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Report of the individual review of the greenhouse gas inventory of Austria submitted in 2006*

* In the symbol for this document, 2006 refers to the year in which the inventory was submitted, and not to the year of publication.

CONTENTS

I. Overview

A. Introduction

1. This report covers the in-country review of the 2006 greenhouse gas (GHG) inventory submission of Austria, coordinated by the United Nations Framework Convention on Climate Change (UNFCCC) secretariat, in accordance with decision 19/CP.8. The review took place from 12 to 17 February 2007 in Vienna, Austria, and was conducted by the following team of nominated experts from the roster of experts: generalist – Mr. Mario Contaldi (Italy); energy – Mr. Francis Yamba (Zambia); industrial processes – Ms. Lisa Hanle (USA); agriculture – Mr. Vitor Gois (Portugal); land use, land-use change and forestry (LULUCF) – Mr. Xiaoquan Zhang (China); waste – Mr. Sabin Guendehou (Benin). Mr. Mario Contaldi and Mr. Francis Yamba were the lead reviewers. The review was coordinated by Ms. Astrid Olsson and Mr. Sergey Kononov (UNFCCC secretariat).

2. In accordance with the "Guidelines for the technical review of greenhouse gas inventories from Parties included in Annex I to the Convention", (hereinafter referred to as UNFCCC review guidelines), a draft version of this report was communicated to the Government of Austria, which provided comments that were considered and incorporated, as appropriate, in this final version of the report.

B. Inventory submission and other sources of information

3. In its 2006 submission, Austria submitted a complete set of common reporting format (CRF) tables for the years 1990–2004 and a national inventory report (NIR). Where needed the expert review team (ERT) also used the previous year's submission, additional information provided during the review and other information. The full list of materials used during the review is provided in the annex to this report.

C. Emission profiles and trends

4. In 2004, the most important GHG in Austria was carbon dioxide (CO_2), contributing 84.4 per cent to total[1] national GHG emissions expressed in CO_2 equivalent, followed by methane (CH_4), 8.1 per cent, and nitrous oxide (N_2O), 5.8 per cent. Hydrofluorocarbons (HFCs), perfluorocarbons (PFCs) and sulphur hexafluoride (SF_6) taken together contributed 1.7 per cent of the overall GHG emissions in the country. The energy sector accounted for 77.3 per cent of total GHG emissions, followed by industrial processes (10.8 per cent), agriculture (8.6 per cent), waste (2.8 per cent), and solvent and other product use (0.5 per cent). Total GHG emissions amounted to 91,360.21 Gg CO_2 equivalent and increased by 15.5 per cent from 1990 to 2004. In a trend similar to those seen in other developed countries over the period 1990–2004, CO_2 emissions increased by 24.5 per cent, mainly due to increased emissions from transport. CH_4 emissions decreased during the same period by 19.2 per cent, mainly due to lower emissions from solid waste disposal on land; and N_2O emissions decreased by 16.6 per cent over the same period due to lower emissions from agricultural soils and from chemical industry. HFC emissions increased by 3,826.8 per cent due to substitution of ozone depleting substances (ODS).

5. Tables 1 and 2 show the greenhouse gas emissions by gas and by sector, respectively.

[1] In this report, the term total emissions refers to the aggregated national GHG emissions expressed in terms of CO_2 equivalent excluding LULUCF, unless otherwise specified.

Table 1. Greenhouse gas emissions by gas, 1990–2004

GHG emissions	Gg CO_2 equivalent								Change
	Base year Convention[a]	1990	1995	2000	2001	2002	2003	2004[a]	BY–2004 (%)
CO_2 (with LULUCF)	49 960.29	49 960.29	49 241.78	50 149.24	51 403.67	56 807.50	60 955.45	60 461.38	21.0
CO_2 (without LULUCF)	61 932.64	61 932.64	63 664.36	66 185.96	70 179.02	71 943.21	77 561.83	77 102.68	24.5
CH_4	9 179.07	9 179.07	8 520.17	7 598.93	7 477.65	7 336.35	7 364.52	7 414.15	–19.2
N_2O	6 344.72	6 344.72	6 586.02	6 586.02	6 087.97	6 080.01	6 048.70	5 323.48	–16.1
HFCs	23.03	23.03	267.34	596.26	695.10	782.44	864.92	904.39	3 826.8
PFCs	1 079.24	1 079.24	68.74	72.33	82.15	86.87	102.54	114.72	–89.4
SF_6	502.58	502.58	1 139.16	633.31	636.62	640.83	593.52	512.51	2.0

Note: BY = Base year; LULUCF = Land use, land-use change and forestry.

[a] Austria submitted revised estimates for the base year and 2004 in the course of the initial review on 28 March 2007. These estimates differ from Austria's GHG inventory submitted in 2006.

Table 2. Greenhouse gas emissions by sector, 1990–2004

Sectors	Gg CO_2 equivalent								Change
	Base year Convention[a]	1990	1995	2000	2001	2002	2003	2004[a]	BY–2004 (%)
Energy	55 654.51	55 654.51	57 827.98	59 890.31	63 999.09	65 187.51	70 907.99	70 582.03	26.8
Industrial processes	10 110.81	10 110.81	9 730.26	10 035.10	9 908.97	10 593.70	10 662.86	9 912.27	–2.0
Solvent and other product use	515.17	515.17	422.38	413.52	426.10	424.85	423.60	422.34	–18.0
Agriculture	9 122.44	9 122.44	9 134.47	8 333.92	8 270.44	8 157.15	8 006.61	7 863.19	–13.8
LULUCF	–11 960.71	–11 960.71	–14 411.36	–16 025.63	–18 762.22	–15 124.79	–16 596.94	–16 629.58	39.0
Waste	3 646.72	3 646.72	3 119.48	2 605.97	2 540.77	2 495.60	2 525.53	2 580.38	–29.2
Other	NA	NA	NA	NA	NA	NA	NA	NA	NA
Total (with LULUCF)	67 088.95	67 088.95	65 823.20	65 253.20	66 383.15	71 734.01	75 929.65	74 730.63	11.4
Total (without LULUCF)	79 049.66	79 049.66	80 234.57	81 278.83	85 145.37	86 858.79	92 526.59	91 360.21	15.6

Note: BY = Base year; LULUCF = Land use, land-use change and forestry; NA = Not applicable.

