be negative (-) and for net CO_2 emissions to be positive (+).

TABLE 5(KP-I)B.3. SUPPLEMENTARY BACKGROUND DATA ON CARBON STOCK CHANGES AND NET CO_2 EMISSIONS AND REMOVALS FOR LAND USE, LAND-USE CHANGE AND FORESTRY ACTIVITIES UNDER THE KYOTO PROTOCOL
Elected Article 3.4 activities: Grazing Land Management[(1), (2)]

AUSTRIA
Inventory 2012
Submission 2014 v1.4

GEOGRAPHICAL LOCATION[(3)]	ACTIVITY DATA			IMPLIED CARBON STOCK CHANGE FACTORS[(7)]										Implied emission/ removal factor per area[(10)]	CHANGE IN CARBON STOCK[(7)]										Net CO_2 emissions/ removals[(10)]
Identification code	Subdivision[(4)]	Area subject to the activity	Area of organic soils[(9)]	Carbon stock change in above-ground biomass per area[(5), (6)]			Carbon stock change in below-ground biomass per area[(5), (6)]			Net carbon stock change in litter per area[(5)]	Net carbon stock change in dead wood per area[(5)]	Net carbon stock change in soils per area[(5)]			Carbon stock change in above-ground biomass[(5), (6)]			Carbon stock change in below-ground biomass[(5), (6)]			Net carbon stock change in litter[(5)]	Net carbon stock change in dead wood[(5)]	Net carbon stock change in soils[(5)]		
				Gains	Losses	Net change	Gains	Losses	Net change			Mineral soils	Organic soils		Gains	Losses	Net change	Gains	Losses	Net change			Mineral soils	Organic soils[(8)]	
		(kha)	(kha)	(Mg C/ha)										($Mg CO_2$/ha)	(Gg C)										($Gg CO_2$)
Total for activity B.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 losses should be reported in the

(7) Note that net change corresponds to increase / decrease of carbon stock (see table 4.2.6b of the IPCC good practice guidance for LULUCF).

(8) The value reported here is an emission and not a carbon stock change.

(9) This information is needed for the calculation of the net carbon stock changes in soils per area.

(10) According to the Revised 1996 IPCC Guidelines, for the purposes of reporting, the signs for removals are always negative (-) and for emissions positive (+). Net changes in carbon stocks are converted to CO_2 by multiplying C by 44/12 and changing the sign for net CO2 removals to be negative (-) and for net CO2 emissions to be positive (+).

TABLE 5(KP-I)B.4. SUPPLEMENTARY BACKGROUND DATA ON CARBON STOCK CHANGES AND NET CO_2 EMISSIONS AND REMOVALS FOR LAND USE, LAND-USE CHANGE AND FORESTRY ACTIVITIES UNDER THE KYOTO PROTOCOL
Elected Article 3.4 activities: Revegetation[(1), (2)]

AUSTRIA
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GEOGRAPHICAL LOCATION[(3)]	ACTIVITY DATA			IMPLIED CARBON STOCK CHANGE FACTORS[(7)]										Implied emission/ removal factor per area [(10)]	CHANGE IN CARBON STOCK[(7)]										Net CO_2 emissions/ removals[(10)]
Identification code	Subdivision[(4)]	Area subject to the activity	Area of organic soils [(9)]	Carbon stock change in above-ground biomass per area [(5), (6)]			Carbon stock change in below-ground biomass per area [(5), (6)]			Net carbon stock change in litter per area[(5)]	Net carbon stock change in dead wood per area[(5)]	Net carbon stock change in soils per area[(5)]			Carbon stock change in above-ground biomass[(5), (6)]			Carbon stock change in below-ground biomass [(5), (6)]			Net carbon stock change in litter[(5)]	Net carbon stock change in dead wood[(5)]	Net carbon stock change in soils[(5)]		
				Gains	Losses	Net change	Gains	Losses	Net change			Mineral soils	Organic soils		Gains	Losses	Net change	Gains	Losses	Net change			Mineral soils	Organic soils[(8)]	
		(kha)	(kha)	(Mg C/ha)										(Mg CO_2/ha)	(Gg C)										(Gg CO_2)
Total for activity B.4		**NA**	**NA**	**NA**	**NA**	**NA**	**NA**	**NA**	**NA**	**NA**	**NA**	**NA**	**NA**	**NA**	**NA**	**NA**	**NA**	**NA**	**NA**	**NA**	**NA**	**NA**	**NA**	**NA**	**NA**
Austria		NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA

Documentation box
Parties should provide detailed explanation on the land use, land-use change and forestry sector in the relevant annex of the NIR: Supplementary information on LULUCF activities under the Kyoto Protocol. Use this documentation box to provide references to relevant sections of the NIR if any additional details are needed to understand the content of this table.

