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Report of the individual review of the greenhouse gas inventory of the United Kingdom of Great Britain and Northern Ireland submitted in 2005*

* In the symbol for this document, 2005 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 centralized review of the 2005 greenhouse gas (GHG) inventory submission of the United Kingdom of Great Britain and Northern Ireland, coordinated by the United Nations Framework Convention on Climate Change (UNFCCC) secretariat, in accordance with decision 19/CP.8. The review took place from 3 to 8 October 2005 in Bonn, Germany, and was conducted by the following team of nominated experts from the roster of experts: Generalist – Ms. Ruta Bubniene (Lithuania) and Ms. Anke Herold (European Community); Energy – Mr. Leif Hockstad (USA), Mr. Steven Oliver (Australia) and Mr. Michael Strogies (Germany); Industrial Processes – Ms. Ionela Draghici (Romania), Ms. Sonia Petrie (New Zealand), and Mr. Kiyoto Tanabe (Japan); Agriculture – Mr. Erda Lin (China) and Mr. Marcelo Rocha (Brazil); Land Use, Land-use Change and Forestry (LULUCF) – Mr. Jozef Mindas (Slovakia) and Mr. Justin Ford-Robertson (New Zealand); Waste – Mr. Ayite-Lo Ajavon (Togo) and Ms. Anke Herold. Mr. Ayite-Lo Ajavon and Ms. Anke Herold were the lead reviewers. The review was coordinated by Ms. Rocio Lichte (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", a draft version of this report was communicated to the Government of the United Kingdom, 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 2005 submission, the United Kingdom submitted a complete set of common reporting format (CRF) tables for the years 1990–2003 and a national inventory report (NIR). Where needed the expert review team (ERT) also used previous years' submissions, 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 2003, the most important GHG in the United Kingdom was carbon dioxide (CO_2), contributing 85.6 per cent to total[1] national GHG emissions expressed in CO_2 equivalent, followed by methane (CH_4), 6.2 per cent, and nitrous oxide (N_2O), also 6.2 per cent. Hydrofluorocarbons (HFCs) contributed 1.6 per cent, perfluorocarbons (PFCs) 0.1 per cent, and sulphur hexafluoride (SF_6) 0.2 per cent to the overall GHG emissions of the country. The Energy sector accounted for 87 per cent of total national GHG emissions, followed by Agriculture (7 per cent) and Industrial Processes (4.1 per cent). Total GHG emissions in 2003 amounted to 651,090 Gg CO_2 equivalent and had decreased by 13.0 per cent from 1990 to 2003. Emissions from the Energy, Agriculture and Waste sectors continue to decline – by 7 per cent, 14 per cent and 60 per cent, respectively, between 1990 and 2003. Emissions from the Industrial Processes sector show a decreasing trend until 2002 and an overall declining trend of 53 per cent over the entire period 1990–2003; however, emissions increased between 2002 and 2003. The LULUCF sector in 2003 constituted a net sink of 1,522 Gg CO_2 equivalent emissions whereas in 1990 it was a net source of 2,662 Gg CO_2 equivalent emissions.

[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.

D. Key categories

5. The United Kingdom has performed a tier 1 key category assessment, by both level and trend, including LULUCF, for its 2003 GHG inventory. Some categories are included in the key categories because of high uncertainties.

6. The United Kingdom's key category assessment includes LULUCF emissions and removals, but no separate analysis without LULUCF emissions and removals has been carried out. However, 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) recommends that key categories should first be identified for the inventory excluding LULUCF and then the analysis should be repeated for the full inventory including the LULUCF categories. Any non-LULUCF categories dropping out in the second step should still be considered as key. The assessment performed by the United Kingdom seems not to follow this stepwise approach and some non-LULUCF categories may have been omitted as a result. The United Kingdom announced that a stepwise analysis will be completed in 2005.

7. The key category analyses performed by the Party and the secretariat[2] produced slightly different results. The secretariat identified 18 key categories whereas the Party identified 13. There are a number of differences between the UNFCCC key category assessment and the analysis of the United Kingdom: category 1.A Stationary Combustion – Oil is not identified as key in the Party's assessment, but table A.1.1 of the NIR shows that this category should be included in the Party's key categories taking into account the 95 per cent threshold. The category 1.B.2 Natural Gas Transmission represents total CH_4 emissions from natural gas and not only transmission emissions. It is not clear why 1.B Oil and Natural Gas is treated at a more highly aggregated level for CO_2 and N_2O but is more disaggregated for CH_4. This does not seem to be fully in line with the IPCC *Good Practice Guidance and Uncertainty Management in National Greenhouse Gas Inventories* (hereinafter referred to as the IPCC good practice guidance). Higher aggregation might possibly make the category a key category. The ERT recommends the United Kingdom to reconsider the key category assessment in the light of these aspects. In its response to the review, the United Kingdom indicated that the analytical method will be reviewed for the 2006 inventory submission.

E. Main findings

8. In general, both the NIR and the CRF are largely complete and transparent. The inventory includes information on key categories, methods, data sources, emission factors (EFs), uncertainty estimates and quality assurance/quality control (QA/QC) procedures, and contains most of the relevant information needed for replication of the inventory. The methodologies for estimating GHG emissions are consistent with 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.

9. The ERT noted some minor questions of transparency and consistency, which are described in the sectoral sections of this report. It is evident that the inventory system of the United Kingdom is seeking to address many of the questions raised by previous review reports, either as part of work already under way or in direct response to the reviews.

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[2] The secretariat identified, for each individual Party, those source categories which 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 and Uncertainty Management in National Greenhouse Gas Inventories*. Key categories according to the tier 1 trend assessment were also identified for those Parties providing a full CRF for the year 1990. Where the Party has 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

10. The United Kingdom has provided complete CRF tables for 1990–2003, including estimates of LULUCF using the CRF LULUCF tables, as required by decision 13/CP.9. The CRF tables provided are largely complete in terms of source categories and geographical coverage with some minor omissions as described in the sectoral sections of this report below.