[a] Austria submitted revised estimates for the base year and 2004 in the course of the initial review on 28 March 2007. These estimates differ from Austria's GHG inventory submitted in 2006.

D. Key categories

6. The key category analyses performed by the Party and the secretariat[2] produced consistent results. In 2004, 33 key categories, including three LULUCF categories, were identified. They were identified at a disaggregated level. An extended list of 40 categories covers 97 per cent of total emissions in 2004; this list comprises all categories identified by both level and trend assessment in all years. The secretariat identified 26 key categories in 2004. Those categories are consistent with Austria's estimates but are identified at a higher level of aggregation. An extended list of 40 sources covers 97 per cent of total emissions in 2004; this list comprises all sources identified by both level and trend assessment in all years. CRF table 7 has been filled in, including the LULUCF categories; however, the NIR only includes key sources. The ERT recommends Austria to include the LULUCF sector in the key categories reported in the NIR. The key category analysis guides inventory preparation and efforts have been made to use category-specific good practice for key categories.

E. Main findings

7. The inventory submitted covers all sectors and categories, and is very detailed and transparent. Quality assurance/quality control (QA/QC) procedures implemented and planned are very elaborated. An uncertainty analysis was first done in 2000, and Austria is planning further improvement of its uncertainty analysis. Austria has significantly improved its inventory following the recommendations of previous reviews. The ERT was informed that Austria is working to further improve the uncertainty analysis and to update, extend and improve its estimates in the LULUCF sector. During the in-country review the ERT suggested further improvements that could be made in the reporting; they include providing more precise descriptions of methodologies that differ from those of the Intergovernmental Panel on Climate Change (IPCC) in the relevant NIR chapters.

8. The ERT identified areas for further improvement for all sectors, and these are described in the sectoral sections below in this report. Two of the inventory problems that it identified led to Austria submitting revised estimates. In the industrial processes sector, two instances of double counting – of CO_2 emissions between ammonia and urea production, and CH_4 from ammonia production – were identified. In the waste sector the ERT identified that estimates of N_2O emissions from human sewage not treated in sewage plants are not included.

F. Cross-cutting issues

1. Completeness

9. The inventory submitted is complete in terms of geographical coverage, years and sectors, and fairly complete in terms of categories and gases. The parts that are not fully covered include the following: for some ODS substitutes (e.g. foam) all emissions may not be covered; table 8(b) of the CRF has not been reported; moreover some non-mandatory LULUCF categories (wetlands, settlements and other land) have been estimated only partially or not estimated. The ERT found only minor discrepancies between the CRF and the latest NIR submitted. The time series are complete.

[2] The secretariat identified, for each Party, those source categories that are key categories in terms of their absolute level of emissions, applying the tier 1 level assessment as described in the IPCC *Good Practice Guidance for Land Use, Land-use Change and Forestry* (hereinafter referred to as the IPCC good practice guidance for LULUCF) for the base year or base year period as well as the latest inventory year. Key categories according to the tier 1 trend assessment were also identified. Where the Party performed a key category analysis, the key categories presented in this report follow the Party's analysis. However, they are presented at the level of aggregation corresponding to a tier 1 key category assessment conducted by the secretariat.

2. Transparency

10. Both the CRF tables and the NIR are transparent, and the methodologies use for estimating emissions and data sources have been appropriately referenced. During the review the Party delivered all additional material requested by the ERT and explained in detail all calculations made. The use of confidential data is fairly limited.

3. Recalculations and time-series consistency

11. The ERT noted that the Party reports recalculations of the time series from 1990 to 2003. The effect of the recalculations for 2003 is an increase in estimated total national emissions by 1.05 per cent. The major changes include:

(a) An increase in reported CO_2 emissions due to revised coke oven coke net calorific values (NCVs);

(b) A revised emission factor (EF) for natural gas CO_2;

(c) A revised EF for CO_2 for industrial waste, due to changes in the estimated composition of waste;

(d) Lower estimated emissions from industrial processes, mainly due to the use of an improved methodology for ammonia production;

(e) A decrease in reported CH_4 emissions due to methodological changes in the categories managed waste disposal on land and waste-water handling;

(f) An increase in reported N_2O emissions due to the revision of the nitrogen (N) excretion rates in the agriculture sector, leading to higher estimates of emissions from manure management and agricultural soils;

(g) A decrease in reported emissions of fluorinated compounds, which is the result of the incorporation of a new study on HFC use and emissions in the subcategory foam blowing.

4. Uncertainties

12. The uncertainty of the total emissions is estimated as 2.4 per cent in 1990 and 1.8 per cent in 2004. For the inventory years 1990 and 1997, a study (Winiwarter and Rypdal, 2001) performed a full Monte Carlo analysis (tier 2), but only for the key categories identified in those years. This analysis produced independent uncertainty estimates for all categories and EFs. Austria explained during the review that it has performed a tier 1 uncertainty estimate using the "error propagation" methodology for all other years, based on these independent uncertainty estimates, for all categories and EFs. After the year 1999 uncertainty estimates have been updated for new key categories identified and where changes in methodology have occurred. Austria has contracted a new study that will update the uncertainty estimates for all the key categories identified for the inventory year 2007. The new study will be based on a Monte Carlo approach and its results should enable Austria to perform a tier 2 analysis each year. Uncertainty analysis has been carried out on the 43 key categories, including three LULUCF categories. The ERT recommends Austria to carry out the uncertainty analysis for all categories.