(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

(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 reported in the “Losses”

(7) Note that net change corresponds to increase / decrease of carbon stock (see table 4.2.6b of the IPCC good practice guidance for LULUCF

(8) The value reported here is an emission and not a carbon stock change

(9) This information is needed for the calculation of the net carbon stock changes in soils per area.

According to the Revised 1996 IPCC Guidelines, for the purposes of reporting, the signs for removals are always negative (-) and for emissions positive (+). Net changes in carbon stocks are converted to CO_2 by multiplying C by 44/12 and changing the sign for net CO_2 removals to be negative (-) and for net CO_2 emissions to be positive (+).

TABLE 5(KP-II)1. SUPPLEMENTARY BACKGROUND DATA FOR LAND USE, LAND-USE CHANGE AND FORESTRY ACTIVITIES UNDER THE KYOTO PROTOCOL
Direct N_2O emissions from N fertilization [(1), (2)]

AUSTRIA
Inventory 2012
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Identification code of geographical location	ACTIVITY DATA	IMPLIED EMISSION FACTOR	EMISSIONS
	Total amount of fertilizer applied (Gg N/year)	N_2O-N emissions per unit of fertilizer (kg N_2O-N/kg N)[(3)]	N_2O (Gg)
A.1.1. Afforestation/Reforestation: units of land not harvested since the beginning of the commitment period [(4)]	**NO**	**NO**	**NO**
Austria	NO	NO	NO
A.1.2. Afforestation/Reforestation: units of land harvested since the beginning of the commitment period [(4)]	**NO**	**NO**	**NO**
Austria	NO	NO	NO
B.1. Forest Management (if elected) [(5)]	**NA**	**NA**	**NA**
Austria	NA	NA	NA

Documentation box
Parties should provide detailed explanation on the land use, land-use change and forestry sector in the relevant annex of the NIR: Supplementary information on LULUCF activities under the Kyoto Protocol. Use this documentation box to provide references to relevant sections of the NIR if any additional details are needed to understand the content of this table.
KP.A.1.1 Austria/2012:There is no practice of fertilisation at AR areas in Austria. See also NIR chapter 10.3.1.2.
KP.A.1.2 Austria/2012:There is no practice of fertilisation at AR areas in Austria. See also NIR chapter 10.3.1.2.

(1) N_2O emissions from fertilization for Cropland Management, Grazing Land Management and Revegetation should be reported in the Agriculture sector. If a Party is not able to separate fertilizer applied to Forest Land from Agriculture, it may report all N_2O emissions from fertilization in the Agriculture sector. This should be explicitly indicated in the

(2) Direct N_2O emissions from fertilization are estimated following section 3.2.1.4.1 of the IPCC good practice guidance for LULUCF based on the amount of fertilizer applied to land under Forest Management. The indirect N_2O emissions from Afforestation and Reforestation and land under Forest Management are estimated as part of the total indirect emissions in the Agriculture sector based on the total amount of fertilizer used in the country. Parties should show that double counting of N_2O emissions from fertilization with Agriculture sector estimates has been avoided.

(3) In the calculation of the implied emission factor, N_2O emissions are converted to N_2O-N by multiplying by 28/44.
(4) Geographical location refers to the boundaries of the areas that encompass units of land subject to Afforestation and Reforestation
(5) Geographical location refers to the boundaries of the areas that encompass land subject to Forest Management (if elected).