2. Transparency

11. The CRF tables and the NIR provide sufficient transparency to enable the assessment of the data used and methodology applied. The United Kingdom provides justification for the assumptions made and the choice of data and methods. More transparency would be appreciated in the Waste sector (source category Solid Waste Disposal on Land), the LULUCF sector (more information on the model used), the Industrial Processes sector (the reasons for the fluctuation in the EF for adipic acid) and the Energy sector (the reasons for the declining EF for coke). There are some inconsistencies between the NIR and the CRF due to recalculations in the Agriculture, Waste and Industrial Processes sectors. These are elaborated in more detail in the relevant sectoral sections of this report below.

3. Recalculations and time-series consistency

12. The ERT noted that recalculations reported by the Party of the time series 1990–2002 had been undertaken to take into account improved methods, revised EFs, updated activity data (AD) or the inclusion of new emission sources. The major changes include: the updating of carbon EFs for most fuels following a review of the United Kingdom; improvements to the method used to estimate emissions from international aviation; improvement of the method used for calculating emissions from iron and steel production; the addition of estimates for emissions from closed mines; the addition of CO_2 emissions from flue gas desulphurization; the revision of the EFs for cattle, affecting CH_4 emissions from enteric fermentation and manure management; the inclusion of CO_2 emissions from solid waste disposal sites; and the revision of methods in the LULUCF sector, including the updating of data on areas that have been afforested and the inclusion of disturbance and drainage of soils. A number of recalculations have been made in the Industrial Processes sector for the complete time series, including CO_2 emissions from limestone and dolomite use, and the categories Soda Ash Production, Ammonia Production and Iron and Steel Production. The United Kingdom provides recalculated estimates in tables 8(a) in the CRF and explanatory information in the CRF and the NIR. The result of the recalculations decreases the estimates of total base year emissions by 0.14 per cent and increases the estimates of total emissions for 2002 by 0.86 per cent. The rationales for the recalculations are usually provided except in the cases listed in the following paragraphs.

13. The recalculations for CH_4 emissions from enteric fermentation and manure management from dairy cattle are reported in the CRF and in the section on recalculations in the NIR, but the sectoral chapter indicates that no recalculations have been performed for enteric fermentation. The ERT would like to see further explanations of the revised EFs used in the NIR. In its response to the review, the United Kingdom indicated that further clarification on this will be provided in its next NIR.

14. In its 2005 inventory submission the United Kingdom has allocated carbon contained in tars and benzoles produced by coke ovens to 6.A.1 Solid Waste Disposal. This reallocation is discussed under Recalculations, and the associated CO_2 emissions are included in the CRF tables for Solid Waste Disposal, but the Waste section of the NIR continues to state that there are no CO_2 emissions from landfills and that no recalculations have been performed. In its response to the review, the United Kingdom indicated that further clarification on this will be provided in the NIR of its 2006 submission.

4. Uncertainties

15. The Party has performed a tier 1 and a tier 2 uncertainty assessment and included the LULUCF sector in the uncertainty estimation. However, the categories included refer to the Revised 1996 IPCC Guidelines and not the revised structure and categories of the IPCC good practice guidance for LULUCF. Detailed information on the uncertainty estimation is presented in an annex to the NIR. The previous (2004) review suggested that the United Kingdom provide quantitative results and qualitative discussions of the sources of uncertainty in individual source categories in the sectoral chapters of the NIR. This information is still not included.

16. The uncertainty estimation has not been updated following major revisions of the present inventory, for example, the major revisions of fuel-specific EFs are not reflected in the uncertainty estimation. The United Kingdom is planning a revision of its uncertainty estimates for AD and EFs, and the ERT supports this plan, in particular for those source categories where major recalculations and improvements have occurred.

5. Verification and quality assurance/quality control approaches

17. The United Kingdom has mainly followed the tier 1 QA/QC procedures set out in the IPCC good practice guidance, with several cases of tier 2 being applied for key categories. Source-specific QA/QC approaches are presented in the relevant sections of the NIR. The inventory is the subject of periodic internal and external audits. External peer reviews on CO_2 emissions from fossil fuel and on the Agriculture sector have been carried out. Quality management is coordinated by the nominated coordinator at the National Environmental Technology Centre (NETCEN), which is accredited for the international and quality management system standards of the United Kingdom. The system incorporates a series of activities which are carried out each year as the inventory is compiled. The ERT encourages the United Kingdom to continue with the implementation of a tier 2 approach for QA/QC for the remaining key categories.

18. The number of inconsistencies and minor mistakes in the NIR which are not critical to the total emission values may indicate that the QC procedures described in the NIR may not yet be fully implemented. For example, recalculations are reported in the CRF but not in the NIR. As indicated in paragraphs 13 and 14, recalculations have been carried out for some categories, but there is no explanation in the respective sectoral chapters of the NIR. Double checking should be carried out more carefully to ensure consistency. The ERT recommends that the United Kingdom describe in the NIR the QC procedures planned as well as those implemented.

6. Follow-up to previous reviews

19. The United Kingdom has made improvements to cross-cutting areas, such as improving the documentation of recalculations, the inclusion of a description of how plant-specific data are verified, the inclusion of tier 2 uncertainty estimation at source category level, a key category analysis for LULUCF categories and improved documentation of the key category analysis.

G. Areas for further improvement

1. Identified by the Party

20. In the NIR and in correspondence with the ERT the United Kingdom identified the following areas for improvement:

(a) A review of the methods for estimating feedstocks and non-energy fuel use and the provision of further information about this category;

(b) A review of the completeness of the GHG inventory of the United Kingdom;

(c) A review of the allocation of emissions to IPCC sectors.