5. Verification and quality assurance/quality control approaches

13. Austria has developed a QA/QC plan which is in accordance with the IPCC *Good Practice Guidance and Uncertainty Management in National Greenhouse Gas Inventories* (hereinafter referred to as the IPCC good practice guidance). The Umweltbundesamt, which has overall responsibility for the national inventory, has been accredited under International Organization for Standardization (ISO)

standard 17020 as the inspection body. Specific responsibilities for the different emission categories ("sector experts") are defined within the inventory system, as well as for all activities related to the preparation of the inventory, including QA/QC, data management and reporting. Sector experts collect activity data (AD), EFs and all relevant information needed for estimating emissions and are also responsible for performing QC activities that are incorporated in the Quality Management System. During the inventory preparation process, all data collected together with emission estimates are fed into a database, where data sources are well documented for future reconstruction of the inventory. QA/QC procedures as defined in the inventory planning process are carried out before the data are submitted to the UNFCCC.

14. Quality control procedures are performed during the inventory preparation by sector experts, and a comprehensive QC procedure is implemented by sector experts once a year, after that year's inventory work has been finished. It includes checks of formal aspects as well as aspects of contents. The ERT recommends Austria to extend the QA/QC procedures to all categories. Austria has indicated that it intends to do so for its future submissions.

6. Follow-up to previous reviews

15. Major improvements of the inventory resulting from previous reviews are the following: tier 1 uncertainty estimates are now reported for all key categories and all years; the time-series consistencies of AD and EFs have been improved; the EF for natural gas has been updated; the consistency and completeness of the AD time series for many industrial processes (e.g. cement and lime production) have been improved; the emission estimates for the waste sector have been revised according to IPCC methodologies; and the reporting of all key categories in the LULUCF sector has improved.

G. Areas for further improvement

1. Identified by the Party

16. Austria indicates that it is working towards full implementation of a tier 2 uncertainty analysis for all categories, and that it will update and extend the reporting of the LULUCF categories that have been estimated only partially or not estimated (wetlands, settlements and other land).

2. Identified by the ERT

17. The ERT identified the following cross-cutting issues for improvement. The Party should:

(a) Provide more precise descriptions of those methodologies that differ from the IPCC methodologies in the relevant NIR chapters, and highlight in the NIR all the work that has been done on QA/QC of the inventory information;

(b) Improve its data collection and related time-series consistency for selected sources;

(c) Investigate whether all stages of equipment life-cycle emissions are included (e.g. for manufacturing/installation);

(d) Extend its QA/QC and uncertainty analyses to all categories of the inventory and evaluate thoroughly the reliability of its statistical data.

18. Recommended improvements relating to specific source/sink categories are presented in the relevant sector sections of this report.

II. Energy

A. Sector overview

19. In 2004, the energy sector accounted for 77.3 per cent of Austria's total national GHG emissions. Emissions increased by 26.8 per cent from 1990 (55,655 Gg CO_2 equivalent) to 2004 (70,582 Gg CO_2 equivalent). Between 2003 and 2004, emissions decreased by 0.5 per cent. In 2004, the most important energy subcategories were transport, with a share of 33.7 per cent, followed by energy industries (22.1 per cent), and manufacturing industry and construction (21.9 per cent).

20. The inventory addresses all the IPCC categories for the energy sector and covers all years and all gases. The level of disaggregation of fuel consumption to individual end-use sectors is in accordance with the IPCC category classification. All the CRF tables, including the sectoral background data tables, are provided.

21. Values for activity data for stationary combustion and fugitive emissions from coal mines come from the national energy balance provided by Statistik Austria. AD for fugitive emissions from oil and natural gas are provided by the industrial associations. The energy balance is continuously updated and is subject to internal quality control, including feedback from local authorities on the quality of the data being provided for their use.

22. The reporting of the energy sector is transparent and the methodologies used are well documented in the NIR. The IPCC tier 2 methodology is used to estimate emissions from stationary combustion. Emissions from road transportation are calculated using the GLOBEMI model. Emissions from off-road machinery (including navigation and railways) are calculated using the GEORG model. The NIR provides sufficient information to make it possible to follow the calculations. The notation keys are used correctly. However, multilateral operations are reported as "included elsewhere" ("IE"). The ERT recommends Austria to report them as "not occurring" ("NO") since emissions from multilateral operations do not occur in Austria.

23. In its 2006 submission, Austria has continued to carry out recalculations, which are well documented in the NIR, for the energy sector. These have been undertaken as a result of changes to methodologies, activity data and emission factors. For the energy sector, the recalculations resulted in an increase of 1.0 per cent in GHG emissions in the energy sector in 2004 compared with the 2005 submission, with the largest changes occurring in other, oil and natural gas, and solid fuels.

B. Reference and sectoral approaches

1. Comparison of the reference approach with the sectoral approach and international statistics

24. CO_2 emissions from fuel combustion have been calculated using the reference approach and the sectoral approach. For the year 2004, there is a difference of 4.7 per cent in the CO_2 emission estimates between the two. Explanations are provided in the documentation box to CRF table 1.A(c). In addition, the NIR provides explanations for the fluctuations in the differences between the approaches. Some of the explanations include: the use of IPCC default NCVs in the reference approach, while in the sectoral approach actual NCVs are taken to calculate energy consumption; and the use of different EFs (carbon content) for the sectoral and reference approaches.

25. Apparent consumption in Austria's reference approach for 2004 corresponds closely to the International Energy Agency (IEA) data. For 2004, there is a difference of 0.5 per cent between the reference approach and the IEA data. The errors are within 1.0 per cent for all available years. The growth rate between 1990 and 2004 for total apparent consumption was 30 per cent according to the CRF tables and 29 per cent according to the IEA data.

