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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 THE YEAR 2002[1]

Desk review

I. OVERVIEW

A. Introduction

1. The Conference of the Parties (COP), by its decisions 6/CP.5 and 34/CP.7, requested the secretariat to conduct individual reviews of greenhouse gas (GHG) inventories submitted by Parties included in Annex I to the Convention (Annex I Parties), according to the UNFCCC guidelines for the technical review of GHG inventories from Annex I Parties, hereinafter referred to as the review guidelines.[2] The principle objectives[3] of the review of the GHG inventories is to ensure that the COP has adequate information on GHG inventories and GHG emission trends, and to examine the information submitted by Annex I Parties in accordance with the UNFCCC reporting guidelines[4] for consistency with those guidelines.

2. The desk review of the United Kingdom of Great Britain and Northern Ireland (the United Kingdom) took place from 9 to 27 September 2002. The desk review was carried out by a team of nominated experts from the roster of experts, working in their own countries. The assignments of the experts were as follows: generalists – Mr. Moussa Cisse (Mali) and Mr. Riccardo De Lauretis (Italy), energy – Ms. Anke Herold (Germany) and Mr. Eilev Gjerald (Norway), industrial processes – Mr. Philip Acquah (Ghana) and Ms. Marian Van Pelt (USA), agriculture – Mr. Mingxing Wang (China) and Ms. Penny Reyenga (Australia), land-use change and forestry – Mr. Wojciech Galinski (Poland) and Mr. Mikhail Gytarsky (Russian Federation), waste – Mr. Eduardo Calvo (Peru) and Mr. Carlos Lopez (Cuba). Ms. Anke Herold and Mr. Moussa Cisse were the lead reviewers for this desk review. The review was coordinated by Ms. Sevdalina Todorova-Brankova (UNFCCC secretariat).

3. In accordance with the UNFCCC review guidelines, 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

4. In its 2002 submission, the United Kingdom submitted the common reporting format (CRF) tables for the years 1990–2000, together with the national inventory report (NIR) containing background

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[1] In the symbol for this document, 2002 refers to the year in which the inventory was submitted, and not to the year of publication. The number (1) indicates that this is a desk review report.

[2] For the UNFCCC review guidelines and decision 6/CP.5 see document FCCC/CP/1999/7, pages 109 to 114 and 121 to 122, respectively.

[3] For the objectives of the review of GHG inventories see document FCCC/CP/1999/7, page 109, paragraph 2.

[4] *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* (FCCC/CP/1999/7), are referred to in this report as the UNFCCC reporting guidelines.

information on methodologies and emission factors used, including methodological changes to the previous inventory submission for each sector. In addition to the CRF and the NIR, the United Kingdom provided additional background data for fuel consumption (detailed data on fuel consumption and gross calorific values) as well as additional background data for agriculture. The submission was received in the secretariat on 10 April 2002.

5. The status report 2002 and the draft 2002 synthesis and assessment (S&A) report, together with the previous status reports and S&A reports and the report of the individual in-country review of the 2000 United Kingdom's GHG inventory,[5] were made available to the review team. The country provided additional information and clarification during the review upon request from experts. The Party's responses are taken into consideration in this report. The full list of materials used during the review is provided in annex I to this report.

C. Emission profile, trends and key sources

6. In the year 2000, the most important GHG in the United Kingdom was carbon dioxide (CO_2), which contributed 83.6 per cent to total[6] national GHG emissions expressed in CO_2 equivalent, followed by methane (CH_4) with 7.9 per cent and nitrous oxide (N_2O) with 6.8 per cent. Perfluorocarbons (PFCs), hydrofluorocarbons (HFCs) and sulphur hexafluoride (SF_6) contributed 1.7 per cent to the country's overall GHG emissions.

7. Over the period 1990–2000, GHG emissions without land-use change and forestry (LUCF) decreased by 7.0 per cent (CO_2), 33.4 per cent (CH_4) and 35.5 per cent (N_2O), respectively. The overall trend for PFCs, HFCs and SF_6 emissions was downward with a decrease of 39 per cent for both PFCs and HFCs and an increase of 36 per cent for SF_6 emissions. The trends showed large fluctuations between 1990 and 2000. Reasons for emission trends are explained in the NIR in a clear and detailed way.