2. Identified by the ERT

21. The ERT identifies the following cross-cutting issues for improvement:

(a) The key category analysis with and without LULUCF should be conducted and presented separately to be consistent with the IPCC good practice guidance for LULUCF, and the aggregation level chosen should be reconsidered;

(b) The uncertainty estimation should be updated, and more analysis and discussion of uncertainties in the sectoral chapters of the NIR should be provided;

(c) Consistency between the NIR and the CRF and within the NIR should be improved;

(d) The transparency of the reporting of some key categories as indicated in the sectoral sections of this review report should be improved.

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

II. Energy

A. Sector overview

23. In 2003, the Energy sector was the largest contributor to the GHG emissions of the United Kingdom, accounting for 87 per cent of total national emissions. Within this sector the largest contributions arose from the energy industries (38 per cent) and transport (23 per cent). Energy sector emissions had declined by approximately 7 per cent since 1990 due to fuel switching and the reduced energy-intensity of the economy according to the NIR. The major sources included power stations, road transport, combustion from industrial sources and the provision of building services. Fugitive emissions are also accounted for in this sector, and include the emissions arising from the production and extraction of coal, oil and natural gas, and their storage, processing and distribution.

24. The reporting of the Energy sector is generally transparent, complete, comparable and consistent, with major source categories reported in all years with all respective gases, and appears to be mostly accurate. The United Kingdom has updated its carbon content EFs for fuel combustion in the Energy sector and has continued to improve the transparency of the NIR by providing the time series for these EFs. For comparability, the NIR continues to provide detailed information on how sources accounted for in the data collection system of the United Kingdom are linked in to the proper IPCC source categories.

B. Reference and sectoral approaches

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

25. The United Kingdom has calculated CO_2 emissions from fossil fuel combustion using the reference and the sectoral approaches for all years in the time series. For the year 2003, there is a difference of 0.6 per cent in the CO_2 emission estimates and a difference of 0.9 per cent in the fuel consumption estimates between the reference and the sectoral approaches. As the differences are below 2 per cent, explanations are not required in the CRF tables. The differences between the two approaches are fairly low across the entire time series.

2. International bunker fuels

26. The United Kingdom inventory submission provides information on the consumption of aviation and marine international bunker fuels. The emissions from international aviation are based on detailed estimates taking into account individual traffic movements and fuel statistics and using a method that is consistent with a tier 2 approach. The emissions from marine bunkers are estimated using a tier 1 approach. The data for consumption in international aviation and international marine bunkers correspond largely to the data reported to international agencies.

3. Feedstocks and non-energy use of fuels

27. The United Kingdom only reports emissions from feedstocks and the non-energy uses of fuels in those instances where an emissive use of the fuels concerned can be identified. These include emissions from: catalytic crackers – regeneration of catalysts; ammonia production; aluminium production – consumption of anodes; benzoles and tars produced in coke ovens (emissions allocated to the Waste sector); combustion of waste lubricants and waste solvents; and incineration of fossil carbon in products disposed of as waste. For the remaining instances of non-energy uses of fuels, the United Kingdom does not use the IPCC default storage factors for the fuels, but instead assumes a 100 per cent storage of the carbon in those fuels. When questioned by the ERT on this method, the United Kingdom replied that the subject of stored carbon is under review. The ERT encourages the United Kingdom in this review and recommends that, rather than assume total storage, it apply the default storage factors, or use more suitable assumptions, consistent with the Revised 1996 IPCC Guidelines. The United Kingdom has indicated, in response to these comments, that it has initiated country-specific research to update the current method and determine appropriate end-use EFs from feedstocks and non-energy use of fuels.

C. Key categories

1. Stationary combustion, energy industries: Natural gas – CO_2

28. In category 1.A.1c Manufacture of Solid Fuels and Other Energy Industries – Gas – defined in the NIR as offshore gas use – the EF for natural gas exhibits a substantial reduction in value over the time series (from 2.08 kt/mth in 1990 to 1.70 kt/mtm in 2003) according to the background data sheets which accompany the NIR. It is not clear why this value differs from other natural gas EFs provided in this accompanying data sheet. In responding to questions from the ERT, the United Kingdom stated that this would be examined further. As activity has increased from this source category over the time series, the ERT believes that further justification for this EF reduction is required, as natural gas is fairly uniform and would not be expected to exhibit such a trend in its carbon content.

2. Road transportation – CO_2, N_2O and CH_4

29. The NIR describes the inclusion of emissions caused by the use of lubricants for road traffic. This is based on a country-specific methodology with a basic assumption that 40–50 per cent of the lubricants used are burnt. The resulting emissions amounted to 1,376 Gg CO_2 in 2003. No other Party has included these emissions in the Transport sector in addition to the estimates from lubricants used as feedstocks. The ERT welcomes this approach to improve the completeness of the inventory.

30. The NIR provides a comprehensive overview of the detailed tier 3 model used for the estimation of the road transport emissions in the United Kingdom. However, it states that cold-start emissions of N_2O and CH_4 are not included. Cold-start emissions could have a significant impact on the total emissions from this category (especially if engines are equipped with catalysts). The ERT recommends that the United Kingdom elaborate further on this apparent omission.

D. Non-key categories

1. Stationary combustion: Coke – CO_2

31. As reported by the United Kingdom, for the categories 1.A.1a Public Electricity and Heat Production and 1.A.1c Manufacture of Solid Fuels and Other Energy Industries (coke) under Energy Industries; 1.A.2a Iron and Steel and 1.A.2f Other under Manufacturing Industries and Construction; 1.A.4a Commercial/Institutional and 1.A.4b Residential under Other Sectors, the EF for coke exhibits a reduction in value over the time series (by about 9 per cent from 1990 to 2003). From the NIR it is not clear why this value differs from other coke EFs provided in the accompanying background data sheet (this also occurs in 1.A.4c. Other Sectors–Agriculture/Forestry/Fishing: Stationary, but there are no associated AD provided for 2003).