2. International bunker fuels

26. The fuel consumption and emissions from international aviation and international marine bunkers are reported separately in CRF table 1.C. Furthermore, fuel consumption for domestic aviation is separated from that for international aviation, and table 1.C provides information on this separation. Given the geographical location of Austria, no emissions are reported for marine bunker fuels.

3. Feedstocks and non-energy use of fuels

27. Information on feedstocks and non-energy use is well documented both in the CRF (table 1.A(d)) and in the NIR.

C. Key categories

1. Public electricity and heat production: solid/gaseous fuels – CO_2

28. The CO_2 implied emission factor (IEF) from solid fuels for public electricity and heat production increased by 5.0 per cent between 1990 (101.75 t/TJ) and 2004 (96.6 t/TJ). The Party explained that the fluctuations are due to changes in the fuel mix over the whole time series. Austria is encouraged to report this explanation in the NIR.

29. The ERT noted that the Party has used an IEF of 55.4 t/TJ for estimating CO_2 emissions from natural gas following the recommendations from previous ERTs that it check the CO_2 IEF for natural gas and update it if needed. The CO_2 IEF that was previously used (55.0 t/TJ) was the lowest of reporting Parties and lower than the IPCC default value (56.1 t/TJ). The ERT encourages the Party to use NCV and EF values based on actual measurements of natural gas composition obtained from the suppliers.

2. Manufacturing industries and construction: gas, solid, liquid fuels – CO_2

30. Some large inter-annual changes in fuel consumption for iron and steel were identified for 1991/1992 (–13.5 per cent) and 1996/1997 (–13.8 per cent). The Party explained that the fluctuations between 1990 and 1997 for iron and steel are due to lack of information on specific coke oven gas stock changes. The ERT recommends Austria to include this explanation in the NIR and also encourages Austria to provide information on coke oven gas stock changes in its next submission, if possible.

31. Some large inter-annual changes in fuel consumption and corresponding emissions in the chemicals, and pulp and paper have been identified. For chemicals (1998/1999 –36.3 per cent and 2003/2004 –16.0 per cent), and for pulp and paper (1993/1994 –20.6 per cent and 1996/1997 –23.2 per cent), respectively. The Party explained that inter-annual changes in fuel consumption for cellulose manufacturing come from two sources reporting either in the chemicals or pulp and paper section of statistics, and varies from year to year according to the main products of that year. The Party assured the ERT that there was no double counting. The ERT encourages the Party to provide this information in the next NIR.

3. Civil aviation: liquid fuels – CO_2

32. Large inter-annual changes in fuel consumption for jet kerosene were identified for civil aviation between 2000 (1,129 TJ) and 2003 (2,230 TJ) yielding a difference of 166.9 per cent for 2000/2001, 65.2 per cent for 2001/2002, and 112.6 per cent for 2002/2003. The Party explained that this difference is due to wrong activity data provided by Statistik Austria, which has since been updated. The ERT encourages the Party to use the updated data in its next submission.

33. CO_2 emissions from domestic civil aviation doubled from 2002 to 2004. The Party explained that the estimates are based on a new methodology introduced by Statistik Austria in 2000 for estimating kerosene consumption. However, this explanation is not consistent with a gradual change in total

landings and take-offs. The ERT recommends Austria to check the consistency of the time series and provide clear explanations in the NIR regarding the increase in emissions.

4. Road transportation: gasoline, diesel oil – CO_2

34. The 2004 value of the CO_2 IEF for gasoline (75.22 t/TJ) is the highest of reporting Parties and higher than the IPCC default value for Europe (73.1 t/TJ). This is due to the use of a low NCV for gasoline (41.6 TJ/t). This NCV is not consistent with standard product specifications and should be re-determined based on refinery measurements. The ERT recommends the Party to revise the NCV estimates using actual data. However, the estimates of CO_2 emissions are correct as the calculations are based on a constant CO_2 EF in kg CO_2/t fuel.

35. The CO_2 IEF for diesel oil between 1990 (74.01 t/TJ) and 2004 (72.81 t/TJ) decreased by 1.6 per cent. The Party explained that the low value of the IEF for 2004 was due to the introduction of biodiesel in the fuel mix in 2004. The ERT recommends Austria to include this explanation in its future NIRs.

5. Fugitive emissions: oil and natural gas – CH_4

36. Austria uses the IPCC tier 1 method based on default emission factors to estimate CH_4 emissions from natural gas distribution. Since CH_4 emissions from natural gas are a key category, the ERT encourages Austria to use a tier 2 method to estimate CH_4 emissions from natural gas distribution.

D. Non-key categories

Other sectors: all fuels – CO_2

37. Total fossil fuel consumption for the residential and commercial categories has remained quite stable in most recent years. However, during this period average climatic conditions did not remain the same and there was an increase in the number of buildings. The Party explained that this result is due to a combination of the switch to district heating (with consumption reported in the energy sector), the use of wood, and improved efficiency of stoves and heating equipment. The ERT recommends that clear explanations of this trend be included in the NIR.

III. Industrial processes and solvent and other product use

A. Sector overview

38. In 2004, emissions from the industrial processes sector accounted for 10.8 per cent of total national GHG emissions. CO_2 accounted for 81.6 per cent of the total emissions of the sector, HFCs for 9.1 per cent, N_2O for 2.8 per cent, SF_6 for 5.2 per cent, PFCs for 1.2 per cent and CH_4 for 0.1 per cent. Metal production was the primary source of emissions (44.7 per cent), followed by mineral products (31.5 per cent) and consumption of halocarbons and SF_6 (15.5 per cent). In 2004, solvent and other product use accounted for 0.5 per cent of total national GHG emissions. N_2O emissions accounted for 55.0 per cent of this total and CO_2 emissions for 45.0 per cent.

