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Report of the individual review of the greenhouse gas inventory of Germany 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 Germany, coordinated by the United Nations Framework Convention on Climate Change (UNFCCC) secretariat, in accordance with decision 19/CP.8. The review took place from 11 to 16 June 2007 in Berlin, Germany, and was conducted by the following team of nominated experts from the roster of experts: generalist – Mr. Art Jaques (Canada); energy – Ms. Kristin Rydal (Norway); industrial processes – Mr. Stanford Mwakasonda (South Africa); agriculture – Mr. Michael Anderl (Austria); land use, land-use change and forestry (LULUCF) – Mr. Nagmeldin Elhassan (Sudan); waste – Mr. Philip Acquah (Ghana). Mr. Art Jaques and Mr. Philip Acquah were the lead reviewers. The review was coordinated by Ms. Astrid Olsson (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 Germany, 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, Germany submitted a complete set of common reporting format (CRF) tables for the years 1990–2004 and a national inventory report (NIR). Germany submitted a revised GHG inventory on 13 July 2007 in response to questions raised by the expert review team (ERT) during the course of the in-country visit. The submission of 13 July is used as the basis for this review. Where needed, ERT also used the previous submission (2005), 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 Germany was carbon dioxide (CO_2), which contributed 87.3 per cent of the total[1] national GHG emissions expressed in CO_2 eq.,[2] followed by nitrous oxide (N_2O), 6.3 per cent, and methane (CH_4), 5.1 per cent. Hydrofluorocarbons (HFCs), perfluorocarbons (PFCs) and sulphur hexafluoride (SF_6) taken together contributed 1.4 per cent of the overall GHG emissions in the country. The energy sector accounted for 81.6 per cent of the total GHG emissions followed by industrial processes (10.6 per cent), agriculture (6.3 per cent), waste (1.4 per cent), and solvent and other product use (0.1 per cent). Total GHG emissions amounted to 1,015,274.12 Gg CO2 eq. and decreased by 17.4 per cent from 1990 to 2004.

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

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

[2] In this report, the values for total and sectoral emissions for the complete time series, and in particular for the base year and in 2004, reflect the revised estimates submitted by Germany in the course of the review. These estimates differ from Germany's GHG inventory submitted in 2006.

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

GHG emissions (without LULUCF)	Gg CO_2 equivalent								Change
	Base year[a]	1990[a]	1995[a]	2000[a]	2001[a]	2002[a]	2003[a]	2004[a]	BY–2004 (%)
CO_2 (with LULUCF)	1 004 160.50	1 004 160.50	888 583.74	851 903.98	864 173.28	851 131.29	856 674.92	849 601.82	–15.4
CO_2 (without LULUCF)	1 032 776.20	1 032 776.20	920 120.46	886 258.25	899 301.01	886 480.30	892 545.17	885 854.24	–14.2
CH_4	99,794.73	99,794.73	81,748.39	64,912.49	62,083.99	59,162.28	56,171.82	51,442.99	–48.5
N_2O	84,783.26	84,783.26	77,682.97	59,627.13	60,352.15	59,779.84	62,433.72	64,282.68	–24.2
HFCs	4,368.78	4,368.78	6,476.87	6,557.30	7,975.22	8,648.48	8,487.63	8,804.72	101.5
PFCs	2,707.58	2,707.58	1,749.60	785.69	723.22	793.72	855.71	830.55	–69.3
SF_6	4,785.03	4,785.03	7,223.76	5,079.03	4,898.93	4,201.51	4,304.58	4,480.56	–6.4

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

[a] Germany submitted revised estimates for all the years of the time series, from the base year to 2004, in the course of the initial review on 13 July 2007. These estimates differ from Germany's GHG inventory submitted in 2006.

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

Sectors	Gg CO_2 equivalent								Change
	Base year[a]	1990[a]	1995[a]	2000[a]	2001[a]	2002[a]	2003[a]	2004[a]	BY–2004 (%)
Energy	987 871.48	987 871.48	870 539.29	831 012.61	847 188.08	834 436.86	839 013.24	827 982.91	–16.2
Industrial processes	120 149.67	120 149.67	121 376.92	101 215.10	99 914.48	100 098.26	103 326.83	107 481.80	–10.5
Solvent and other product use	2 088.54	2 088.54	1 672.86	1 257.18	1 174.04	1 174.04	1 174.04	1 174.04	–43.8
Agriculture	78 302.34	78 302.34	66 829.08	67 411.49	66 747.40	64 893.91	64 639.70	63 982.94	–18.3
LULUCF	–28 240.83	–28 240.83	–31 161.86	–33 932.66	–34 706.12	–34 927.40	–35 448.63	–35 830.80	26.9
Waste	40 428.68	40 428.68	34 209.03	21 901.90	19 888.90	18 041.46	16 223.20	14 652.43	–63.8
Other	NO	NO	NO	NO	NO	NO	NO	NA	NA
Total (with LULUCF)	1 200 599.88	1 200 599.88	1 063 465.32	988 865.62	1 000 206.78	983 717.12	988 928.39	979 443.32	–18.4
Total (without LULUCF)	1 228 840.71	1 228 840.71	1 094 627.18	1 022 798.28	1 034 912.90	1 018 644.53	1 024 377.02	1 015 274.12	–17.4

Note: BY = Base year; LULUCF = Land use, land-use change and forestry; NA = Not applicable; NO = Not occurring.

[a] Germany submitted revised estimates for all the years of the time series, from the base year to 2004, in the course of the initial review on 13 July 2007. These estimates differ from Germany's GHG inventory submitted in 2006.

D. Key categories

6. Germany has reported a tier 1 key category analysis, both level and trend assessment, as part of its initial report submission. The key category analysis was performed for 1990 and 2004, and both excluding and including emissions from the LULUCF sector. The ERT noted inconsistencies in the text of the NIR that suggested that Germany had performed its key category analysis incorrectly and not according to the Intergovernmental Panel on Climate Change (IPCC) *Good Practice Guidance for Land Use, Land-use Change and Forestry* (hereinafter referred to as the IPCC good practice guidance for LULUCF), which requires that the contributions from all categories should be entered as absolute numbers for both the level and trend analysis. However, Germany clarified that the key category analysis was carried out correctly (confirmed on page 314 of the NIR), and that the apparent inconsistencies are the result of editing and translation problems in the NIR. Germany identifies CH_4 emissions from industrial wastewater as a key category, but this should be domestic and commercial wastewater. CH_4 emissions from industrial wastewater are reported as not estimated ("NE") or not occurring ("NO"), depending on the year. The results of the key category analysis along with areas identified through the quality assurance/quality control (QA/QC) plan are used as driving factors for the preparation of the inventory, particularly in prioritizing areas for improvement. The ERT recommends that Germany provide clearer and more consistent text on key category analysis in future NIRs. Germany indicated that improved documentation of the key category analysis is included in its 2007 submission.

7. The key category analyses performed by the Party and the secretariat[3] produced broadly similar results, with some slight differences. The analysis performed by Germany is more detailed and is based on information on 113 categories according to category, fuel use and different species of livestock, whereas the analysis performed by the secretariat is not as disaggregated (e.g. total stationary combustion, total enteric fermentation and total manure management). Germany is also developing a tier 2 key category analysis. The ERT commends this and recommends that Germany continue its work in this area.

E. Main findings

8. Germany has a very good inventory system, utilizing sector experts and other ministries in the preparation of the inventory. The NIR and CRF are complete and Germany has addressed many of the issues raised in previous ERT reports. Nevertheless, there are still areas that could be improved, including provision in the NIR of additional and more detailed information on methods used, in order to improve the transparency, completeness and comparability of the inventory. Additional references to sources and additional detail contained in the annexes to the NIR would help to achieve this. Germany has a very detailed and systematic QA system, and the ERT commends Germany for the work to date and encourages it to fully implement the QA/QC system. The ERT notes that this should be facilitated by the Policy Paper on the National System in which clear roles, responsibilities and funding are set out for a number of institutions.