2. Civil aviation – CO_2

32. For practical reasons, the classification of national and international air transport used in the United Kingdom is different from the definition given in the Revised 1996 IPCC Guidelines (NIR, page 219). An international flight with a stopover in the United Kingdom is completely accounted for as part of international air transport and the related emissions are not included in the national inventory. This deviation from the procedures set out in the Revised 1996 IPCC Guidelines will only have a small impact on the emissions estimates, but the assumptions made should be elaborated in more detail and the United Kingdom should try to quantify the impact of the different definition in the interests of improved transparency. The methodology used could lead to the CO_2 emissions from national air traffic being underestimated.

3. Fugitive emissions from coal mining – CH_4

33. The NIR states that a new source, emissions from "Closed Mines", has been included in category 1.B.1a Coal mining and handling. The ERT encourages the United Kingdom to report these emissions under the more appropriate category 1.B.1c Other and then specify what these emissions are. Separating Underground Mining activities from "Closed Mines" would make the reporting more transparent and would prevent the underground mines implied emission factor (IEF) from being distorted. In addition, an inconsistency was noted: the documentation box to CRF table 1.B.1 states that emissions from closed mines are not reported. The United Kingdom has confirmed that these emissions are included and that the incorrect text will be deleted in its next NIR.

4. Fugitive emissions from manufacture of solid fuels – CO_2, CH_4

34. The United Kingdom reports emissions from solid fuel transformation processes as fugitive (1.B.1b), and has demonstrated in the NIR that the resulting CO_2 emissions are not double counted in 1.A.1c Manufacture of Solid Fuels.

5. Fugitive emissions from oil and natural gas

35. Emissions are estimated using field-specific EFs and emissions data reported by operators or relevant associations and organizations. The NIR notes under Planned Improvements that an internal review has highlighted time-series inconsistencies in the Oil and Gas data. It notes that gaps in the data and the methods used for interpolating estimates have led to significant step changes in the time series of IEFs. The ERT encourages the Party to undertake revisions accordingly with the aim of including an improved EF in the 2006 inventory submission.

36. For Natural Gas Distribution the Party is encouraged to extend the analysis of natural gas composition to CO_2 and to report corresponding CO_2 emissions, or to use the notation key "not estimated" ("NE").

37. The notation key "included elsewhere ("IE") is used for many Oil and Gas subcategories. However, details are often not reported in CRF table 9. The United Kingdom is encouraged to use table 9 to explain where sources are included elsewhere.

III. Industrial Processes and Solvent and Other Product Use

A. Sector overview

38. In 2003, the Industrial Processes sector accounted for 4.1 per cent of the total GHG emissions of the United Kingdom. CO_2 represented 40.6 per cent of emissions from the sector (predominantly from cement production) and N_2O 12.0 per cent (dominated by nitric acid production). Actual emissions of the fluorinated gases (F-gases) (HFCs, PFCs and SF_6) contributed 47.2 per cent. Emissions of CH_4 were very minor as compared to the other gases (it contributed 0.3 per cent of emissions from the sector). As regards the Solvent and Other Product Use sector, no direct GHG emissions are reported.

39. From 1990 to 2003, emissions from the Industrial Processes sector decreased by 52.6 per cent, mainly due to a decrease in N_2O emissions – by 89.0 per cent – due to major reductions in emissions from nitric acid and adipic acid production after the installation of abatement technologies. In the same period, CO_2 emissions decreased by 17.5 per cent (due to a reduction in cement production) and emissions of F-gases decreased by 8.8 per cent.

40. Both actual and potential emissions of HFCs, PFCs and SF_6 are reported; however, HFC and PFC emissions are reported at the aggregated level for confidentiality reasons.

41. The estimates for the sector are mostly complete except for a small number of minor sources which are noted as "NE" (CH_4 from ammonia, iron and steel, and ferroalloys and aluminium production). The United Kingdom has commented in previous reviews and inventory submissions that these sources have been excluded either because of a lack of methodology or because they are assumed to be negligible.

42. A number of recalculations have been made for the complete time series as indicated in the overview section of this report (see paragraph 12 above). The ERT commends the United Kingdom for the continued improvement in its Industrial Processes emissions estimates.

B. Key categories

1. Nitric acid production – N_2O

43. N_2O emissions from this source decreased by 37 per cent over the time series 1990–2003 due to the introduction of abatement technology in 1998 and the closure of a plant. Following the recommendation of the previous (2004) review report, the United Kingdom has explained in the NIR the methodologies used as well as details of the abatement technology at one of the plants. The ERT welcomes these improvements.

2. Adipic acid production – N_2O

44. N_2O emissions from adipic acid production decreased significantly (by 98 per cent) over the period 1990–2003. There are some large inter-annual variations in the IEF, between 1999 and 2000 (from 0.01t/t to 0.03 t/t) and between 2001 and 2002 (from 0.04 t/t back to 0.01 t/t). This does not appear to be fully explained by changes in production levels, total N_2O emissions and the introduction of abatement technology in 1998. The United Kingdom notes in the NIR (pages 67–68) that fluctuations in the N_2O EF from this plant have only been apparent since the abatement technology was installed and that the reasons for them are not known. In its response to the review, the United Kingdom indicated that further investigations revealed that the variability of the down time of the abatement plant is the reason for the annual fluctuations. A specific research programme into emissions from the nitric acid and adipic

acid production plant was scheduled for 2005. The ERT encourages relevant outcomes/conclusions of this research programme to be included in the NIR of its next submission and commends the United Kingdom for its research efforts.