8. The United Kingdom reported a key source tier 2 analysis, both level and trend assessments, as part of its 2002 submission. Choice of methodologies and the determination of areas for improvement are based on the national key source analysis. The UNFCCC secretariat performed a preliminary tier 1 key source analysis[7], which produced different results. In addition to the use of different tiers, the differences between the approaches arise from the different subsectoral classifications used. However, some differences are relevant. For example, categories such as CO_2 and CH_4 fugitive emissions and N_2O emissions from adipic acid production were not considered as key sources in the United Kingdom's analysis although they account for more than 40 per cent of the total emission reduction from 1990–2000. The reasons for these differences are explained in the sectoral chapters. The key sources discussed in this report cover the key sources identified in either of the approaches.

D. General assessment of the inventory

9. The national inventory submitted by the United Kingdom is in conformity with the UNFCCC reporting guidelines. The methodology for estimating the GHG emissions is consistent with the Revised 1996 Intergovernmental Panel on Climate Change (IPCC) Guidelines for National Greenhouse Gas Inventories, hereinafter referred to as the IPCC Guidelines, and the IPCC Good Practice Guidance and Uncertainty Management in National Greenhouse Gas Inventories, hereinafter referred to as IPCC good practice guidance. The information submitted in the NIR is consistent with the CRF.

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[5] See document FCCC/WEB/IRI/2000/GBR.

[6] Total national GHG emissions refer to aggregate emissions of CO_2, CH_4, N_2O, PFCs, HFCs and SF_6, all expressed in terms of CO_2 equivalent, excluding CO_2 emissions/removals from LUCF.

[7] The UNFCCC had identified, for each individual Party, those source categories which are key sources in terms of their absolute level of emissions, applying the tier 1 level assessment as described in the IPCC good practice guidance. Key sources according to the tier 1 trend assessment were also identified for those Parties providing a full CRF for the year 1990. They might differ from the key sources identified by the Party itself.

1. Completeness

10. The national inventory submitted by the United Kingdom is comprehensive and complete. All major source/sink categories and direct and indirect GHGs are reported in the inventory, except CH_4 emission from industrial waste-water treatment, and CO_2 and CH_4 emissions from some minor source categories of the industrial processes sector. Disaggregation of emissions for some subsectors of manufacturing industries and construction is not reported. The United Kingdom is encouraged to provide estimates for the missing source categories, although they are minor sources. The United Kingdom provides a detailed overview on the correspondence between national source categories, and the IPCC source categories, which is essential in assessing completeness. The inventory is considered complete in terms of geographical coverage.

2. Transparency

11. Information reported in the NIR and complementary information reported in the CRF submitted by the United Kingdom provides a high level of transparency. The use of notation keys and documentation boxes of the CRF contributes to the transparency of the inventory reporting. The inventory submission explains in detail the methodologies used to estimate emissions, to reference activity data and emission factors and in reporting gaps in the inventory.

3. Recalculations

12. The United Kingdom has provided recalculations and explanatory information for all years of the period 1990–1999 (tables 8(a) and 8(b)). The recalculations result in an increase in CO_2 emissions in 1999 of 0.94 per cent (0.04 per cent for 1990), a decrease of CH_4 emissions by 1.64 per cent (0.7 per cent for 1990) and an increase in N_2O emissions by 4.63 per cent (1.38 per cent for 1990). The largest sectoral changes occurred for CH_4 and N_2O from industrial processes for 1999 compared with the previous submission: mainly metal production (54 per cent change), CO_2 emissions from soils (28 per cent change) and HFCs emissions from production of halocarbons and SF_6 (124 per cent change), causing a 39 per cent change in total actual HFCs emissions. Justifications for the recalculations are provided in the CRF and the NIR in a clear and systematic way.