[3] The secretariat identified, for each Party, those 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 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.

F. Cross-cutting topics

1. Completeness

9. The inventory submitted is essentially complete and covers all years from 1990 to 2004 and all sectors and gases, including actual emissions of HFCs, PFCs and SF_6. The CRF tables are completely filled in but there are minor inconsistencies with notation keys and explanatory notes are missing. Although to date no detailed information is available on the assessment of potentially excluded categories, the ERT notes that Germany reports in the NIR that it has carried out a research study examining other potential categories based on other countries' inventory data and plans to use the results in inventory planning. CRF table 7, on key categories, was not submitted with the original set of CRF tables; however, it was provided with Germany's resubmission.

2. Transparency

10. The NIR provides most of the information necessary to fully assess the inventory. The report is well structured and contains considerable information and explanatory material. Some additional information could improve the transparency of the NIR and will facilitate future reviews, particularly centralized and desk reviews. For example: additional information on sector-specific QA/QC activities; additional information on the choice of methods, activity data (AD) and emission factors (EFs), and data sources (why and how); and trends analyses of underlying drivers (population, gross domestic product, etc.). However, the ERT recommends that Germany reduce the descriptions of IPCC methods already contained in the *Revised 1996 IPCC Guidelines for National Greenhouse Gas Inventories* (hereinafter referred to as the Revised 1996 IPCC Guidelines) and the IPCC *Good Practice Guidance and Uncertainty Management in National Greenhouse Gas Inventories* (hereinafter referred to as the IPCC good practice guidance).

3. Recalculations and time-series consistency

11. The ERT noted that Germany's recalculations of its emissions between the 2005 submission and the 2006 submission resulted in a 1.2 per cent decrease for 1990 and a 0.7 per cent increase for 2003, excluding LULUCF and based on the revised estimates submitted on 13 July 2007.

12. The ERT noted that recalculations of the time series from the base year to 2003 had been undertaken to take into account a number of changes. The major changes were: increased emissions resulting from new surveys of secondary fuels, waste incineration and limestone inputs in iron and steel production; and decreased emissions from agriculture.

13. The recalculations have resulted in real improvements to the inventory. Many of the improvements are due to new survey data, the inclusion of previously omitted categories, changes in animal numbers, and the use of higher tier methods, which have all made the inventory more complete.

14. The ERT noted that Germany provides a substantial amount of information on recalculations in an explanatory form and recommends Germany to provide documentation in the NIR that reflects the essential elements of reporting on recalculations in accordance with the IPCC good practice guidance. These elements include: a description of the changed or refined method; the justification for the methodological change or refinement in terms of an improvement in accuracy, transparency or completeness; the approach used to calculate the previously submitted estimates; and a comparison of the results obtained using the new approach.

15. The ERT identified some inconsistencies between the information provided in the CRF tables and that provided in the NIR, primarily with respect to notation keys. These inconsistencies have been noted by the Party and will be addressed in future submissions. Apart from the inconsistencies noted, the ERT found the German inventory to be consistent in methods and approaches over the entire time series, and in line with the IPCC good practice guidance.

4. Uncertainties

16. Germany has provided a tier 1 uncertainty analysis for each category and for the inventory in total, following the IPCC good practice guidance. In the NIR, Germany noted that it has not determined all of the uncertainties for its GHG inventory and that efforts to do so are continuing. The ERT was informed during the in-country review that using expert judgement, uncertainties have been developed for some categories for the 2007 submission using a tier 2 Monte Carlo analysis. The uncertainty values for AD and EFs appear reasonable and are comparable with estimates reported by other Parties. EFs range from about 50 per cent for N_2O from combustion to 3 per cent for CO_2 for the same categories.

17. The NIR correctly identifies the underlying factors affecting the development of quantitative uncertainty analysis, given that a systematic and complete assessment is hindered by the variety of sources of AD, the variety of sources of expert judgements, and how model calculations and data manipulation affect the overall uncertainty rate. Table 6.1 of the IPCC good practice guidance is included in the NIR and presents tier 1 uncertainty estimates. Tier 2 uncertainty estimates have not been prepared and are therefore not presented in table 6.2 of the IPCC good practice guidance. Nor were the uncertainty estimates used in the key category analysis to prioritize improvements in the inventory; however, this is only one factor guiding inventory improvements. In response to the draft review report, Germany explained that Germany intends to perform a tier 2 uncertainty analysis every three years, and has done so for the first time for the 2007 submission. The ERT commends this and recommends that Germany continue its work in this area.

5. Verification and quality assurance/quality control approaches

18. Germany has elaborated and implemented a QA/QC plan in accordance with the IPCC good practice guidance. This includes general QC procedures (tier 1) as well as category-specific procedures (tier 2) for key categories and for those individual categories in which significant methodological and/or data revisions have occurred. The plan or "QSE Manual" includes specific tasks such as the identification of a QA/QC coordinator; general QC procedures (tier 1); category-specific QC procedures (tier 2); procedures for external reviews; procedures for monitoring, assessing and modifying the system for improvements; system documentation; and guides to implementing the QA/QC plan. There are clear benefits from well established relationships with data providers in government, private industry and consulting, and this allows for implementation of higher tier good practice methods. The ERT notes that this is a very positive aspect of Germany's national system, although there are implications for management of external data, specifically issues related to the treatment of confidentiality and the timeliness of data. The German system includes a detailed central archive as well as archives that are linked to the central archive but specific to certain institutions and sectors, for example, LULUCF.

19. The ERT recommends that Germany continue its current QA/QC practices and enhance them where possible (e.g. by holding regularly scheduled workshops to discuss methods, data quality, etc., developing additional agreements with industry associations and formalizing agreements with other government institutions to ensure continued timely and accurate information). Although the QA/QC plan is in line with the IPCC good practice guidance, the ERT notes that it is still evolving, in particular in respect of the specific roles and responsibilities of data developers and data suppliers in institutions outside Umweltbundesamt (UBA). Implementation of the policy paper on the national system, which was provided to the ERT during the in-country review, will be essential to fully implementing the QA/QC plan. The ERT further recommends that Germany clearly document the QA/QC systems of external data providers to ensure that they conform to the IPCC good practice guidance on the implementation of the national QA/QC plan.

20. Verification activities, such as comparisons with other countries (e.g. Finland), and comparisons of CO_2 emissions from other data sets (those of EUROSTAT, the International Energy Agency (IEA) and the Bundesländer) are good and in line with the IPCC good practice guidance. The ERT recommends

that additional category-specific analyses, such as those prepared for the in-country review, be incorporated into the QA/QC activities (e.g. analyses of trends and underlying drivers, as well as additional reviews, such as peer reviews, as part of QA). Currently, independent external reviews consist of United Nations reviews, reviews occurring as part of periodic workshops and ad hoc reviews with industry and outside experts. While not mandatory, the ERT recommends that a more formal, annual external peer review process be established as a means of improving the inventory, and notes that this is something that could be undertaken by the coordination committee proposed in the policy paper on the National System.

6. Follow-up to previous reviews

21. Germany has made improvements to the inventory, such as establishing more formal arrangements with data providers and data developers, the inclusion of additional categories, particularly in the industrial processes sector, agreements with data providers to produce more timely energy balances and the development of quantitative uncertainties.

G. Areas for further improvement

1. Identified by the Party

22. The NIR identifies several areas for improvement. These relate in particular to:

(a) Revisions to energy data for the new German Länder to improve consistency for the years 1991–1994;

(b) Research projects to review EFs that are technology dependent;

(c) Improved breakdown of energy versus non-energy use of fuels, and;

(d) The production of more timely national energy balances.