3. Production and consumption of halocarbons and SF_6 – HFCs

45. By-product and fugitive emissions from production of HFCs are reported in an aggregated manner under "by-product emissions" for confidentiality reasons. The United Kingdom mentions in the NIR (page 81) that it is investigating the possibility of reporting emissions by individual gas. The ERT encourages this investigation.

46. It is mentioned in the CRF that the significant decrease in HFC emissions after 1999 is due to the installation of an HFC destruction system into the hydrochlorofluorocarbon (HCFC) plant in 1999. The ERT encourages the United Kingdom to include this explanation in the NIR of its next submission.

47. There is a significant increase in PFC emissions from the production of halocarbons from 1990 to 1996 (with the trend stabilizing after 1996) but there is no interpretation of this trend in the NIR. The ERT encourages the United Kingdom to explain this trend in its next NIR.

C. Non-key categories

1. Lime production – CO_2

48. Emissions have been calculated using consumption of limestone and dolomite instead of lime production data. Dolomite calcination data are not given explicitly but are included in the limestone data, and this has caused an underestimation of emissions. The United Kingdom states in the NIR that dolomite calcination is believed to be a small proportion of the total and the underestimation is unlikely to be significant. The ERT encourages the United Kingdom to provide information in its next NIR to justify this assumption.

2. Limestone and dolomite use – CO_2

49. In the CRF, the United Kingdom reports a very large increase in the AD (more than 300-fold) between 1990 and 2003, which is very different from what was reported in CRFs provided as part of the 2004 inventory submission. However, estimated CO_2 emissions have not increased. This has resulted in an unusual change in the IEF (0.45 t/t in 1990–1993, while it is 0.00 t/t from 1994 onwards). The ERT recommends the United Kingdom to provide clarifications on this issue in its next NIR. In its response to the review, the United Kingdom explained that this was due to an erroneous data entry for AD in the CRF which will be corrected in the 2006 inventory submission.

3. Ferroalloys production

50. In the CRF, the notation key "IE" is given for this source category, and table 9 explains "Complete time series for ferroalloy fuel consumption not available – included with iron & steel". However, in the NIR (section 4.15) there is the statement "This category is not relevant to United Kingdom emissions". The ERT recommends the United Kingdom to address this inconsistency in its next submission.

4. Aluminium production – PFCs

51. In the CRF, tetrafluoromethane (CF_4) and hexafluoroethane (C_2F_6) emissions are reported as a sum, not separately. The IEF for the PFCs is fairly low and outside the range of the IPCC default. The ERT recommends that, for transparency, the United Kingdom report CF_4 and C_2F_6 emissions separately in its next NIR. In its response to the review, the United Kingdom indicated that reasons of commercial confidentiality may prevent such detailed reporting.

5. Solvent and other product use – N_2O

52. N_2O emissions from this sector are not estimated. There is no explanation in the NIR as to why the United Kingdom is not able to estimate emissions of N_2O from medical uses. This should be further explained in its next inventory submission.

IV. Agriculture

A. Sector overview

53. In 2003, the Agriculture sector was responsible for 46.4 per cent of all emissions of CH_4; 67.0 per cent of total N_2O emissions; and 7.0 per cent of the total national emissions of the United Kingdom. Over the period 1990–2003, emissions from the sector decreased by 14.1 per cent. According to the NIR, the causes of these reductions are trends in livestock numbers and in fertilizer application. Emissions from Agricultural Soils represented 56.2 per cent of the sector's emissions in 2003, followed by Enteric Fermentation with 35.3 per cent and Manure Management with 8.6 per cent.

54. For the Agriculture sector, the NIR provides no specific descriptions of the improvements planned for the Party's future submissions, although it does for other sectors. The ERT encourages the United Kingdom to be more specific in its description of improvements planned. QA/QC procedures followed are described in a general manner. The ERT recommends that the United Kingdom describe the QC procedures applied in the Agriculture sector for each source category and the QA procedures for the sector as a whole.

B. Key categories

1. Enteric fermentation in domestic livestock – CH_4

55. The United Kingdom uses a tier 2 method for cattle and a tier 1 method for other animal categories, in line with the IPCC good practice guidance. The IEFs for dairy cattle are increasing (by 18 per cent over the period 1990-2003) due to increases in animal weights, but emissions are reported as decreasing (by 9 per cent over the same period). The United Kingdom assumes that for lambs the EF is 40 per cent of the value for sheep. This assumption produces an IEF for sheep that is lower than the IPCC default. During the review the United Kingdom provided additional methodological background information on this matter. The ERT recommends that this information be included in the NIR of the next submission.

2. Manure management – N_2O

56. The United Kingdom has applied a tier 1 method for calculating emissions from this source, which have been decreasing since 1990 (by 13 per cent over the period 1990–2003). The animal waste management systems (AWMS) responsible for the decrease over that period are: liquid systems (a 15 per cent decrease), solid storage and dry lot (a 14 per cent decrease) and others (a 0.7 per cent decrease). The United Kingdom continues to assume that 20 per cent of the total nitrogen (N) emitted by livestock volatilizes as nitrogen oxide (NO_X) and ammonia (NH_3) and therefore does not contribute to N_2O emissions from AWMS. The ERT reiterates the suggestions of previous reviews that this assumption be reviewed.

C. Non-key categories

1. Manure management – CH_4

57. CH_4 emissions from manure management have been recalculated in the 2005 submission due to the revision of the EF, but no details or data sources for the recalculations are provided. In its response

to the review, the United Kingdom explained that the change was due to the use of a different EF for cattle which reflects the IPCC methane conversion factor value for liquid systems.