39. Austria has produced a relatively complete inventory of emissions for these sectors, although for some ODS substitutes (e.g. foam) all emissions may not be covered. For the year 2004, the Party has reported for the first time CO_2 emissions for limestone used in desulphurization, HFC emissions from aerosols/metered dose inhalers and solvents, and CH_4 emissions from ethylene. In the past, Austria was not assured of receiving data for some key categories, for example, cement production, due to problems with the availability of statistical data. Questions of data availability will be resolved for most key categories in future submissions as a result of the reporting requirements of the European Union emissions trading scheme. To improve the completeness of the inventory, the ERT encourages Austria to consider the recommendation below regarding consumption of halocarbons and SF_6 (see para. 41).

B. Key categories

1. Ammonia production – CO_2

40. Austria estimates CO_2 and CH_4 emissions from ammonia production. During the in-country review, Austria indicated that it assumes that all carbon in the natural gas feedstock is fully converted to CO_2. Given the assumption of full conversion to CO_2, the ERT concluded that CH_4 emissions from ammonia production are already accounted for in the CO_2 estimate. Furthermore, the ERT recommended that Austria investigate any possible double counting of CO_2 emissions between ammonia and urea production. Austria agreed with the ERT's recommendations, and subsequently provided revised estimates that reduced the estimates of CO_2 emissions from ammonia production by the quantity double counted.

41. The *Revised 1996 IPCC Guidelines for National Greenhouse Gas Inventories* (hereinafter referred to as the Revised 1996 IPCC Guidelines) state that intermediate binding of CO_2 in downstream products should not be accounted for; however, Austria accounts for the CO_2 bound in melamine production. During the review, Austria provided additional information on melamine production and the methodology for calculating emissions. The ERT considers the methodology to be consistent with the IPCC good practice guidance and encourages Austria to provide this detail in its NIR in order to enhance the transparency of its reporting.

2. Consumption of halocarbons and SF_6 – HFCs

42. Austria provides activity data for fluid filled into new products for various applications of ODS substitutes, for example, foams. Emissions from manufacturing, however, are reported as "not applicable" ("NA"). According to the IPCC good practice guidance, emissions occur as a result of manufacturing/installation, annual losses, and decommissioning. Although the study Austria references for its estimates of emissions for foams only considers annual losses, it acknowledges the existence of these other losses. The ERT encourages Austria to investigate whether emissions occur from foam manufacturing/installation or other ODS substitute applications to determine whether emissions are currently being underestimated.

3. Semiconductor manufacture – HFCs, PFCs, SF_6

43. Emission estimates are reported directly by industry for this category. Austria does not provide information in the NIR on the methodology used to estimate emissions. During the review, it was determined that the methodology is consistent with the IPCC good practice guidance. To enhance transparency in the inventory for this and other categories where company-specific data are reported, Austria is encouraged to provide information on the monitoring methods used, as well as the subsequent QA/QC procedures carried out to ensure data quality.

C. Non-key categories

1. Soda ash production and use – CO_2

44. Austria includes CO_2 emissions from soda ash use only in the glass industry. During the review, it indicated that it does not know of, or consider, any other industries where soda ash might be consumed. The ERT encourages Austria to review the additional uses of soda ash described in the Revised 1996 IPCC Guidelines (e.g. soaps and detergents, pulp and paper production and water treatment).

IV. Agriculture

A. Sector overview

45. In 2004, total emissions from the agriculture sector amounted to 7,863 Gg CO_2 equivalent and accounted for 8.6 per cent of total national GHG emissions. CH_4 accounted for 53.0 per cent of the sector's emissions and N_2O for 47.0 per cent. Emissions in 2004 were 13.8 per cent lower than in 1990. All relevant categories and GHGs are reported. Additionally, emissions of CH_4 from the spreading of sludge on soil as a fertilizer are estimated and reported under agricultural soils. The reporting for agriculture is consistent and complete for all years and categories.

46. The inventory uses a set of country-specific methodologies, in accordance with the IPCC good practice guidance, and they are supported by extensive background documentation based on surveys and scientific studies representing the country-specific conditions of all the Austrian regions. In particular, Austria uses country-specific methodologies to estimate gross energy intake, volatile solids excretion (VS) and N excretion rates from cattle in a consistent way for the source categories enteric fermentation (CH_4) and manure management (CH_4, N_2O). The ERT welcomes this development, but recommends that Austria further improve the transparency of the NIR by providing more information about supporting studies, and showing whether they reflect field data, expert judgement or studies reported in the scientific literature.

47. There are still some inconsistencies in the time series, particularly for livestock numbers of dairy cows, mother/suckling cows, young cattle (less than one year), young cattle (one to two years), poultry and equines, and these result from changes in the statistical information over the period. Austria has only made corrections to the original statistical information in order to achieve consistency for swine. The major problem concerns dairy cows, the numbers of which are estimated by subtracting the number of premium cows (representing mother cows) from the total number of cows. This is causing inter-annual variations in the number of dairy cows and mother cows. The ERT recommends that Austria make further efforts to improve the consistency of the time series.

B. Key categories

1. Enteric fermentation – CH_4

48. The time series of the CH_4 IEF for dairy cattle shows possible inconsistencies, with an inter-annual increase of 13.3 per cent from 1994 to 1995; this corresponds with a similar increase in milk yield which reflects (a) a conversion of some dairy cows to mother cows over these two years, following milk quota constraints and financial support for the change, and (b) a change in the statistical procedures that Statistik Austria used to quantify milk yield. This causes problems in the transparency of the inventory and its comparability to those of other Parties, and the ERT recommends that Austria make efforts to improve the consistency in the time trend of milk yield, dairy cows and mother cows and further verify the strong inter-annual variation from 1994 to 1995.