TABLE 5(KP-II)2. SUPPLEMENTARY BACKGROUND DATA FOR LAND USE, LAND-USE CHANGE AND FORESTRY ACTIVITIES UNDER THE KYOTO PROTOCOL

Elected Article 3.4 activities: Forest Management

N_2O emissions from drainage of soils [(1), (2)]

AUSTRIA
Inventory 2012
Submission 2014 v1.4

Identification code of geographical location[(3)]	ACTIVITY DATA Area of drained soils (kha)	IMPLIED EMISSION FACTOR N_2O-N per area drained (kg N_2O-N/ha)[(4)]	EMISSIONS N_2O (Gg)
B.1. Forest Management (if elected)	**NA**	**NA**	**NA**
Total for organic soils	NA	NA	NA
Total for mineral soils	NA	NA	NA
Austria	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 N_2O emissions from drainage of soils are not addressed in the Revised 1996 IPCC Guidelines, but Appendix 3a.2 of the IPCC good practice guidance for LULUCF provides methodologies for consideration.

(2) N_2O emissions from drainage of soils include those resulting from Forest Management. N_2O emissions from drained Cropland and Grassland soils are covered in the

(3) Geographical location refers to the boundaries of the areas that encompass land subject to Forest Management (if elected).

(4) In the calculation of the implied emission factor, N_2O emissions are converted to N_2O-N by multiplying by 28/44.

TABLE 5(KP-II)3. SUPPLEMENTARY BACKGROUND DATA FOR LAND USE, LAND-USE CHANGE AND FORESTRY ACTIVITIES UNDER THE KYOTO PROTOCOL

N_2O emissions from disturbance associated with land-use conversion to cropland[(1), (2)]

AUSTRIA
Inventory 2012
Submission 2014 v1.4

Identification code of geographical location	ACTIVITY DATA	IMPLIED EMISSION FACTOR	EMISSIONS
	Land area converted (kha)	N_2O-N per area converted [(5)] (kg N_2O-N/ha)	N_2O (Gg)
A.2. Deforestation [(3), (6)]	**4.20**	**0.54**	**0.00**
Total organic soils	NO	NO	NO
Total mineral soils	4.20	0.54	0.00
Austria	4.20	0.54	0.00
Organic soils [(7), (10)]	NO	NO	NO
Mineral soils [(7)]	4.20	0.54	0.00
B.2. Cropland Management (if elected) [(4), (8)]	**NA**	**NA**	**NA**
Total organic soils	NA	NA	NA
Total mineral soils	NA	NA	NA
Austria	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 subject	**NO**		
Total organic soils	NO		
Total mineral soils	NO		
Austria	NO		
Organic soils [(7), (10)]	NO		
Mineral soils [(7)]	NO		

Documentation box
Parties should provide detailed explanation on the land use, land-use change and forestry sector in the relevant annex of the NIR: Supplementary information on LULUCF activities under the Kyoto Protocol. Use this documentation box to provide references to relevant sections of the NIR if any additional details are needed to understand the content of this table.
KP.A.2 Austria/2012:Further information on the methodology is provided in the NIR chapters 10.2 (land-related information) and 10.3. (Activity specific information)

(1) Methodologies for N_2O emissions from disturbance associated with land-use conversion to Croplands are found in section 3.3.2.3.1.1 of the IPCC good practice guidance for LULUCF. N_2O emissions from fertilization in the preceding land use and new land use should not be reported here. Parties should avoid double counting with N2O emissions from drainage and from cultivation of organic soils reported in the Agriculture sector under Cultivation of Histosols.

(2) According to the IPCC good practice guidance for LULUCF N_2O emissions from disturbance of soils are only relevant for land conversions to Cropland. N_2O emissions from Cropland Management when Cropland is remaining Cropland are included in the Agriculture sector.

(3) Geographical location refers to the boundaries of the areas that encompass units of land subject to Deforestation.

(4) Geographical location refers to the boundaries of the areas that encompass land subject to Cropland Management, if elected.

(5) In the calculation of the implied emission factor, N_2O emissions are converted to N_2O-N by multiplying by 28/44.

(6) N_2O emissions associated with Deforestation followed by the establishment of Cropland should be reported under Deforestation even if Cropland Management is not elected under Article 3.4.

(7) Parties may separate data for organic and mineral soils, if they have data available.

(8) This includes N_2O emissions in land subject to Cropland Management from disturbance of soils due to the conversion to Cropland of lands other than Forest Lands.

(9) Units of land subject to Deforestation under Article 3.3 otherwise subject to elected activities under Article 3.4 are implicitly included under A.2. They are reported here for transparency and to fulfil the requirement of paragraph 6 (b) (ii) of the annex to decision 15/CMP.1.

(10) N_2O emissions from Cropland are included in the Agriculture sector.