2. Identified by the ERT

23. The Party should:

(a) Provide a more precise description of country-specific methodologies that differ from the IPCC methodologies, focusing on the choice of methodology, a description of the specific methods applied and detailed reference to equations and parameters, such as information on the development of EFs for emissions from composting;

(b) Reduce the descriptions of IPCC methods already contained in the Revised 1996 IPCC Guidelines and the IPCC good practice guidance, and focus more reporting and documentation in the NIR on:

(i) Which method was used and why;

(ii) A short description of the methodology;

(iii) Clear references to the equations and parameters used;

(c) Improve the timeliness of the national energy balances;

(d) Continue the implementation of the QA/QC plan, in particular (where feasible and appropriate) the establishment of regular and systematic external peer reviews including QA/QC activities undertaken by agencies outside the UBA;

(e) Continue to improve the institutional arrangements by implementing the policy paper on the national system. Key to this will be the establishment of the coordination committee, and an ongoing commitment to fund the relevant agencies for all aspects of data development and quality.

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

II. Energy

A. Sector overview

25. In 2004, emissions from the energy sector accounted for 81.6 per cent of total emissions. CO_2 comprised 97.2 per cent of sectoral emissions, while CH_4 and N_2O contributed 2.0 per cent and 0.8 per cent, respectively. Fuel combustion accounted for 98.2 percent of the sectoral emissions and fugitive emissions for the remaining. Energy industries was the largest emitting category in 2004, contributing 44.4 per cent to total sectoral emissions, followed by transport (20.9 per cent), other sectors (20.7 per cent), and manufacturing industries and construction (12.1 per cent).

26. Total GHG emissions from the energy sector decreased by 16.2 per cent in the period 1990–2004. Since 1990, Germany has made large changes to the energy system, including the closure of inefficient plants, energy efficiency improvements and fuel switches, for example, from coal to natural gas. Changes have been particularly large in the new Länder.

27. The energy inventory of Germany is generally transparent and is complete with respect to all major and most minor categories. General and category-specific QA/QC procedures are in place. Improvements have been implemented since the 2005 submission, in particular improvements to the estimates for the base year and in the transparency in reporting manufacturing industries and construction by providing more disaggregated emissions data and AD. In response to previous review reports, emission estimates for CO_2 from biomass burning have been provided, estimates from waste incineration and use of secondary fuels in industry were improved, new categories were included for fugitive emissions from oil and gas (1.B.2), and the N_2O estimate for road transportation was revised as was the estimate of CH_4 emissions from solid fuels.

28. General combustion CO_2 EFs are not provided in the NIR for all fuels (only for coal and some types of gas) and this makes the review of inter-annual variations in implied emission factors (IEFs) difficult. These data were made available to the ERT during the review. It is recommended that the Party include data for the most important fuels, ranges if high detail, in the NIR.

29. Uncertainties have been estimated for all categories in line with the IPCC good practice guidance. These are transparently presented in the NIR. Country-specific values have been derived for most key categories.

30. Germany is planning further improvements in the coming years. The most important expected change is the consideration of non-energy use of fuels. The ERT was informed that this could result in a slight increase in reported emissions.

31. There is a lag in the delivery of final energy statistics for Germany of approximately four years. For this reason, data submitted for the two latest years (2003 and 2004 in the 2006 submission) are based on preliminary data and will be recalculated in future submissions. The delayed delivery of final energy statistics causes severe problems for the review of energy sector AD. The ERT was informed that Germany is undertaking measures to improve the timeliness of its energy statistics with the objective of providing final data with a delay of 1.5 years by 2008 and improved preliminary data. Noting the necessity of providing a timely inventory, the ERT welcomes this undertaking.

32. The process of reunifying East and West Germany began in 1990. The statistical system of East Germany had a different structure and level of accessibility to that of West Germany, which the current statistical system was developed from. The ERT was informed of Germany's efforts to ensure the quality and consistency of the energy statistics and emission estimates for the base year and to fill the gaps identified using the available data sources and expertise. The measures taken include consideration of the industrial structure, production volumes and energy use in the years for which more accurate information was available, and analysis of trends. Revisions were made within the framework of the national energy balance. EFs were also reviewed with respect to their applicability to the base year. This work has resulted in revised estimates for 1990.

B. Reference and sectoral approaches

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

33. For the years 1990 to 2004, CO_2 emissions from fuel combustion have been calculated using the reference approach and the sectoral approach. For 2004, the CO_2 emission estimates calculated using the sectoral approach are 7.6 per cent higher than those calculated using the reference approach. If emissions from the iron and steel industries are reallocated from the industrial processes sector to the energy sector, this difference is reduced to 1.9 per cent (these emissions are reported under industrial processes in the sectoral approach, while the fuel used is included in the energy balance used for the reference approach). The figures presented in this paragraph were provided during the review. In the official 2006 submission, the difference between the estimates obtained from the two approaches was 38,875.67 per cent and the Party suggested that this was due to problems with the transfer of data using the UNFCCC reporting software. One explanation for this huge difference could be that conversion factors in the column TJ/unit were entered with a factor of 1,000 rather than one. Liquid fuels were not included in the 2004 calculation. Germany is encouraged to perform a QA/QC of the reference approach calculation for all years to clarify the reasons for the huge discrepancies.

34. For 2004, the energy statistics provided in the CRF differ from those reported to the IEA. This is because of the abovementioned delays in the finalization of the energy statistics. The ERT strongly welcomes the planned improvements in timeliness.

35. The ERT noted with appreciation the work Germany has done in assessing the differences obtained using the reference approach and the sectoral approach and is satisfied with the explanations given both during the review and in the NIR. In general, additional improvements could be made by providing more concise and detailed descriptions of national methods and the underlying studies on which they are based. The ERT also notes the work done to date and recommends that, where possible, Germany continue to improve on the separation of fossil fuels used for feedstocks and non-energy use and combustion emissions.

2. International bunker fuels

36. Emissions from international aviation bunker fuels are estimated assuming that 80 per cent of total jet kerosene is used for international bunker fuel. This value is based on studies of flight movements in the 1990s. The ERT was informed that there are indications that international aviation is growing faster than domestic aviation, meaning that emissions from international bunker fuels reported for the most recent inventory years could be underestimated. Germany expects the results of ongoing work to improve future estimates for years after 1995. The ERT welcomes this planned improvement in future submissions.

37. Shipping bunker consumption is reported for gas/diesel oil and residual fuel oil. There is a high level of agreement between IEA data and the data reported in the CRF. In line with the Revised 1996 IPCC Guidelines, emissions from international bunker fuels are calculated and reported but not included in total national emissions.

3. Feedstocks and non-energy use of fuels

38. Germany has a large industrial sector that uses energy as feedstock. The complexity of energy flows and the confidentiality of plant-specific data prevent a top-down assessment of non-energy use of fuels. Furthermore, Germany has frequently used non-energy data as AD in the industrial processes sector. Germany explained that it has implemented QA/QC systems to avoid double counting or omissions of emissions. Germany has initiated a project for a more detailed assessment of non-energy use of fuels, which will result in revised estimates in future submissions. The ERT was informed that this could result in a slight increase in the level of reported emissions.

39. Process emissions from iron and steel production are reported under industrial processes in line with the Revised 1996 IPCC Guidelines. Emissions from the combustion of blast furnace gas are also reported under industrial processes, although the gas might be combusted in power plants or other combustion in the energy sector. However, AD are reported in the energy sector. The ERT was informed that QA/QC procedures are in place to avoid double counting of emissions.

4. Country-specific issues

40. Germany is assuming 100 per cent oxidation of fuels rather than a fraction unoxidized as recommended in the Revised 1996 IPCC Guidelines. This is based on expert judgement. The assumption of 100 per cent oxidation is consistent with the latest scientific literature available. The ERT strongly recommends that the chosen approach is used consistently in future submissions.

C. Key categories

1. Energy: general

41. Implementation of the European Union Emissions Trading Scheme (EU ETS) implies that a large share of Germany's CO_2 emissions will be reported by facilities included under this scheme. Germany is intending to use these data as a source of information to verify the inventory data reported to the UNFCCC. The inventory team does not have access to plant-specific data from the ETS but does have access to information at a more aggregated level. Verification will include both EFs and energy data. The ERT invites the Party to report the results of this verification in future NIRs and to use the results actively to improve the inventory if necessary. During the in-country visit, the ERT was provided with preliminary results showing that CO_2 EFs are generally applicable across the entire time series.