4. Uncertainties

13. The United Kingdom has provided quantitative uncertainties in the NIR based on both tier 1 and tier 2 approaches. The overall uncertainty of the inventory is estimated as around 2.7 per cent in 1990 and 2.2 per cent in 2000. The uncertainty in the trend is found to range between –6.5 per cent and –9.2 per cent.

5. Quality assurance/quality control (QA/QC)

14. The United Kingdom provides information concerning the national system and describes in detail the QA/QC system and procedures put into place for the current inventory as suggested by the IPCC good practice guidance. Elements of national self-verification and QA/QC procedures are even applied to the LUCF sector. The NIR includes the QA/QC plan up to 2004. Each year the inventory is updated to include new data and methodological improvements due to activities by IPCC, CORINAIR and specific research programs sponsored by the Department for Environment, Food and Rural Affairs (DEFRA). After the methodological improvements are made, the backward recalculations are performed to ensure consistent representation of inventory estimates. Further QA/QC activities are planned by the United Kingdom, such as national and sectoral external peer review, documentation source review, energy data harmonisation and other sectoral verification and review activities. In October 2002, an external peer review of United Kingdom's CO_2 emissions from fuel combustion was completed and the report was made available to the expert review team (ERT) for information with the comments to the draft desk review report.

6. Issues relating to previous reviews

15. In comparison with the 2000 in-country review of the United Kingdom, information and documentation about QA/QC have been improved and reported in the NIR.

16. Findings from the draft 2002 S&A report that have already been explained plausibly in the previous reports, or for which explanations were found in the detailed review of the NIR, are not addressed in the following sections of this report. Detailed information on methodologies is included in the report from the individual in-country review of the United Kingdom's inventory.[8] This report updates the findings of the previous review reports with new and additional information such as methodological changes, or with more detailed information that was not available in previous years.

7. Areas for further improvement

17. The United Kingdom has developed an inventory QA/QC plan containing planned mprovements. With regard to QA/QC activities, the plan envisaged checking whether all data supplying agencies adhered to QA/QC procedures, the further development of documentation in an on-line manual, and the implementation of external peer reviews. With regard to the estimation of individual source categories, the United Kingdom is updating the halocarbon inventory and CH_4 emissions from landfills. The United Kingdom informed the team that it is preparing to report aviation emissions using a tier 3 methodology for the 2004 inventory submission, and is also developing a methodology for estimating CH_4 emissions from closed mines, a source that is not currently included in the inventory.

18. In addition, the ERT recommends that the Party should attempt to estimate categories not yet included or estimated as indicated in the sectoral sections. The Party should also add more specific information in the NIR as to how time series consistency was achieved when different data sets or emission factors were used for different periods, such as for fugitive emissions in the energy sector.

19. The United Kingdom indicated that it will consider incorporating recommendations in this report in the next NIR, specifically more detailed clarification of how time series consistency was achieved, further disaggregation of data in manufacturing industries and construction sector.

I. ENERGY

A. Sector overview

20. The energy sector represents 85 per cent of total GHG emissions in the United Kingdom in 2000. Emissions from energy industries, which is the largest energy subsector, contributed 36 per cent to total CO_2 emissions in 2000. CO_2 emissions from the energy sector decreased by 6.9 per cent between 1990 and 2000, of which fuel combustion activities dropped by 6.3 per cent and fugitive emissions from fuels by 35.6 per cent.

21. The United Kingdom reported a complete inventory in the energy sector; the NIR provides clear and transparent documentation of the underlying data as well as clear and comprehensive explanations of the country-specific methodologies used for data compilation.

22. The inventory submitted in 2002 reports many data revisions of energy statistics for the year 1999 and in some cases for earlier years. It would be useful to get further explanations in the NIR if such revisions take place frequently because the data submitted annually to the UNFCCC is still preliminary (which is the case for some reporting Parties), or if the revisions occurred due to a less frequent general revision of the statistical system.

B. Key sources

1. Stationary combustion

[8] See document FCCC/WEB/IRI/2000/GBR.