49. Austria uses country-specific CH_4 IEFs for non-dairy cattle, set individually for each cattle sub-class, but they are constant over the period 1990–2004. The EF for the sub-class mother/suckling cows is not well documented in the NIR, and the basic assumption – an annual milk yield of 3,000 kg/head/year – appears to be high when compared both to the underlying data in the Revised 1996 IPCC Guidelines and to the milk yield reported by Austria for dairy cows for the year 1990. Further information/documentation provided during the in-country review explains this value. The reasons for it are (a) the existence of a long milking period (8–11 months) and (b) the use of the breeds Fleckvie, Simmental and Pinzgau with a high milking capacity and whose calves have high daily weight gains (1.020–1.493 kg/day) and feeding requirements. The milk production per mother cow appears to be consistent with the growth rate of calves and the solid feed intake that Austria uses to derive the country-specific CH_4 IEF for young cattle less than one year old, and Austria provided supporting documentation

during the in-country visit. Nevertheless, there is no clear justification as to why the EF should be constant from 1990 to 2004 or as to why the CH_4 IEFs for each non-dairy cattle sub-class remain constant over the period. This could be causing underestimation of emissions in the more recent years. The ERT recommends that Austria analyse the possible existence of time trends in the CH_4 IEF for each sub-class, in particular for mother cows, and provide further explanation of the comparatively high CH_4 IEF for suckling cows in the base year in its future NIRs.

2. Manure management – CH_4

50. Austria has used a constant share of animal waste management systems (AWMS) in the period 1990–2004 based on information from surveys made in the early 1990s. However, Austria is aware that the real shares of the different AWMS have changed over the period and that new treatment systems, such as anaerobic treatment and biogas production, are currently changing the original pattern. The ERT welcomes Austria's intention to update this information. The ERT also recommends that Austria make efforts to improve its information about "other" treatment for poultry.

3. Manure management – N_2O

51. In CRF table 4.B(b), the population of swine multiplied by the corresponding N excretion ratio does not equal the total N excretion rate reported in the same table. According to explanations provided by Austria, the reason for this is that "animal numbers of young swine were not taken into account because the emission factor for breeding sows already includes nursery and growing pigs". Although this does not affect the emission estimates, it may introduce some lack of transparency and comparability, and the ERT recommends Austria to revise its reporting procedures.

4. Agricultural soils – N_2O

52. Austria is using two-year annual sales of synthetic nitrogen fertilizers, while in accordance with the IPCC good practice guidance activity data should refer to fertilizer use. The time-trend in the period 1990–1994 shows the existence of strong inter-annual variations, but Austria, during the in-country visit, stated that these annual variations result only from market conditions, taxes and inter annual variations in price and stocking, and that annual use of fertilizer should show a more stable evolution. The ERT recommends that Austria consider revising the time-series in order to determine true fertilizer use and improve consistency in time-series.

53. From the information provided during the in-country visit, Austria is not considering some sources of nitrogen to soil, such as compost produced from wastewater. Emissions could be underestimated and the ERT recommends Austria to clarify this issue and add this source if adequate.

54. Austria has not provided sufficient information about the volatilization ratios of ammonia (NH_3) and nitrogen oxide (NO_X) from animal manure in the NIR. The methodology and parameters referenced are from the EMEP/CORINAIR Emission Inventory Guidebook and are included in Austria's Informative Report submitted under the United Nations Economic Commission for Europe (UN-ECE) Convention on Long-Range Transboundary Air Pollution (CLRTAP). Because Austria is currently using a different $Frac_{GASM}$ for each specific AWMS, while only one value is reported in CRF table 4.D, with no clear explanation as to which specific AWMS is applicable, the transparency of the inventory is impaired. The ERT recommends Austria to include the relevant information about the determination of volatilization ratios in its future NIRs.

C. Non-key categories

Agricultural soils – CH_4

55. Austria reports a small quantity of CH_4 emissions from the application of sewage sludge to soils under "other". The ERT acknowledged that Austria is using an appropriate country-specific

methodology which, although different from the methodology proposed in the IPCC good practice guidance and the Revised 1996 IPCC Guidelines, is well documented and does not cause double counting of emissions reported in the waste sector.

V. Land use, land-use change and forestry

A. Sector overview

56. In 2004, the LULUCF sector in Austria represented a net sink of 16,630 Gg CO_2 equivalent, offsetting 18.2 per cent of total national GHG emissions. Since 1990, the LULUCF sector has continuously been a net sink, ranging between 9,659 and 21,375 Gg CO_2 equivalent.

57. The CRF for 2004 includes estimates of CO_2 emissions/removals for all six land-use categories in the LULUCF sector, and N_2O emissions from disturbance associated with land-use conversion to cropland, as well as N_2O and CH_4 emissions from wildfires in forests. Carbon stock changes in living biomass, dead organic matter and soils, as well as CO_2 emissions from liming, are reported under the relevant categories.

58. Austria's GHG inventory is largely based on its National Forest Inventory (NFI), which has a very comprehensive QA/QC system. The Party reports a complete uncertainty analysis for the categories forest land, cropland and grassland. Tier 1 methods in the IPCC *Good Practice Guidance for Land Use, Land-Use Change and Forestry* (hereinafter referred to as the IPCC good practice guidance for LULUCF) are used to estimate emissions/removals for the key categories cropland remaining cropland, and grassland remaining grassland and partly for forest land remaining forest land. The ERT recommends the Party to use higher-tier methods in its future submissions.

59. The ERT noted that an additional parameter (0.66) has been introduced when the Party uses the IPCC tier 1 method to estimate carbon stock changes in soils for land-use conversions. This is not consistent with the IPCC good practice guidance for LULUCF and tends to underestimate soil carbon stock changes. The ERT therefore recommends the Party either to follow the IPCC tier 1 method strictly or to develop a country-specific method.