2. Stationary combustion: all fuels – N_2O

42. The N_2O EFs applied are based on a study of the technologies and fuels used for energy industries, and manufacturing industries and construction, which generally results in lower EFs than those reported in previous submissions. These revisions have only been implemented for inventory years after 1995. While inter-annual variations in IEFs can result from annual changes in the fuel and technology mix and are expected to fluctuate somewhat from year to year, the issue here is that the underlying EFs used for the years 1995–2004 are different from those used for the years 1990–1994. For all fuels there is a trend break between 1990 and 1995, where in most cases the IEFs for the base year are higher than those used for later years. This appears in all subcategories. Germany has informed the ERT that the problem described forms part of the ongoing inventory improvement process, and that it intends to include the updated N_2O EFs for the years before 1995 in the next submission of inventory data. As a follow-up to the review, Germany provided a recalculation of the N_2O emissions released from the energy industries and manufacturing industries and construction categories, demonstrating that this will lead to slightly higher emission estimates than those reported in the submitted inventory. This recalculation was not provided in the revised CRF and the ERT welcomes Germany's intention to improve the estimates for the years 1990–2004 in its 2009 submission.

43. Emissions from combustion of chemicals are reported as not occurring ("NO"), except for solid fuels which have been reported as included elsewhere ("IE"). The ERT was informed that all fuel combustion emissions in this category are reported under other (1.A.2.f) and that all fuels are relevant. The same is seen for fossil fuels for pulp, paper and print. The ERT recommends that emissions from chemicals and pulp, paper and print be reported separately or, if this is not possible, that the use of the notation key be changed from "NO" to "IE".

3. Civil aviation: liquid – CO_2

44. A CO_2 EF of 74.00 t/TJ has been used for the years 1990–1999 while a value of 73.265 t/TJ has been used for 2000–2004. The value used for 2000 onwards reflects the best available information on the actual carbon content of jet kerosene, and is consistent with values used by other Parties. There is no indication that the carbon content of jet kerosene changed substantially in the period 1990–2004. This implies an inconsistency in the time series 1990–1999. During the review, Germany provided revised estimates for CO_2 estimates for civil aviation for 1990–1999. The ERT concluded that the identified problem was resolved by this revision.

45. As reported under bunker fuels, the assumption of a 20:80 split for domestic to international aviation is likely to imply that domestic aviation emissions are being overestimated for the more recent years because international aviation has been growing faster than domestic. The ERT welcomes the planned improvements in emission estimates based on EUROCONTROL data and methods.

4. Road transportation: liquid – CO_2

46. The AD and emissions data for road transportation in the CRF tables are based on sales data for fuels. Germany also calculates fuel consumption bottom-up, using a model. The ratio of calculated fuel consumption to sales data has increased over the period 1990–2004. In 2004, sales data were 3.5 per cent lower than fuel consumption data. It was explained to the ERT during the in-country visit that the main reason for the difference in recent years is that German drivers are filling their vehicles with fuel in other countries due to tax differences. The ERT invites Germany to explain the effect on its fuel consumption of fuel purchased abroad in its next NIR and verify the fuel sold–fuel consumed discrepancy with independent data on the fuel trade with neighbouring countries if possible. In response to the draft review report, Germany informed the ERT that this recommendation is addressed in its 2008 submission.

5. Coal mining and handling: solid – CH_4

47. CH_4 emissions from decommissioned mines were lower in 2004 than in 1990 as reported in the CRF tables. Germany uses a country-specific method for its calculation, but this method is not explained in detail in the NIR and the underlying AD are provided neither in the NIR nor in the CRF. The ERT was provided with additional information and data during the in-country visit. The number of decommissioned mines has increased since 1990, but in recent years gas recovery has increased substantially owing to the country's renewable energy policy. The ERT recommends that Germany add transparency to its calculation by providing the number of decommissioned mines, potential emissions and gas recovery per year in its NIR.

6. Fugitive emissions: oil and natural gas – CH_4

48. CH_4 EFs for gas distribution have been declining since 1990 (the value was 789 kg/km in 1990 but 439 kg/km in 2004). The reference for EFs is a study from 1993. No details are provided in the NIR to explain the decline in the EF. During the in-country visit, additional information was made available to the ERT showing technology-specific EFs. Old technology used in East Germany in 1990 has been phased out and replaced with technologies with lower EFs. The ERT invites the Party to better explain the underlying drivers for reductions in emissions in the NIR. The ERT also encourages Germany to review the EFs used for more recent years, given that the EFs used are derived from a study which is

quite old. In response to the draft review report, Germany has informed the ERT that this recommendation is addressed in its 2008 submission.

49. Emissions of CO_2 from venting and flaring have been reported as included elsewhere ("IE"). However, no CO_2 emissions are reported under sector 1.B.2. Germany is invited to provide an estimate in its next submission or revise the notation key to not estimated ("NE").

D. Non-key categories

1. Road transportation: liquid – N_2O

50. Germany has updated its EFs for N_2O from road transport. The implied N_2O EF for gasoline for recent years (2.26 kg/TJ in 2004) is lower than those reported by most Parties with similar technology (an average of 8.2 kg/TJ for Western Europe and non-European Annex I Parties for 2004). Germany reports in its NIR that EFs have previously been considered too high for modern catalytic cars, and provides references to studies. It also states that there is limited empirical evidence for choosing technology-specific EFs and consequently some uncertainty. The ERT invites Germany to continue QA of the chosen EFs in the light of the results of future studies.

2. Navigation: liquid – All

51. The 2004 value of fuel consumption emissions from navigation is 57.6 per cent lower than the 1990 value. According to the Party, this is caused by changes in tax regimes which make German ships bunker abroad although in reality involved in domestic transport. According to the definitions contained in the IPCC good practice guidance, these emissions should be included in national totals. Germany is encouraged to assess the magnitude of the identified problem.

52. In the 2004 and 2005 review reports it was pointed out that passenger and fishing vessels were not included in the emission estimates. During the in-country visit, the ERT was informed that this category is included. Germany is invited to briefly clarify reporting of these categories in the NIR.

3. Other sectors: biomass, gas and other fuels – CO_2, CH_4 and N_2O

53. Use of biomass as energy has been increasing in recent years and the ERT was informed that consumption may be underestimated in official statistics. Work undertaken by the Renewable Energy Statistics Committee is expected to improve the estimates in the future. The ERT welcomes this planned improvement.

54. During the in-country visit, the ERT was informed that work was also under way to improve the emission estimates for residential combustion in general. It is expected that this revision will have the largest impact on CH_4 emissions from gaseous fuels.

55. CO_2 emissions from other fuels have been reported as not estimated ("NE"). The Party is encouraged to report these emissions in its future submissions or to demonstrate that emissions are negligible.

4. Fugitive emissions: oil and natural gas – CO_2

56. CO_2 emissions (venting and flaring) are reported as included elsewhere ("IE"). However, the NIR states that CO_2 emissions have not been estimated. Germany is invited to provide an estimate in its next submission or to revise the notation key to not estimated ("NE").

III. Industrial processes and solvent and other product use

A. Sector overview

57. Total GHG emissions from industrial processes amounted to 107,481.80 Gg CO_2 eq. in 2004, which was 10.6 per cent of total national GHG emissions (excluding LULUCF). Emissions from solvents and other products use, which consist only of N_2O emissions, were reported as 1,174.04 Gg CO_2 eq., which was 0.1 per cent of total national emissions (without LULUCF). Emissions from metal production accounted for 44.0 per cent of total sectoral emissions in 2004, followed by CO_2 emissions from the chemical industry (25.6 per cent) and from mineral products (19.2 per cent). Production of halocarbons and SF_6, and consumption of halocarbons and SF_6 emissions in the industrial processes sector accounted for 0.5 per cent and 10.5 per cent of emissions, respectively.