Energy industries: coal, gas, oil – CO_2

23. The potential issues stated in the draft 2002 S&A report regarding the CO_2 implied emission factor (IEF) for solid fuels (public electricity and heat production) and the CO_2 IEF for liquid fuels (manufacture of solid fuels), which appear to be the lowest of all the reporting Parties, can be explained by the specific fuel use in these categories. The carbon emission factor for the individual fuels provided in the reference approach are within the range of Annex I Parties.

Manufacturing industries and construction: coal, gas, oil – CO_2

24. For the estimation of emissions from iron and steel a country-specific method is presented in the NIR which provides for a clear separation of process emissions and emissions from fuel combustion, which avoids double counting.

25. Emissions and other data are not reported for the subcategories 1.A.2.b. Non-ferrous metals, 1.A.2.c Chemicals, 1.A.2.d Pulp, paper and print, 1.A.2.e Food processing, due to a lack of activity data for further disaggregation as explained in table 9 of the CRF. The emissions from subcategories (b) to (e) are included under subcategory 1.A.2.f Other. The ERT encourages the Party to try to get activity data at an appropriate disaggregated level.

Other combustion – N_2O[9]

26. The United Kingdom applies a detailed bottom-up country-specific method formulated for this source category which covers emissions from other off-road sources. The bottom-up approach is based on population data for seventy classes of off-road sources and their specific circumstances and was cross-checked with known fuel consumption for certain classes of off-road sources. The methodology was modified according to the results of this check. N_2O emission factors are differentiated between different classes of off-road source categories. This means that this key source was addressed using a detailed method.

2. Mobile combustion

Road transportation – CO_2 and N_2O

27. Emissions are estimated using a drive-related bottom-up approach and cross-checked with fuel consumption data which is in line with the IPCC good practice guidance. Emission factors for CH_4 and N_2O were revised in the 2000 inventory, considering the effects of speed in a more detailed way. A normalization procedure ensured consistency between the tier 2 bottom-up approach and total fuel consumption. N_2O emission factors are calculated from specific measurements by the Department for Transport (DfT) whereas the effects of speed and drive cycles were taken from the COPERT III model.

Civil aviation – CO_2[10]

28. See section E on bunker fuels.

3. Fugitive emissions

Coal mining and handling – CH_4[11]

29. The IPCC good practice guidance recommends the use of tier 3, that is the use of mine-specific measurement data, for underground mining. Such data were available in the United Kingdom for 1998–2000 for only about 90 per cent of deep mine production. The NIR reports that 1998 emission factors were also used for earlier years. Reasons for variations in emission factors are explained. The emission estimate does not currently cover emissions from closed mines. The NIR reports that a recent

[9] Identified as a key source only by the key source analysis of the United Kingdom.
[10] Identified as a key source only by the key source analysis of the United Kingdom.
[11] Identified as a key source only by the key source analysis of the UNFCCC secretariat.

review suggested that these emissions may be significant. The United Kingdom is currently developing a methodology for estimating emissions from abandoned mines. Recognizing the difficulties of emission estimates for closed mines, the United Kingdom is encouraged to continue these research efforts.

30. Taking into account the fact that no complete time series data for mine-specific measurement exist, that measurement data cover only 90 per cent of underground mines and that closed mines are not covered, the uncertainties of 13 per cent assumed for CH_4 emission factors from coal mines and of 1.2 per cent for the activity data seem to be rather low (uncertainties as documented in table 2 of appendix 8 of the NIR). The IPCC good practice guidance suggests uncertainties of ±50–75 per cent for CH_4 emission factors from underground mining using a tier 2 approach (mine-specific measurements) and a factor of 2 using tier 1. The low uncertainties used in this source category may also explain why this sector was not mapped as a key source in the United Kingdom's key source analysis, but was identified as a key source by the UNFCCC analysis. The ERT recommends reconsidering the uncertainty estimates associated with the emissions from the source.

31. The draft 2002 S&A report observes that the value of the CH_4 IEF (13.96 kg/t) for underground mines (mining activities) has increased by 40 per cent compared to the 1990 value (10 kg/t). The NIR (appendix 3) explains that the emission factors for the period 1990–1993 were derived from a different source (study) than the emission factors for 1998–2000 (operator's measurements). The United Kingdom should further explain how time series consistency was achieved in this case.