TABLE 5(KP-II)4. SUPPLEMENTARY BACKGROUND DATA FOR LAND USE, LAND-USE CHANGE AND FORESTRY ACTIVITIES UNDER THE KYOTO PROTOCOL
Carbon emissions from lime application[1]

AUSTRIA
Inventory 2012
Submission 2014 v1.4

Identification code of geographical location	ACTIVITY DATA	IMPLIED EMISSION FACTOR	EMISSIONS
	Total amount of lime applied (Mg/year)	Carbon emission per unit of lime (Mg C/Mg)	Carbon (Gg)
A.1.1. Afforestation/Reforestation: units of land not harvested since the beginning of the commitment period [2], [8], [9]	**NO**	**NO**	**NO**
Total for limestone	NO	NO	NO
Total for dolomite	NO	NO	NO
Austria	NO	NO	NO
Limestone ($CaCO_3$)	NO	NO	NO
Dolomite ($CaMg(CO_3)_2$)	NO	NO	NO
A.1.2. Afforestation/Reforestation: units of land harvested since the beginning of the commitment period [2], [8], [9]	**NO**	**NO**	**NO**
Total for limestone	NO	NO	NO
Total for dolomite	NO	NO	NO
Austria	NO	NO	NO
Limestone ($CaCO_3$)	NO	NO	NO
Dolomite ($CaMg(CO_3)_2$)	NO	NO	NO
A.2. Deforestation [3], [8], [9]	**3 331.76**	**0.12**	**0.40**
Total for limestone	3 331.76	0.12	0.40
Total for dolomite	IE	IE	IE
Austria	3 331.76	0.12	0.40
Limestone ($CaCO_3$)	3 331.76	0.12	0.40
Dolomite ($CaMg(CO_3)_2$)	IE	IE	IE
B.1. Forest Management (if elected) [4], [8], [9]	**NA**	**NA**	**NA**
Total for limestone	NA	NA	NA
Total for dolomite	NA	NA	NA
Austria	NA	NA	NA
Limestone ($CaCO_3$)	NA	NA	NA
Dolomite ($CaMg(CO_3)_2$)	NA	NA	NA
B.2. Cropland Management (if elected) [5], [8], [9]	**NA**	**NA**	**NA**
Total for limestone	NA	NA	NA
Total for dolomite	NA	NA	NA
Austria	NA	NA	NA
Limestone ($CaCO_3$)	NA	NA	NA
Dolomite ($CaMg(CO_3)_2$)	NA	NA	NA
B.3. Grazing Land Management (if elected) [6], [8], [9]	**NA**	**NA**	**NA**
Total for limestone	NA	NA	NA
Total for dolomite	NA	NA	NA
Austria	NA	NA	NA
Limestone ($CaCO_3$)	NA	NA	NA
Dolomite ($CaMg(CO_3)_2$)	NA	NA	NA
B.4. Revegetation (if elected) [7], [8], [9]	**NA**	**NA**	**NA**
Total for limestone	NA	NA	NA
Total for dolomite	NA	NA	NA
Austria	NA	NA	NA
Limestone ($CaCO_3$)	NA	NA	NA
Dolomite ($CaMg(CO_3)_2$)	NA	NA	NA

Documentation box

Parties should provide detailed explanation on the land use, land-use change and forestry sector in the relevant annex of the NIR: Supplementary information on LULUCF activities under the Kyoto Protocol. Use this documentation box to provide references to relevant sections of the NIR if any additional details are needed to understand the content of this table.

KP.A.1.1 Austria/2012:There is no practice of fertilisation at AR areas in Austria. See also NIR chapter 10.3.1.2.
KP.A.1.2 Austria/2012:There is no practice of lime applilcation 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 tota
(9) A Party may report aggregate estimates for total lime applications when data are not available for limestone and dolomite

TABLE 5(KP-II)5. SUPPLEMENTARY BACKGROUND DATA FOR LAND USE, LAND-USE CHANGE AND FORESTRY ACTIVITIES UNDER THE KYOTO PROTOCOL
GHG emissions from biomass burning