58. The ERT noted recalculations made in the industrial processes sector, prompted by new EFs, improved data and a change in methods. It was reported that new surveys of limestone inputs in the iron and steel production sector led to a major increase in emissions from the industrial processes sector. The ERT notes that these improvements should result in a more accurate inventory.

59. The ERT noted the Party's planned improvements in the estimation of emissions from non-energy use of feedstock in the industrial processes sector to reflect the importance of these emissions in the sectoral contribution to the total national GHG emissions of specific activities in the chemical industry (e.g. the use of natural gas for ammonia production) and in metal production (e.g. the use of coke as a reducing agent in iron and steel production, and in aluminium production). This is expected to lead to greater insight into how many fossil fuel industrial processes are included in the national energy balance under non-energy-related consumption. The ERT recommends that Germany continue to pursue such improvements.

60. The ERT noted that Germany provided a general discussion of uncertainties in different emission sources of the industrial processes sector, and mentioned planned improvement measures. Adequate details of category-specific QA/QC procedures were consistently included for every category.

B. Key categories

1. Cement production – CO_2

61. Germany uses a tier 2 approach to calculate cement production emissions on the basis of clinker production, as required by the IPCC good practice guidance. The NIR reports high country-specific calcium oxide (CaO) content in clinker of 64 to 67 per cent, which is higher than the IPCC default value of 65 per cent, and a subsequent EF of 0.53 t CO_2/t cement over the entire time series, also cited as used in the EU ETS. The ERT recommends that Germany continue monitoring average values of the CaO content of clinker so that an estimate can be developed periodically, for example every five years, to reflect changes in the industry, rather than rely on the same factor throughout the entire time series.

2. Lime production – CO_2

62. Germany reports estimates of emissions from lime production in accordance with the IPCC good practice guidance. Germany calculates EFs based on a combination of lime and dolomite lime production, resulting in an EF comparable with the IPCC default factors. The ERT recommends that Germany continue to use this approach in future inventories.

3. Ammonia production – CO_2

63. The Revised 1996 IPCC Guidelines state that the most accurate method for estimating CO_2 emissions from ammonia production is to base the calculation on the amount of natural gas used as feedstock. The German energy balance cannot provide this information. The ERT noted that Germany

normalizes ammonia production AD to nitrogen content AD. Plant-specific data are not available, so Germany uses the IPCC default value of 1.5 t CO_2/t NH_3 to estimate CO_2 emissions. As AD are given per tonne of nitrogen instead of tonne of ammonia, the EF is calculated per tonne of nitrogen, resulting in 1.815 t CO_2/t N. The ERT recognizes that Germany is making efforts to have plant-specific data available in future. The ERT recommends that this approach be followed.

4. Nitric acid production – N_2O

64. Because Germany does not have plant-specific EFs for estimating N_2O emissions, it uses the same EF of 5.5kg N_2O/t HNO_3 for all the years of the times series, which is a low value for old plants. The NIR indicates planned emission control standards for old plants, which should result in lower emissions and thus lower EFs. The ERT recommends that Germany pursue the use of plant-specific EFs, which the ERT notes will improve the inventory.

5. Adipic acid production – N_2O

65. The NIR states that production data for adipic acid are confidential. However, AD in the CRF tables are reported as not estimated ("NE") instead of confidential ("C"). The NIR states that adipic acid producers report their N_2O emissions along with necessary background information. Germany explained that emissions are calculated at a tier 3 level, which means that the two producers deliver data directly for the inventory. The ERT recommends that Germany use the appropriate notation key for the AD.

6. Other (chemical) – CO_2

66. The ERT noted that these emissions are reported for the first time in the 2006 inventory, and commends Germany for preparing a more complete inventory. The ERT further noted that the CO_2 emissions are reported as a non-key category in the body of the NIR, whereas they are included in the key categories table in the introduction. The ERT encourages Germany to address this discrepancy in future reporting.

7. Iron and steel production – CO_2

67. The ERT commends Germany for separating energy and process emissions in the use of reducing agents in blast furnaces, in accordance with the IPCC good practice guidance and as recommended in previous review reports. The ERT recommends Germany, if possible, to make a more concise description of the emission estimation method in the NIR rather than split it between the body of the report and the annex. Germany subsequently informed the ERT that it has revised its documentation completely in order to deliver a comprehensive description of the methods applied in its 2008 NIR.

8. Consumption of halocarbons and SF_6 – HFCs

68. The ERT noted a wide spectrum of emission activities due to consumption of halocarbons and SF_6. The ERT noted continued work on recalculation of previous estimates resulting from a research study and the resulting refinement of 1995 emissions. The ERT recommends that Germany complete the recalculation and fully document the changes in the next inventory report, as Germany has indicated in the NIR.

69. The ERT encourages Germany to provide additional details of the methodological issues affecting the reporting of actual emissions of fluorinated gases (F-gases) for the years 1990–1994.

C. Non-key categories

SF_6 used in aluminium and magnesium foundries – SF_6

70. The ERT noted that Germany used direct surveys (information from companies selling SF_6) to determine consumption of SF_6 gas in aluminium and magnesium foundries and, where possible, encourages Germany to obtain data directly from the aluminium and magnesium foundries using SF_6.

IV. Agriculture

A. Sector overview

71. In 2004 total emissions from the agriculture sector amounted to 63,982.94 Gg CO_2 eq. and contributed 6.3 per cent to total national GHG emissions. In 2004 CH_4 accounted for 36.1 per cent of the sector's emissions and N_2O for 63.9 per cent. Emissions in 2004 were 18.3 per cent lower than in 1990. All the relevant categories and GHGs are reported.

72. The inventory uses a set of country-specific methodologies, in accordance with the IPCC good practice guidance. For cattle and swine an enhanced livestock characterization is applied consistently across all categories. In particular, the input parameters applied for the estimations of gross energy intake, volatile solid (VS) excretion rate and nitrogen (N) excretion rates are obtained from official published studies and reflect German conditions.

73. In the 2006 submission a tier 2 approach has been applied for the first time for the calculation of CH_4 emissions for cattle and swine from enteric fermentation. The recalculation led to considerably lower estimates of emissions from non-dairy cattle. A tier 2 approach was also applied for the first time for the CH_4 emission estimates for cattle and swine from manure management, which again led to lower estimates. The more detailed calculations of N excretions for the manure management category as well as the inclusion of goats' manure for the first time caused slightly higher N_2O emissions from agricultural soils. Some inconsistency arose from incomplete activity time series for buffalo, sewage sludge and imported manure. This, however, had only a minor effect on emission totals. In response to the draft review report, Germany informed the ERT that complete time series have now been established including the base year.

74. The ERT welcomes the use of higher tier methods in the German inventory, but recommends that Germany further improve the transparency of the NIR by providing more detailed references and background information on the supporting studies. No AD are reported in the NIR. These data were provided in an appendix volume. Tables of the AD used should be included in the NIR. If data are different from those given in the official statistics, the rationale for this and the method of adjustment should be described more clearly. Additionally, a description of the most important trends in AD should be added. Particularly when input data are the result of a model (e.g. AD generated by the RAUMIS (Regionalisiertes Agrar- und Umweltinformationssystem für die Bundesrepublik Deutschland) modelling system), a more detailed description of the model as well as an interpretation of the main results of the model (e.g. animal waste management system (AWMS) distribution) should be given in the NIR.