Solid fuel transformation – CO_2[12]

32. The United Kingdom has developed a country-specific carbon balance approach (due to the absence of IPCC methods) that clearly separates emissions from transformation processes and emissions from combustion processes and avoids double accounting.

33. The draft 2002 S&A report observes that the value of the CO_2 IEF for this subcategory fluctuated during the period 1990–1999 (from a value of 339.2 kg/t in 1990, it decreased to 246.71 kg/t in 1994 and then increased again to 347.3 kg/t in 2000). The variation may be an effect of the carbon balance method used where calculations are so arranged that total carbon emissions correspond to the carbon content of the input fuels. This explanation should be confirmed by the Party and added to the respective section in the NIR.

Fugitive emissions from oil operations – CO_2 and CH_4
Fugitive emissions from natural gas operations – CO_2 and CH_4[13]
Venting and flaring – CO_2 and CH_4[14]

34. Since 1999 all emission estimates for flaring and production and distribution of oil and gas have been based on detailed plant-specific data provided by the operating companies. The United Kingdom has followed a detailed source-specific estimation approach for flaring, production and distribution as recommended by the IPCC good practice guidance. Emissions from exploration are less exact, as actual data for well testing were not collected.

35. Emission estimates for oil and gas flaring are not disaggregated. The value of the CH_4 IEF reported in the CRF for combined flaring fluctuates considerably, whereas the CH_4 emission factors used for the estimation as reported in appendix 3 of the NIR do not fluctuate very much. The ERT suggests that the Party should clarify this finding.

36. The draft 2002 S&A report observes many fluctuations of IEFs in time series. Differences in IEFs in different years could arise from the use of different data sources covering different years as explained in the NIR. Although detailed information is provided in the NIR, it remains difficult to assess

[12] Identified as a key source only by the key source analysis of the UNFCCC secretariat.
[13] Identified as a key source only by the key source analysis of the UNFCCC secretariat.
[14] Identified as a key source only by the key source analysis of the UNFCCC secretariat.

consistency of time series, especially for source categories where the NIR reports that different sources for activity data and emission factors have been used for different time periods. It is recommended that the Party includes information on how time series consistency has been achieved as well as the actual activity data used for the estimation if these data are different from the data reported in the respective CRF tables.

C. Non-key sources

37. For several non-key source categories the United Kingdom has provided detailed tier 2 approaches for non-CO_2 emissions sources, which is required by the IPCC good practice guidance mainly for key source categories.

D. Reference and sectoral approaches

38. A comparison of all fuel-specific carbon emission factors provided in table 1.A(b) (reference approach) with other Annex I Parties has indicated only very few anomalies in the United Kingdom's data: United Kingdom's carbon emission factor (28.2 tC/TJ) for coking coal (coal oils and tars) is the highest within the range of Annex I Parties, the emission factor for BKB and patent fuel is also comparably high with 30.1 tC/TJ (range between 25.2 and 30.1 tC/TJ). According to appendix 2 of the NIR, the emission factor for coke is provided from British Coal (personal communication from 1989). The NIR also indicates that the position regarding coal is under review and more data will be sought. Such a data review is recommended based on the findings in relation to the emission factors.

39. Comparison with the International Energy Agency (IEA) data sets indicates the following deviations from the CRF data: LPG exports are 20,519 TJ lower in the CRF data than in the IEA data; crude oil exports are 11,412 TJ lower in the CRF data. No clarification has been received with regard to this discrepancy which was highlighted in the draft 2002 S&A report. The ERT suggests that the Party should clarify this finding.

40. For the year 2000, CO_2 emissions from fuel combustion calculated using the reference and the sectoral approach differ by 6.23 per cent. Clear and comprehensive explanations were provided in the documentation box of table 1.A(c) of the CRF and in appendix 2 of the NIR. Main differences arise from (1) the statistical differences for the fuel consumption data, (2) the use of default emission factors for primary fuels in the reference approach and the use of other emission factors for secondary fuels, which are known with greater certainty for the sectoral approach, and (3) fuel consumption by non-energy use which is treated as fuel combustion in the reference approach and not included in the sectoral approach, and which is only partly included in the estimates of non-energy use of fuels.