2. Field burning of agricultural residues

58. Field burning has largely ceased since 1993, so no estimates are reported from 1993 to 2003.

V. Land Use, Land–use Change and Forestry

A. Sector overview

59. The United Kingdom has submitted data for LULUCF using both the "new" CRF tables for LULUCF as required by decision 13/CP.9 and the tables of the previous CRF for Land-use Change and Forestry (LUCF) from decision 18.CP.8, which were based on the structure of the Revised 1996 IPCC Guidelines. The Party identifies the relationship between them in the NIR. The data and methods used for this sector have been revised to take into account the IPCC good practice guidance for LULUCF.

60. In 2003, total net removals by the LULUCF sector amounted to 1,522 Gg CO_2 equivalent or 0.2 per cent of total national CO_2 emissions (including LULUCF) for that year. Net CO_2 removals in LULUCF are reported as 1,536 Gg CO_2. This includes emissions (soils and deforestation) of 14,734 and removals of 16,270 Gg CO_2. Between 1990 and 2003, the LULUCF sector changed from being a net source – of 2,662 Gg CO_2 equivalent emissions – to being a net sink.

61. Emissions of CO_2 from the sector (in 2003 amounting to 2.3 per cent of total national emissions including LULUCF) decreased by 16 per cent between 1990 and 2003. This is reported to be due to changes in the pattern of land use. Cultivation of mineral soils is the main contributor to emissions. Data are provided for categories 5.B.2, 5.C.2 and 5.E.2. An increase in biomass of forests appears to be the main contributor to the increase in CO_2 removals.

62. Recalculations are reported for changes in soil carbon following land-use change, notably afforestation (in LULUCF category 5.A.2 Land Converted to Forest Land (previously 5.A.2 Temperate Forests under Changes in Forest and Other Woody Biomass Stocks according to the "old" LUCF categories)). This has resulted in an increase in the estimates of removals of approximately 40 per cent for each year of the inventory. For the year 1990, estimated net CO_2 emissions have been reduced to 2,645 Gg CO_2 from 9,050 Gg CO_2 in the 2004 submission, which corresponds to a 71 per cent downward revision compared to last year's submission. For the year 2002, the estimated net CO_2 emissions of 1,903 Gg CO_2 shown in the 2004 submission have now become a net removal of 1,489 Gg CO_2. The United Kingdom states that the change is the result of methodological improvements due to new information becoming available, rather than a switch in methods as a result of the United Kingdom's adoption of the IPCC good practice guidance for LULUCF.

63. The key category analysis has been performed using the LUCF categories from the Revised 1996 IPCC Guidelines. It identified the following as key categories by level in 2003: 5.D CO_2 Emissions and Removals from Soil and 5.A Changes in Forest and Other Woody Biomass Stocks. There were no LUCF categories identified as key categories by trend analysis. The ERT recommends the United Kingdom to use the "new" reporting categories according to the IPCC good practice guidance for LULUCF for the key category assessment in its next inventory submission.

64. The LULUCF inventory does not include estimates of N_2O from fertilization or disturbance due to lack of data. Nor are data available for emissions caused by wildfires. The ERT encourages the United Kingdom to collect data to address these gaps.

65. Extensive use is made of the notation keys, which are often explained in documentation boxes but not included in CRF table 9. The ERT encourages the United Kingdom to include information on LULUCF in all the relevant tables of the CRF.

66. The ERT noted a discrepancy between the emissions/removals values reported in the key category analysis in annex 1 to the NIR (categories 5.D and 5.A) and those reported in the CRF LULUCF tables. It appears that the values from the "old" CRF based on the LUCF categories of the Revised 1996 IPCC Guidelines have been used, causing some confusion. The ERT encourages the United Kingdom to adopt one set of values for this sector throughout the inventory to improve transparency and consistency.

67. The previous ERT noted a need for complete reporting of emissions from biomass burning. The LULUCF CRF table 5(V) is largely filled in with the notation keys "not occurring" ("NO"), "NE" and "IE". Non-CO_2 gases for category 5.E Settlements are reported as "NO" in this table, but in table 5 estimates are provided for 5.E.2 Land Converted to Settlements. The ERT recommends the United Kingdom to improve consistency between the tables.

68. The United Kingdom has reported planned improvements in the LULUCF sector. These include the development of new methods for estimating emissions/removals resulting from afforestation, by 20 x 20 km grid cells, and improvements to the AD for land-use change. The ERT encourages the United Kingdom to implement its planned methodological improvements including those to its estimates related to afforestation.

B. Sink and source categories

1. Forest land – CO_2

69. The carbon (C) flow model used is reported as a tier 3 method as defined in the IPCC good practice guidance for LULUCF. The model includes calculations of all five carbon pools and wood products harvested from forests in the United Kingdom. The United Kingdom reports the release of harvested carbon over time rather than adopting the default instant oxidation assumption. This is consistent with the IPCC good practice guidance for LULUCF.

70. It is not clear whether the assumptions regarding forest species and management systems are applicable, that is, whether it is valid to assume only two types of forest and apply one yield table to each. The ERT encourages the United Kingdom to provide data on actual forest composition, details of management systems and actual harvest volumes to support the assumptions made.

71. There is very little explanation in the NIR of the calculations for wood products, for example, with regard to the basis for the assumed decay period or the decay profile over time (e.g. whether it is linear). Furthermore, sufficient information is not available to answer questions such as whether any allowance is made for immediate losses due to processing, whether the model outputs are compared with harvest statistics, or how the different product types produced in the United Kingdom are included in the model (since they affect decay period). It is also not clear why the product stock reflects afforestation rather than harvest volume or why the trend of declining removals has been reversed (to become a source of net emissions) in 2003. Many of these questions were addressed by information provided to the ERT during the review. The United Kingdom is encouraged to improve the transparency of the inventory by addressing these issues in the NIR in future submissions.