AUSTRIA
Inventory 2012
Submission 2014 v1.4

Identification code of geographical location	ACTIVITY DATA			IMPLIED EMISSION FACTOR			EMISSIONS		
	Description[7]	Unit	Values	CO_2	CH_4	N_2O	CO_2 [8]	CH_4 [8]	N_2O
	Area (AB) or biomass burned (BB)	ha or kg dm		(Mg/activity data unit)			(Gg)		
A.1.1. Afforestation/Reforestation: units of land not harvested since	**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 since the	**ab**	**ha**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**
Total for controlled burning	ab	ha	NO	NO	NO	NO	NO	NO	NO
Total for wildfires	ab	ha	NO	NO	NO	NO	NO	NO	NO
Austria	ab	ha	NO	NO	NO	NO	NO	NO	NO
Controlled burning	ab	ha	NO	NO	NO	NO	NO	NO	NO
Wildfires	ab	ha	NO	NO	NO	NO	NO	NO	NO
A.2. Deforestation[2], [9]	**ab**	**ha**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**
Total for controlled burning	ab	ha	NO	NO	NO	NO	NO	NO	NO
Total for wildfires	ab	ha	NO	NO	NO	NO	NO	NO	NO
Austria	ab	ha	NO	NO	NO	NO	NO	NO	NO
Controlled burning	ab	ha	NO	NO	NO	NO	NO	NO	NO
Wildfires	ab	ha	NO	NO	NO	NO	NO	NO	NO
B.1. Forest Management (if elected) [3], [9]	**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) [4], [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

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/2012: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/2012:There is no practice of biomass burning at ARD areas in Austria. See also NIR chapter 10.3.1.2.
KP.A.2 Austria/2012: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. The implied emission
(8) If CO_2 emissions from biomass burning are not already included in Tables 5(KP-I)A.1.1 to 5(KP-I)B.4, they should be reported here. This also includes the carbon component of CH_4. This should be clearly documented in the documentation box and in the NIR. Parties that include all carbon stock changes in the carbon stock tables (5(KP-I)A.1.1 to 5(KP-I)B.4) should report IE (included elsewhere) in the CO_2 column.

(9) Parties should report controlled/prescribed burning and wildfires emissions separately, where appropriate.

(10) Burning of agricultural residues is included in the Agriculture secto
(11) Greenhouse gas emissions from prescribed savannah burning are reported in the Agriculture secto

INFORMATION TABLE ON ACCOUNTING FOR ACTIVITIES UNDER ARTICLES 3.3 AND 3.4 OF THE KYOTO PROTOCOL

AUSTRIA
Inventory 2012
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Commitment period accounting: YES
Annual accounting: NO

Number of the reported year in the commitment period: 5

GREENHOUSE GAS SOURCE AND SINK ACTIVITIES	BY(5)	Net emissions/removals(1)						Accounting Parameters[7]	Accounting Quantity [8]
		2008	2009	2010	2011	2012	Total[6]		
	(Gg CO_2 equivalent)								
A. Article 3.3 activities									
A.1. Afforestation and Reforestation									-10 116.70
A.1.1. Units of land not harvested since the beginning of the commitment period[2]		-1 947.59	-2 032.69	-2 039.08	-2 045.47	-2 051.86	-10 116.70		-10 116.70
A.1.2. Units of land harvested since the beginning of the commitment period[2]									NO
Austria		NO	NO	NO	NO	NO	NO		NO
A.2. Deforestation		1 071.26	583.08	570.81	558.54	546.28	3 329.97		3 329.97
B. Article 3.4 activities									
B.1. Forest Management (if elected)		NA	NA	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	NA	NA	0.00	0.00
B.3. Grazing Land Management (if elected)	0.00	NA	NA	NA	NA	NA	NA	0.00	0.00
B.4. Revegetation (if elected)	0.00	NA	NA	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 submissio

(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.

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The National Inventory Report 2014 (NIR 2014) gives a detailed and comprehensive description of the methodology applied in the Austrian air emissions inventory for the greenhouse gases of the "Kyoto basket" (carbon dioxide, methane, nitrous oxide, HFC, PFC and SF_6). With this report, Austria complies with its reporting obligations under the UNFCCC and the Kyoto Protocol by providing transparent and verifiable documentation. It contains emissions data by sector as well as information on emission factors, activity data and other basic data for emission calculations. By submitting data for the years 1990 to 2012, it serves as the basis for final reporting and accounting under the first commitment period under the Kyoto Protocol. Moreover, the report provides documentation of the national inventory system and quality assurance as performed by the accredited inspection body (ISO/IEC 17020) on emission inventories.

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