B. Key categories

1. Forest land remaining forest land – CO_2

60. Net CO_2 removals for forest land remaining forest land for the year 2004 amounted to 16,936 Gg CO_2. Carbon stock changes in dead wood have been estimated and reported for the first time. Allometric equations are used to estimate the carbon stock changes in living biomass of the non-commercial part of trees.

61. The areas of land converted to forest land are estimated based on NFIs for the periods 1992–1996 and 2000–2002. This is not consistent with the IPCC good practice guidance for LULUCF, which defines the land-use conversion period as 20 years or longer. Austria's current breakdown of the category forest land tends to overestimate CO_2 removals for forest land remaining forest land. The ERT recommends the Party to use 20 years as the conversion period to distinguish the subcategories for forest land, with help from statistical data and/or satellite imagery/aerial photography.

62. Carbon stock changes in soils for forest land remaining forest land are assumed to be zero, based on the tier 1 method in the IPCC good practice guidance for LULUCF. A reassessment of the forest soil inventory is currently ongoing, and there is a proposal to derive models. The ERT acknowledges that this would make it possible to improve the estimates of carbon stock changes in forest soils.

2. Cropland remaining cropland – CO_2

63. Cropland remaining cropland in Austria was a net sink of 82 Gg CO_2 in 2004. Except for soil carbon stock changes, where a country-specific method is used, tier 1 methods and default parameters from the IPCC good practice guidance for LULUCF are used. The ERT recommends Austria to use higher-tier methods for this category.

3. Land converted to grassland – CO_2

64. Austria has established a complete land use and land-use change matrix related to grassland. This provides the basis for complete and transparent estimating and reporting of CO_2 removals/emissions for the category land converted to grassland. This category was a net source of 326 Gg CO_2 in 2004. Except for soil carbon stock changes, where a country-specific method is used, tier 1 methods and default parameters from the IPCC good practice guidance for LULUCF are used. The ERT recommends Austria to use higher-tier methods for this category.

C. Non-key categories

1. Wetlands, settlements and other land – CO_2

65. For the categories wetlands, settlements and other land, Austria estimates CO_2 removals/emissions for forest land converted to x land. 'Land remaining land' is reported as "not estimated" ("NE"), while all other categories are reported as "NO". Uncertainties have not been analysed for any of these categories. The ERT encourages Austria to extend its reporting and its uncertainty analysis in these categories.

2. Land converted to forest land – CO_2

66. The methods and parameters used for estimating carbon stock change in soil for land conversion to and from forests are not clearly documented in the NIR. The ERT recommends Austria to present the formula and related parameters (e.g., equilibrium carbon stock in soils before and after land conversion) in its future submissions.

3. Carbon emissions from agricultural lime application – CO_2

67. The calculation of activity data (the amount of lime applied) for carbon emissions from agricultural lime application is not presented sufficiently clearly in the NIR. The ERT recommends Austria also to present area and amount of liming for each land use/management type with lime application in its future submissions.

VI. Waste

A. Sector overview

68. In 2004, the waste sector in Austria emitted 2,580 Gg CO_2 equivalent, or 2.8 per cent of total national GHG emissions. In the base year the corresponding figures were emissions of 3,647 Gg CO_2 equivalent (4.6 per cent of total national GHG emissions). The decrease in emissions is mainly due to the implementation of a policy of separate collection of bio-organic and paper waste, which resulted in a decrease in degradable organic carbon (DOC) throughout the period.

69. The emissions inventory for the waste sector is almost complete since it covers all categories and gases, except that an estimate for a part of waste-water handling is missing. All the required CRF tables have been provided for all years 1990–2004.

70. Following the recommendation of the previous review, Austria has made considerable improvements to both the methodology and data preparation. The methodologies used are transparent, although some additional explanations had to be provided during the in-country visit.

71. Recalculations for 1990–2003 have been carried out because of methodological changes and the collection of new data. During the in-country review, the Party carried out additional recalculations, in response to the ERT's comments, in order to complete the emission estimates for waste-water handling.

72. QA/QC procedures are implemented for data collection as well as for estimating emissions. The Party provided uncertainty estimates for some categories based on a study conducted in 1999–2001 and expert judgement. The ERT welcomes the Party's plan to collect more data to fill some of the data gaps identified, mainly for the amounts of waste landfilled, industrial waste water, clinical waste and waste oil incinerated, and to update the uncertainty estimates based on a study that is planned for 2007.

73. It is praiseworthy that Austria reports the emissions correctly under the appropriate sectors when there is a link between the waste and other sectors. For example, it reports CH_4 from solid waste disposal on land and CH_4 from anaerobic digestion of waste water and sludge in the energy sector, as landfill gas and CH_4 from anaerobic digestion are used to produce energy. Also, when waste incineration is used for energy purposes, Austria reports the emissions in the energy sector. Emissions from sludge spreading on agricultural soils are reported in the agriculture sector.

B. Key categories

1. Solid waste disposal on land – CH_4

74. Following a recommendation by the previous review, Austria has moved from a country-specific method, which overestimates emissions, to the IPCC tier 2 methodology. The use of IPCC tier 2 is in line with the IPCC good practice guidance as this is a key category.

75. Austria has used a combination of well-documented country-specific parameters (DOC, half-life periods, fractions of CH_4 in landfill gas, share of landfill gas recovered) and IPCC default values (for the fraction of DOC dissimilated and the methane correction factor (MCF)). The decrease in the DOC, as correctly justified by Austria, is due to changes in the composition of landfilled waste because of the policy of separating bio-organic waste and paper. Nonetheless, the values from 1999 onwards should be updated when the planned studies become available; so far Austria has used the same figure for all years in the period since 1999 as no activity data are available.