2. Cropland – CO_2

72. The ERT suggests that the United Kingdom provide in the NIR additional information on the way the estimates from lowland drainage have been obtained, in particular with regard to the large difference between the reported IEFs for thick and thin peat (see table A3.7.10 of the NIR). The United Kingdom

advised the ERT during the review of a typographical error, and provided further explanation of the difference identified. The United Kingdom is encouraged to clarify this issue in the next submission.

VI. Waste

A. Sector overview

73. In 2003, the Waste sector contributed approximately 1.7 per cent of the total GHG emissions in the United Kingdom. CH_4 from landfills was the most important source in the sector, contributing 77.5 per cent to total sectoral emissions. From 1990 to 2003 emissions in the sector decreased by 60.0 per cent, mostly thanks to the implementation of methane recovery systems.

74. The transparency of the information provided in the NIR for the Waste sector has improved, but in a number of areas the information provided still is not enough to allow the ERT to form a complete understanding of the estimation method, and the information should be completed as indicated below.

75. As it is expected that in future biodegradable waste will be progressively diverted away from landfills to other waste management systems in the United Kingdom, as in other European Union Member States, the United Kingdom is encouraged to start estimating emissions from other waste treatment systems such as composting as they may become more relevant in the future.

B. Key categories

1. Solid waste disposal – CH_4

76. The model used to estimate methane generation from landfills was updated and revised in 2003. In response to questions raised during the review, the United Kingdom explained that this involved the revision of AD (a recalculation of values for the years 1995–1998 back-calculated from the 1999 data), the introduction of new values for the degradable organic carbon (DOC) and the fraction of DOC dissimilated (DOC_F) parameters, as well as new methane generation rate constants, and a new methane oxidation sub-model. The estimates of total CH_4 generation resulting from the revised model are more than double the figure produced by the previous model. However, the corresponding CH_4 emissions resulting from the revised model are about 20 per cent lower than those calculated using the previous model.

77. The United Kingdom uses a very high oxidation factor of 90 per cent for landfills with caps thicker than 0.3 m. The IPCC default is 10 per cent; thus a significant amount of emissions is considered as being oxidized and not accounted for in the inventory. As the high oxidation factor is related to the CH_4 recovery in more modern landfills, a larger share of CH_4 seems to be considered as oxidized in recent years compared to early inventory years. A background report provided to the ERT (Land Quality Management Ltd 2003) did not provide sufficient additional evidence to support the selection of 10 per cent as the amount of CH_4 lost through fissures or the assumed field efficiency of the CH_4 oxidation capacity. Recent on-site measurement campaigns in other countries and the use of a mass balance method in the Netherlands also measured higher oxidation rates than those provided as IPCC defaults, but those rates range between 19 and 40 per cent and do not reach 90 per cent. In response to questions raised during the review, the United Kingdom indicated that it reviewed the CH_4 oxidation factors and that a modified factor will be used for its next inventory submission. The ERT strongly supports this review.

78. The DOC provided in the CRF with 0.07 (fraction of DOC in municipal solid waste (MSW)) is the lowest among reporting Parties. The NIR gives a value of 0.22 for household waste, and an additional background report provided to the ERT explains that three DOC values for different fractions – of 3.5, 12 and 9.2 per cent – were used. The IPCC default DOC values vary between 15 per cent for food waste and 40 per cent for paper and textiles. The country-specific DOC values indicated in the NIR

therefore seem to be very low. In response to questions raised during the review, the United Kingdom provided additional tabular overviews on the disaggregated DOC parameters used that sufficiently justify the national approach used. The ERT recommends the United Kingdom to include these tables in an annex to its NIR.

79. CH_4 recovery is significant in the United Kingdom and among the highest in all reporting Parties. However, here the United Kingdom has not implemented the IPCC good practice, which recommends using measurement data. Further information should be provided in the NIR on the coverage and completeness of the surveys and on how the time series for CH_4 recovery has been established (e.g. by providing data for total CH_4 generation). In response to questions raised during the review, the United Kingdom informed the ERT that an 85 per cent CH_4 collection efficiency was assumed as this efficiency is required by guidance provided by the Environment Agency. However, other Parties assume much lower gas collection efficiencies. In response to questions raised during the review, the United Kingdom agreed that 75 per cent would be a more representative value over the life of the landfill sites. This value would be used in the subsequent inventory submission and can, in part, be validated with the number of landfill gas engines and flares installed on the landfills of the United Kingdom. The ERT recommends the United Kingdom to provide justification of the gas collection efficiency in its next NIR.

80. For 1990, the rate of CH_4 recovery reported for the United Kingdom is very high compared to those of all other Parties (it is between 10 and 100 times higher than those of other European countries with comparably advanced environmental legislation, such as Austria, Germany, Denmark, the Netherlands, Sweden or Norway). In response to questions raised during the review, the United Kingdom provided corrected time series for CH_4 captured. The NIR of the next submission should include these corrected time series.

81. For industrial and commercial solid waste, amounts of waste have been extrapolated based on employment rates. However, production rates seem to be a better indicator than employment rates (e.g. considering the outsourcing trends in many sectors). In its response to questions raised during the review, the United Kingdom indicated that these estimates for AD from 1945 to 1995 are subject to considerable errors. The United Kingdom should investigate whether a backward extrapolation based on production rates for commercial and industrial waste could replace the current AD.

82. The documentation box in the CRF explains that the figures for waste composition are assumptions used in the model, not measured data. In response to questions raised during the review, the United Kingdom explained that the latest estimates available were data for 1999 and that the amounts and composition of waste for 2000 onwards were modelled. The United Kingdom informed the ERT that it is updating its model with real waste composition data for actual years, and the ERT strongly encourages it to include this update in its next inventory submission. Real waste composition data should also be presented in the NIR.