B. Key categories

1. Enteric fermentation – CH_4

75. CH_4 emissions from enteric fermentation of dairy and non-dairy cattle are estimated using a tier 2 methodology. Although CH_4 emissions from swine are not a key category, a tier 2 methodology has been applied. CH_4 emissions from other animals are estimated using a tier 1 approach. This is in line with the IPCC good practice guidance. Gross energy intake of dairy and non-dairy cattle was calculated following the IPCC procedure, based on the feed requirements of the animals and the actual feed composition. The calculations resulted in considerably lower CH_4 IEFs for non-dairy cattle

(37.16–38.01 kg/head/yr 1990–2004) than those reported by other reporting Parties and the IPCC default value for Western Europe (48 kg/head/yr). During the in-country visit the low values could be explained by the specific age and breed composition of this animal category, resulting in low animal weights and lower required energy demand. In addition, for calves a lower methane conversion rate ($Y_m = 0.02$) than the default rate of 0.06 contained in the Revised 1996 IPCC Guidelines has been applied, as calves of these weights are not yet ruminants. These data were provided in an appendix volume. However, the ERT recommends that Germany provide more information on gross energy intake, corresponding milk yields and underlying feed properties in the NIR. More background information on the calculation of average animal weights should also be given.

2. Manure management – CH_4

76. For the storage of liquid manure, the methane conversion factor (MCF) of 10 per cent listed in the Revised 1996 IPCC Guidelines has been used rather than the MCF of 39 per cent listed in the IPCC good practice guidance. This produced considerably lower emission estimates than those in the previous (2005) submission. Germany explained that the value applied better reflects the current state of science and that it is consistent with the latest scientific literature available for liquid systems with and without natural crust cover. In a subsequent communication with the ERT, Germany stated that it will use the latest scientific literature available and the frequency distributions of crusted and uncrusted storage systems for the 2008 submission.

3. Direct soil emissions – N_2O

77. N_2O emissions from imported poultry manure and the spreading of sewage sludge are not estimated for 1990–1993, but are reported from 1994 (poultry manure) and 2001 (sewage sludge) onwards. To improve the consistency in the trend of AD, the Party is recommended to check whether emissions from imported manure and the spreading of sewage sludge occurred in the years 1990–1993 and 1990–2000, respectively. Direct N_2O emissions from these activities should be reported under other direct soil emissions (4.D.1.6).

78. Germany's calculations of N_2O emissions are based on the mass-flow approach. The detailed consideration of this approach to N losses in the different stages of manure management improves the accuracy of the estimates, but causes problems with the transparency of the inventory. To make the derivation of $Frac_{GASF}$ and $Frac_{GASM}$ more reproducible, the ERT recommends that Germany provide more information on the volatilization losses, especially the resulting N amounts from housing and storage and the N left for spreading and N input to soils.

4. Indirect emissions – N_2O

79. As a result of the German mass-flow approach, the amount of N used as AD for calculating atmospheric deposition is not consistent with the amount of N used for synthetic fertilizer and manure in the CRF and the reported values for $Frac_{GASF}$ and $Frac_{GASM}$. Nor is the amount of N used as AD for calculating leaching and run-off consistent with the data reported for the amount of N for synthetic fertilizer and manure in the CRF and the $Frac_{LEACH}$. To increase transparency in the calculation of AD as well as the derivation of the $Frac_{GASM}$ and $Frac_{GASF}$, the ERT recommends Germany to present more information on the N amounts and losses in the different stages of manure management.

V. Land use, land-use change and forestry

A. Sector overview

80. According to the data reported by Germany in its submission for 2004, the net GHG removal by the LULUCF sector is estimated at 35,830.80 Gg CO_2, which indicates an increase of 26.9 per cent compared to 1990 when net removal was 28,240.83 Gg CO_2. This net removal by sink offset about

3.5 per cent of the total GHG emissions from other sectors in 2004. The data submitted show that the LULUCF sector has been a net sink since 1990 with an annual average increase of about 1.7 per cent.

81. Germany provided a complete inventory submission in terms of the NIR and CRF tables, including recalculations for the period 1990–2004. However, not all the categories, pools and gases have been estimated. Under forest land, carbon stock change in dead organic matter and soil has been reported as not estimated ("NE"). The non-CO_2 gases (CH_4, CO and NO_X) are reported as not estimated and not occurring ("NE, NO") and N_2O is mostly reported as "NE, NO" except for land converted to cropland. Biomass burning is reported as included elsewhere ("IE"), "NO" and "NO", although the NIR does provide data for wildfires in managed forests. In a subsequent communication with the ERT, Germany explained that CO_2 emissions from wildfires are included in forest land remaining forest land (table 5.A) as the area burned remains as forest land and thus is covered by the forest inventories. Emissions from non-CO_2 gases due to wildfires are reported as "NO, NE" as there are no valid data for estimating them. Areas of wetlands and settlements are reported as "IE" without explanation of where they are included, while emissions/removals from these two categories are reported as "NE". CRF table 9(a) does not provide the required explanatory information on notation keys used. The NIR attributes this incompleteness in reporting to the lack of good quality data. During the in-country visit, Germany explained that the lack of good quality data is the main reason for the incompleteness in reporting. The ERT recommends that Germany use its best available data and expertise and, where possible, data from similar countries or international sources to provide complete reporting of at least for all the mandatory categories.

82. The NIR does not provide sufficient information on land-use definitions or the correspondence on the classification systems used for the LULUCF categories, the areas and land-use data sets used for the inventory preparation, the assumptions used in extrapolations and interpolations of AD and GHG estimates, or documentation on the country-specific methods. In addition, a summary table on the national areas of different land use and land-use change is missing from the QA/QC section. The ERT recommends that Germany improve the transparency of its GHG inventory by providing all the necessary documentation and information (e.g. the above-mentioned) in its future submissions, following closely the "Guidelines for the preparation of national communications by Parties included in Annex I to the Convention, Part I: UNFCCC reporting guidelines on annual inventories" (hereinafter referred to as the UNFCCC reporting guidelines) and the IPCC good practice guidance for LULUCF.

83. The NIR does not include sufficient information on the approaches and methods used for consistent land representation. Apart from tracking land-use change for cropland and grassland, it appeared to the ERT that Germany has not conducted a complete and consistent land representation for all land-use categories. Without consistent land representation, double counting or omission of an area might occur, leading to incorrect estimates of a source or a sink. The ERT observed that only three of the six IPCC categories have been reported separately; areas of wetland and settlement have been included in the other land category. It was therefore difficult for the ERT to track land-use changes and the derivation of the AD (e.g. areas). The total land area given in CRF tables 5.A–5.F differs from the land area of Germany according to data from the Food and Agriculture Organization of the United Nations (FAO). This could be an indication of double counting. The ERT recommends that Germany report a consistent representation for its total land area in accordance with the IPCC good practice guidance for LULUCF, harmonize its land-use definitions with the IPCC good practice guidance for LULUCF definitions (e.g. for other land, wetlands and settlements) and report each category separately, and provide sufficient documentation on the approaches, methods and data used for land representation in the NIR.

84. The institutional arrangements define roles and responsibilities for organizations involved in the preparation of the inventory for the LULUCF sector. During the in-country visit, the ERT learned that responsibility for forest land is assigned to the Federal Research Centre for Forestry and Forest Products (BFH) and that responsibility for cropland and grassland is assigned to the Federal Agricultural Research

Centre (FAL). For the remaining categories the responsible organization for the 2006 inventory preparation was not clearly identified. This will be resolved by the policy paper on the national system, which specifies the responsible organization for all the LULUCF categories. The ERT noted that some of the issues raised in this review report may be attributable to the current allocation of responsibilities and coordination mechanisms between the two institutions. It was also unclear to the ERT how the responsibility for decisions relating to the completeness of the inventory (e.g. coverage of sources/sinks) is handled during the inventory planning and preparation phase. The ERT recommends that good coordination and cooperation by organizations be maintained where it exists and enhanced where needed to ensure that a mechanism is in place to develop consistent land representation; a necessity for developing an inventory of good quality.

B. Key categories

1. Forest land – CO_2

85. Tier 2 methods are used and AD are mostly either country-specific or based on IPCC default data (e.g. density and root ratio values).