76. To fill in data gaps, Austria has used extrapolation based on a driver (gross domestic product (GDP)) to estimate activity data for non-residual waste, and during the in-country visit it provided the spreadsheet used to apply the method. Austria has used also a comparison of data sets to estimate the amount of residual waste from administrative facilities of industries and businesses. However, the amount of waste considered as landfilled waste in 2002–2004, and possibly later as well, should be reconsidered to avoid overestimating CH_4 emissions, because the current method double counts the waste removed from old landfills to other landfills. The ERT encourages Austria to implement the data checks from statistics during the QA/QC procedures in order to identify possible double counting of data.

77. Austria reports CH_4 emissions from landfill gas collected and used for energy purposes in the energy sector. The ERT encourages Austria to continue to do so.

2. Waste-water handling – N_2O

78. Austria uses a transparent country-specific method to estimate N_2O emissions from human sewage, which is in line with the IPCC good practice guidance. The country-specific method is an improvement on the IPCC default method because two additional factors – the percentage of nitrogen

that is denitrificated and the amount of waste water treated in sewage plants – have been added to better account for the national circumstances of Austria.

79. However, the estimate in this category is incomplete because this method applies only to human sewage treated in sewage plants and does not take into account the fact that N_2O emissions from human sewage occur regardless of whether the sewage is treated in a sewage plant or not. As the share of the population not connected to sewage plants was about 41 per cent in 1990, and 11 per cent in 2004, excluding that population leads to an underestimate of emissions for the whole time series.

80. After a discussion during the in-country visit, the Party agreed to apply the country-specific method to the proportion of the population that is connected to sewage plants and to use the IPCC default for the population that is not so connected, in order to make the emission estimates complete. During the review Austria provided a well-based recalculation which shows that the missing estimate for 1990 is 0.29 Gg N_2O (i.e. 91 Gg CO_2 equivalent) and for 2004 is 28 Gg CO_2 equivalent. Austria is encouraged to take into account the recalculation for the whole time series and to apply the same approach to its next submission.

81. Regarding N_2O emissions from industrial waste-water handling, relevant activity data do not exist. Austria therefore uses expert judgement, which assumes that N_2O emissions from industrial waste-water handling account for 30 per cent of total N_2O from waste water. This assumption is not supported by data at present, but Austria plans to conduct a study on N_2O emissions from industrial waste-water handling. The ERT encourages it to take the results of that study into account in its future submissions.

C. Non-key categories

1. Waste-water handling – CH_4

82. The estimates for this category have been prepared using a transparent method and are complete: they cover CH_4 emissions from municipal and domestic waste-water handling. The Party has used IPCC defaults for biochemical oxygen demand (BOD_5) as well as for methane producing capacity (B_o). A well-documented country-specific MCF for municipal waste water, which was derived from national studies taking into account the temperature in septic tanks and cesspools, has been used. During the in-country review Austria provided data on the proportion of the population that is connected to septic tanks and cesspools. With regard to industrial waste water, treatment is usually carried out under aerobic conditions. Emissions relating to the energy recovered from the anaerobic digestion of waste water and sludge are reported in the energy sector, and the CH_4 emitted from sludge spread on agricultural soils is reported in the agriculture sector, which is in line with the IPCC good practice guidance.

2. Waste incineration – CO_2, CH_4, N_2O

83. The Party uses a mix of well-documented country-specific data and IPCC defaults. Emissions from incineration with energy recovery are reported in the energy sector and emissions from incineration without energy recovery are reported in the waste sector.

84. During the review, the Party provided data on different types of waste incinerated with and without energy recovery (municipal waste, clinical waste, waste oil). Austria is encouraged to provide such a table in its next submission. Some lack of data on clinical and oil wastes from 1995 and 1999, respectively, was identified, but the Party plans to collect these data through a study that is already being planned.

3. Compost production – CH_4, N_2O

85. Austria uses a country-specific method and emission factors (for mechanical–biological-treated residual waste; bio-waste, loppings, home composting; sewage sludge) from country-specific studies. The method and factors are correctly applied.

VII. Conclusions and recommendations

86. Austria has submitted a complete set of CRF tables for the years 1990–2004 and an NIR which is complete in terms of geographical coverage, years and sectors, and fairly complete in terms of categories and gases. During the in-country review the Party and the ERT agreed on some changes to be made for some categories in the industrial processes, agriculture and waste sectors.

87. In the course of the review, the ERT formulated a number of recommendations relating to the completeness and transparency of Austria's information reported. The key recommendations[3] are that Austria:

- In the general part: extend its QA/QC and uncertainty analyses to all categories of the inventory;
- In the energy sector: revise the NCV estimates of gasoline using actual data, consistent with the reported EF; include explanations in the NIR of the trend of total fossil fuel consumption for the residential and commercial categories in most recent years;
- In the agriculture sector: make further efforts to improve the consistency of the time series of the number of dairy cows and mother cows; include more information in its NIR about methodologies used to estimate gross energy intake, VS and N excretion rates from cattle, in particular providing supporting studies and showing whether they reflect field data, expert judgement or literature studies; and provide further explanation of the comparatively high CH_4 IEF for suckling cows in the base year in its future NIRs;
- For LULUCF: use higher-tier methods in its future submissions to estimate emissions/removals for the key categories forest land remaining forest land, cropland remaining cropland and grassland remaining grassland; use 20 years as the conversion period to distinguish the subcategories of forest land in order to be consistent with the IPCC good practice guidance for LULUCF; and document in the NIR the methods and parameters used for estimating soil carbon stock change for land conversion to and from forests, and for calculating activity data (the amount of lime applied) for the category carbon emissions from agricultural lime application.

[3] For a complete list of recommendations, the relevant sections of this report should be consulted.

Annex

Documents and information used during the review

A. Reference documents

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Anderl M. (2007b): Comments about milk yield and length of suckling in Austria. Including consultation with ZAR (Federation of Austrian Cattle Breeders). Provided in written format to the ERT on 15 February 2007.

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