83. The AD estimated by the model cover England only and scaling factors have been used to estimate the amounts of waste generated for Scotland, Wales and Northern Ireland. Further information should be provided about how those factors were derived. The high gas collection efficiency is the result of legislation from the Environment Agency which only applies to England and Wales. The United Kingdom should explain whether the same standards apply in Scotland and Northern Ireland and, if they do not, whether the model has calculated emissions separately for these areas using appropriate parameters.

2. Waste-water handling – N_2O

84. The value reported for protein consumption per capita for the entire time series (3.4 kg/person/yr) is extremely low and the lowest of all reporting Parties. The average across all Parties is 33 kg/person/yr, with a range from 19 to 43 kg/person/yr. The IEF for N_2O from human sewage (0.08 kg N_2O-N/kg N) is

higher than the IPCC default of 0.01 kg N_2O-N/kg N. Further justifications should be provided in the NIR for these values reported in CRF table 6.B.

C. Non-key categories

1. Waste-water handling – CH_4

85. The United Kingdom uses a country-specific methodology and the NIR states that the model complies with the IPCC good practice guidance. Reference to the methodology is provided in a separate document as well as some EFs and explanations. However, key information to explain the method used is still not included in the documentation, in particular on how emissions from waste-water sources not connected to the public sewage system have been estimated (this means for waste-water fractions that remain uncollected or untreated) and whether those fractions are estimated at all. No information is provided about the waste-water treatment systems used in the United Kingdom. The NIR should include a waste-water characterization that includes descriptions of all major waste-water treatment types (not only the sludge treatment types, as these do not include uncollected waste-water fractions), the fraction of each waste-water type treated by a particular type of system, and the AD and EF used for these fractions. The sources of the AD should also be provided.

86. The emissions from private waste-water treatment plants operated by companies prior to discharge into the public sewage system or rivers are not estimated and it is not indicated how large this fraction is. In other European countries, private industrial treatment accounts for a substantial share, of more than 80 per cent. The ERT recommends that the United Kingdom provide data about the amounts of waste water generated by industry that are connected to public waste-water collection systems and the amounts treated by industrial plants, as well as about the treatment types used in industrial waste-water plants. This is the first step in the decision tree (figure 5.2) provided in the IPCC good practice guidance and should be clearly explained in the NIR. If substantial amounts are treated in separate industrial waste-water plants, those should be included in an additional part of the emissions estimation.

87. The NIR explains that from 1995 onwards per capita production of sewage sludge is a projection and is not based on collected AD. The ERT strongly recommends the United Kingdom to update the AD on waste water and sewage sludge production with a new survey because over the 10 years since 1995 considerable changes can have occurred which may not be reflected by a projection that uses data from a publication that appeared in 1993.

88. Further information should also be provided on how the model accounts for recovery of methane and its subsequent utilization and flaring, and on the basis on which the United Kingdom estimates the proportion of anaerobic digester emissions that are recovered.

89. Table 8.1 of the NIR, which shows specific CH_4 EFs for sludge handling, includes EFs for handling systems which are specified as “to agriculture”. The IPCC good practice guidance requires that CH_4 emissions from sludge used in agriculture should be included not in this sector but rather in the Agriculture sector or in emissions from landfills. It is not clear from the NIR whether sludge used in the Agriculture sector is appropriately accounted for in the inventory. This should be clarified in the next NIR.

2. Waste incineration – CO_2

90. According to the NIR, the emissions estimates for chemical waste incineration currently do not include the burning of chemical wastes in flares or the burning of chemical wastes as fuels. The estimates therefore underestimate actual emissions from combustion of chemical wastes. The ERT encourages the United Kingdom to further develop the methodology to account for these omitted sources.

Annex

Materials 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/>.

IPCC. Good practice guidance for land use, land-use change and forestry, 2003. Available at <http://www.ipcc-nggip.iges.or.jp/public/gpglulucf/gpglulucf.htm>.

IPCC/OECD/IEA. Revised 1996 IPCC Guidelines for national greenhouse gas inventories, volumes 1–3, 1997. Available at <http://www.ipcc-nggip.iges.or.jp/public/gl/invs1.htm>.

UNFCCC. Guidelines for the preparation of national communications by Parties included in Annex I to the Convention, Part I: UNFCCC reporting guidelines on annual inventories. FCCC/SBSTA/2004/8. Available at <http://unfccc.int/resource/docs/2004/sbsta/08.pdf>.

UNFCCC. Guidelines for the technical review of greenhouse gas inventories from Parties included in Annex I to the Convention. FCCC/CP/2002/8. Available at <http://unfccc.int/resource/docs/cop8/08.pdf>.

UNFCCC secretariat. Status report for the United Kingdom . 2005. Available at <http://unfccc.int/files/national_reports/annex_i_ghg_inventories/inventory_review_reports/application/pdf/2005_status_report_United Kingdom .pdf>.

UNFCCC secretariat. Synthesis and assessment report on the greenhouse gas inventories submitted in 2005. FCCC/WEB/SAI/2005. Available at <http://unfccc.int/files/national_reports/annex_i_ghg_inventories/inventory_review_reports/application/pdf/sa_2005_part_i_final.pdf>.

UNFCCC secretariat. United Kingdom of Great Britain and Northern Ireland: Report of the individual review of the greenhouse gas inventory submitted in the year 2004. FCCC/WEB/IRI/2004/GBR. Available at <http://unfccc.int/files/national_reports/annex_i_ghg_inventories/inventory_review_reports/application/pdf/2004_irr_centralized_review_United Kingdom .pdf>.

B. Additional information provided by the Party

Responses to questions during the review were received from Mr. Watterson, AEA Technology, including the following additional material on the methodology and assumptions used:

Land Quality Management Ltd 2003. Methane Emissions from Landfill Sites in the United Kingdom , Report for DEFRA.

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