86. Estimation of carbon stock change in living biomass is based on the stock change method in the IPCC good practice guidance for LULUCF. The rationale for using the stock change method needs to be substantiated, given the good practice guidance on the selection of such a method. The application of the method differs from the IPCC good practice guidance for LULUCF. Germany estimates the change in carbon stock based on the total stock at two points in time regardless of any change in area, whereas the IPCC good practice guidance for LULUCF concept is based on the estimation of changes in carbon stock between two points in time in an equal unit of land. The way that Germany applies the stock change method can lead to an overestimation or underestimation of the carbon stock if the area of forest land at the latest point in time has increased or decreased.

87. Germany's application of the stock change method needs to be carefully assessed in the light of the following: In the NIR, it is stated that "forest-area data is not required for calculation of biomass stocks pursuant to the 'stock change method', but it must be reported in the CRF. The area data for individual years is based on linear interpolation". In the same section of the NIR it is reported that in the old German Länder (former West Germany), forest land remaining forest land decreased from 7,626.14 kha in 1990 to 7,572.27 kha in 2002, and in the new German Länder (former East Germany), it increased to 3,027 kha in 2004 from 2,582.5 kha in 1993. The ERT noted that the resulting estimates for net CO_2 removals in the forest land remaining forest land category show the same value (74,063.51 Gg) for every year in the time series 1990–2004, even though there is a change in area indicated by the abovementioned reported conversions. The ERT recommends that further clarification be provided in future NIRs on the approach used; specifically, which data are used from the federal forest inventory (BWI (Bundeswaldinventur) and BWI II) surveys in terms of definitions and survey data components.

88. Equation 25 in the NIR is a modification of equation 3.2.3 in the IPCC good practice guidance for LULUCF. The description of the logic and terms of this equation is not clear. For example, the same term V (volume) is multiplied by two types of density (D). In addition, the ERT notes that the units of the terms are not included. As is noted above, the manner in which the stock change method is applied can lead to an overestimation or underestimation of the carbon stock if the area of forest land changes. The ERT recommends that Germany provide a clearer description of the method and parameters used and the rationale for their choices, including additional notation for the volume of tree branches.

89. The ERT recommends that Germany revisit its application of the stock change method and the estimates obtained, taking into consideration the area and carbon stock for each species and/or forest type to ensure that estimates are in line with the IPCC good practice guidance for LULUCF, and sufficiently document all country-specific methods and equations. The ERT notes that there are inconsistencies in the text of the NIR that appear to indicate that Germany has performed its key category analysis

incorrectly and not according to the IPCC good practice guidance for LULUCF, which requires that the contributions from all categories should be entered as absolute numbers for both the level and trend analysis. Germany clarified this for the ERT indicating that the key category analysis was carried out correctly (confirmed on page 314 of the NIR), and that the apparent inconsistencies are the result of editing and translation problems in the NIR. The ERT recommends that Germany provide clearer and more consistent text on the key category analysis in future NIRs. Germany indicated that an improved documentation of the key category is included in its 2007 submission.

2. Cropland – CO_2

90. The same value for the net carbon stock change in living biomass/area for land converted to cropland is reported for all years from 1990 to 1999 (1.65 Mg C/ha) and from 2000 to 2004 (1.74 Mg C/ha). Similarly, the same value for the net carbon stock change in soils/area for land converted to cropland is reported for all years from 1990 to 1999 (–28.91 Mg C/ha) and from 2000 to 2004 (–30.78 Mg C/ha). The ERT believes this problem is probably due to the lack of consistent representation of land area. In the NIR, it is stated that "since 'wetlands' and 'settlement areas' are not reported and differentiated, the excess agricultural area is listed completely in table 5.F (other land), and additions to the agricultural area are shown, in tables 5.B and 5.C, in the line 'Other Land converted to…'". This statement indicates that the definitions and classification of land use are inconsistent with the IPCC good practice guidance for LULUCF, which may result in overestimation or underestimation of sources/sinks, as is described above. It is therefore apparent that there is an inconsistency in the time series due to inconsistent use of the carbon stock factors in living biomass/area for land converted to grassland (–12.57 Mg C/ha for the years 1990–1999 and –10.29 Mg C/ha for the years 2000–2004), and in soils/area for land converted to grassland (10.35 Mg C/ha for the years 1990–1999 and 11.09 Mg C/ha for the years 2000–2004).

91. In addition, the reason for changing the carbon factors is not provided in section 14.5 of the NIR, "Other detailed methodological descriptions for the source/sink category land-use change and forestry". The ERT recommends that the Party provide the justification for changing the carbon stock factors for the entire time series. The ERT also recommends that Germany harmonize its land-use definitions with the IPCC good practice guidance for LULUCF to avoid changes in carbon stock factors in living biomass/area for land converted to cropland and in soils/area for land converted to cropland for the entire time series.

3. Grassland – CO_2

92. Similar to cropland above, a number of subcategories have the same emissions and IEFs for the entire time series or have one value for the period 1990–1999 and another value for 2000–2004. For example, land converted to grassland is reported as a net source for the years 1990–1999 (273.02 Gg CO_2) and as a net sink from 2000 onwards (7,220 Gg CO_2). The value for the net carbon stock change in living biomass/area for land converted to grassland is stable between 1990 and 1999 (–12.57 Mg C/ha) and between 2000 and 2004 (–10.29 Mg C/ha). The value for the net carbon stock change in soils/area for land converted to grassland is also stable between 1990 and 1999 (10.35 Mg C/ha) and between 2000 and 2004 (11.09 Mg C/ha). As is noted in paragraph 91 above, the ERT recommends that Germany harmonize its land-use definitions with the IPCC good practice guidance for LULUCF to avoid changes in carbon stock factors in living biomass/area for land converted to grassland and in soils/area for land converted to cropland for the entire time series.

C. Non-key categories

Cropland – N_2O

93. The same value for the N_2O–N emissions per area converted to cropland is reported for every year between 1990 and 1999 (24.77 kg N_2O–N/ha). During the in-country visit, the ERT was informed

that this is due to the lack of good quality data and an incomplete time series of new data. The ERT believes that this problem could also be attributed to the lack of consistent representation of land area. In the NIR, it is stated that "since 'wetlands' and 'settlement areas' are not reported and differentiated, the excess agricultural area is listed completely in table 5.F (other land), and additions to the agricultural area are shown, in tables 5.B and 5.C, in the line 'Other Land converted to…'". This statement indicates that definitions and classification of land use are inconsistent with the IPCC good practice guidance for LULUCF, which may result in overestimation or underestimation of sources/sinks, as is described above. As is also noted above, the ERT recommends that Germany harmonize its land-use definitions with the IPCC good practice guidance for LULUCF to avoid changes in carbon stock factors in living biomass/area for land converted to grassland and in soils/area for land converted to cropland for the entire time series.

VI. Waste

A. Sector overview

94. In 2004, the waste sector accounted for 1.4 per cent of Germany's national total CO_2 eq. emissions, compared to 3.3 per cent in 1990. The largest category is CH_4 emissions from solid waste disposal on land, which contributed 82.2.per cent of sectoral emissions. Domestic and commercial wastewater handling accounted for 16.2 per cent. Sectoral emissions declined substantially by 63.8 per cent from 1990 to 2004.

95. Germany attributes the sharp reduction in the sectoral emissions (63.8 per cent) from 1990 to 2004 to the steady decrease in CH_4 emissions from solid waste disposal on land (–66.5 per cent) and from domestic and commercial wastewater (–95.9 per cent) between 1990 and 2004. These trends have been driven by various waste management policies and legislation since 1975, which promote and enforce compliance with recycling, reuse, and recovery of valuable waste materials as a sustainable resource for reductions in energy use and emissions. The legislation and enforcement of waste management policies has led to an increase in recycling of 650 per cent, in composting of 235 per cent, and in incineration with energy generation of 11 per cent, as well as a reduction in the amount of waste sent to landfill of 80 per cent. The ERT recommends that Germany provide more information, as presented during the in-country review, on its waste management policies and legislation in its next NIR.

B. Key categories

1. Solid waste disposal on land – CH_4

96. Solid waste disposal on land contributed 1.4 per cent of total national GHG emissions in 2004. The development and promotion of mechanical and biological treatment of waste before the landfilling of residues with very low degradable fractions has increased significantly since 1995. The ERT learned that the continued reduction in degradable fractions deposited in landfill sites is already leading to the closure of some disposal sites as a result of low activity rates.

97. Germany uses a revised first order decay (FOD) model (tier 2) to estimate CH_4 emissions from solid waste disposal on land. The revision of the model is based on results from a comprehensive national research project on the study and estimation of CH_4 emissions from solid waste disposal on land. The ERT notes the significant improvement in the methodology and AD provided by the research project, such as the compilation of AD for solid waste and sewage sludge disposed of to solid waste disposal sites from 1950 to 1975. In addition, the AD for industrial waste sent to landfill sites were estimated and accounted for in the model. Consistent with the IPCC good practice guidance, and in response to previous review reports (2004 and 2005), the research project also included a survey and construction of a waste composition time series that reflect the changing degradable organic carbon (DOC) over time. The DOC has hitherto been assumed to be constant for the entire time series.

2. Wastewater handling – CH_4

98. CH_4 emissions from domestic and commercial wastewater handling amounted to 91.1 Gg CO_2 eq. in 2004, a decrease of 95.9 per cent from 1990. The category comprises emissions from cesspool and septic tanks (1990–2004), and emissions from open sludge digestion that existed in the former East Germany from 1990–1994. CH_4 emissions from anaerobic treatment processes are integrated with gas recovery and therefore do not contribute to the emissions in this category. The sharp decline in emissions is attributed to the phasing out of open sludge digestion in 1995, and the increased percentage of the population connected to wastewater treatment facilities in areas that were not previously connected to the sewer network, especially in East Germany.

99. Germany used a tier 1 method for emissions from septic tanks and open sludge digestion, which is consistent with the IPCC good practice guidance. The organic load and the methane generation potential reported are based on IPCC default values. However, the MCF is based on values from other countries considered relevant to Germany's national circumstances. The methodological choices and assumptions are well documented in the NIR. The ERT noted that, in response to previous review comments, transparency in reporting of CH_4 emissions from domestic wastewater handling in the NIR has been improved with regard to separation of AD for the old and new Länder. For instance, the AD for organic wastewater loads for cesspool and septic tanks are included separately in the NIR for East and West Germany for the period 1990–1995.

100. During the in-country visit, the ERT learned that CH_4 emissions from industrial wastewater treatment plants with integrated aerobic and anaerobic processes are recovered for energy purposes or flared. The potential emissions are not estimated. Germany reported CH_4 emissions from aerobic and anaerobic wastewater treatment plants as not estimated ("NE"). The ERT notes that in aerobic processes, CH_4 emissions are reported as not occurring ("NO") because the fraction that actually degrades can be assumed to be zero in accordance with the IPCC good practice guidance. As such, the approach is comparable with that of other Parties and consistent with the IPCC good practice guidance. The notation key "NO" may therefore be appropriate and consistent with the information provided in the NIR. Nevertheless, the ERT encourages Germany to implement its improvement plan outlined in section 8.2.2.1.6 of the NIR and to carry out a research project to explore whether CH_4 can form in aerobic wastewater treatment under certain conditions and in certain process steps, which may improve on the current IPCC good practice guidance approach. In a subsequent communication with the ERT, Germany explained that at the time of preparing its 2007 inventory report, additional experts where involved in the inventory process who confirmed that CH_4 emissions only occur in anaerobic waste water treatment, where it is captured and used for energy recovery or is flared. No CH_4 emissions occur in aerobic wastewater treatment. Therefore, Germany concentrated its resources on other areas of inventory improvement. The chapter in the 2007 NIR was redrafted accordingly.

C. Non-key categories

1. Composting – CH_4, N_2O

101. Germany reported CH_4 and N_2O emissions from composting for the entire time series. The category was not estimated in previous years because EFs were not available. The ERT noted that Germany developed and documented country-specific EFs in 2002 in a research study referenced in the NIR. These EFs were summarized in the NIR. The ERT recommends that Germany summarize the country-specific methodology in future submissions to improve the transparency of the EF measurement, and of the emissions estimation method and assumptions. In response to the draft review report, the ERT was informed that Germany has summarized the methodological background of the country-specific EFs in its 2008 submission.

2. Wastewater handling – N_2O

102. Germany uses the tier 1 IPCC method to estimate N_2O emissions from human sewage. The ERT notes that Germany does not use the country-specific EF of 0.07–0.08g/m^3 wastewater that was developed and published in 1994 for lack of validation of it. The ERT welcomes Germany's intention to verify this country-specific EF as indicated in its future improvement plan.

103. Germany recalculated N_2O emissions from human sewage as a result of new population data obtained for the entire time series. The results showed a decrease in N_2O emissions of 0.1 per cent in 2004. The impact on the national total, however, is negligible.

VII. Conclusions and recommendations

104. The ERT concluded that the information provided by Germany is complete and submitted in accordance with the reporting guidelines for national GHG inventories. The Party's institutional arrangements are fully functional and, while complex, designed to utilize the best expertise and resources available to develop the inventory. Notwithstanding some limitations to the current institutional arrangements, the ERT was notably impressed. In order to make further improvements, the policy paper on Germany's national system must be fully implemented ensuring clear roles and responsibilities for different institutions, ongoing adequate resources, and the timely delivery and development of data.

105. Germany 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. The inventory is consistent with the UNFCCC reporting guidelines, the Revised 1996 IPCC Guidelines and the IPCC good practice guidance. However, there are some areas for further improvement. These include increased transparency in methods and QA/QC activities and further implementation of both more timely delivery of the energy balances and fully formalized institutional arrangements.

106. In the course of the review, the ERT formulated a number of recommendations relating to the completeness and transparency of Germany's information presented in the initial report. The key recommendations[4] are that Germany:

- Improve its institutional arrangements by implementing the policy paper on the national system. Key to this will be the establishment of the coordination committee, and an ongoing commitment to fund the relevant agencies for all aspects of data development and quality;
- Continue its current QA/QC practices and enhance them where possible (e.g. regularly scheduled workshops to discuss methods, data quality, etc; develop additional agreements with industry associations; and formalize agreements with other government institutions) to ensure continued timely and accurate information;
- Continue the improvements to the timeliness of the energy data and balances, improve on the allocation of non-energy use of fuels, provide better documentation of fugitive emissions, undertake additional verification studies and in general provide additional explanatory information on methods used in the NIR and clear references to additional material in annexes or other sources;
- Continue to document and implement the IPCC good practice guidance for LULUCF.

[4] 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

IPCC. Good practice guidance and uncertainty management in national greenhouse gas inventories, 2000. Available at <http://www.ipcc-nggip.iges.or.jp/public/gp/english/>.

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B. Additional information provided by the Party

Responses to questions during the review were received from Mr. Michael Strogies and Ms. Marion Dreher (Federal Environmental Agency) including additional material on the methodology and assumptions used.

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Roedenbeck, Inga A.E.: Bewertungskonzepte für eine nachhaltige und umweltverträgliche Landwirtschaft: Fünf Verfahren im Vergleich. BIOGUM-Forschungsbericht/BIOGUM Research-Paper No. 8, BIOGUM, Universität Hamburg, Hamburg, February 2004.

Schwarz, W., Wartmann, S.: Emissions and Emission Projections of HFC, PFC and SF_6 in Germany – Present State and the Development of a Monitoring System. Emissions 1990, 1999–2003 and Emission Forecast for 2010 and 2020. Umweltbundesamt, FKZ 202 41 356, 2005.

UBA DEHST. Report to the UNFCCC-pursuant to Decision 24/CP.8 on data Exchange Standards for Registry Systems under the Kyoto Protocol: Registry Initialization Specifications. April 2007.

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