41. The difference between the reference approach and the sectoral approach in 2000 is greater than in previous reporting years and in general the difference fluctuates (see figure in the draft S&A 2002 report). From the explanation provided to account for the difference, the variation is not easily identifiable. It is suggested that the Party should provide some further explanation for the variations in the differences between the approaches.

E. Bunker fuels

42. The emissions from international marine bunkers and 1.A.3.d Navigation are separated in the following way. Total fuel deliveries (marine diesel oil, fuel oil, gas oil) to marine bunkers are provided in national statistics. Fuel consumption associated with international marine is calculated as marine bunkers total minus naval consumption. Naval fuel consumption is assumed to be the consumption of marine diesel oil. It would be useful if some more information were to be provided justifying the assumption with regard to marine diesel oil consumption.

F. Feedstocks and non-energy use of fuels

43. For some source categories, a more complex method has been developed to calculate fuel used as a feedstock and subsequently transformed into another fuel. A carbon balance over coke production,

solid smokeless fuel (SSF) production and blast furnaces has been performed. This procedure ensures that there is no double counting of carbon emissions. For these source categories, emissions arising from fuel combustion are reported in the energy sector and process-related emissions in the industrial processes sector. The procedure is consistent with the IPCC Guidelines.

III. INDUSTRIAL PROCESSES AND OTHER SOLVENT USE

A. Sector overview

44. In the year 2000, the industrial processes sector contributed 4.7 per cent to total national GHG emissions (without LUCF). Within the sector, the contributions of subcategories are as follows: Mineral products contribute 27.7 per cent, chemical industry 24.7 per cent, consumption of halocarbons and SF_6 20.7 per cent, production of halocarbons and SF_6 14.0 per cent and metal production 13.0 per cent. During the period 1990–2000, sectoral emissions decreased by 49.4 per cent, with the smallest decrease for CO_2 (7.34 per cent), and large decreases for CH_4 (55.86 per cent), N_2O (78.86 per cent), and PFCs (70.70 per cent), whereas SF_6 emissions doubled in this period. Emissions of HFCs increased between 1990 and 1998, but rapidly declined in 1999 to 43 per cent of the 1998 levels. This drop is explained by the retrofitting of an HCFC plant with an HFC destruction system whereas HFC emissions from other subcategories are increasing. The development of N_2O emissions reduction is explained as due to the introduction of abatement measures. Decreasing PFC emissions are explained as being a result of improved process control and recycling in aluminium industries. Trends for other gases are not explained.

45. The sectoral emission estimates are complete with the exception of direct CO_2 emissions from 2.A.5 Asphalt roofing and 2.A.6 Road paving with asphalt, CH_4 emissions from 2.B.1 Ammonia production, 2.C.2 Ferroalloys production and 2.C.3 Aluminium production. The United Kingdom explains that for most of the sources reported as not estimated (NE), methodologies are not available. For CH_4 from ammonia production no data are available. CH_4 emissions from ammonia production are, however, considered not significant by the Party.

46. The NIR of the 2002 inventory submission contains considerable amounts of additional information and refinement of country-specific methodological approaches which increase transparency and also integrate the IPCC good practice guidance. The NIR also explains the selection of emission factors and any significant variations in activity data. Further, a number of new sources have been identified and estimated in 2000 as a result of increased data availability reported in the National Pollution Inventory of the Environment Agency, thus increasing the sectoral coverage. These include CO_2 emissions from source category 2.A.7 Other emissions from mineral products, and CH_4 emissions from source categories 2.C.1 Iron and steel production, and 2.B.5 Other emissions from the chemical industry, and N_2O emissions from source categories 2.B.2 Nitric acid production and 2.B.3 Adipic acid production.

47. The recalculations led to a reduction in sectoral CO_2 emissions by 2.4 per cent and increases in CH_4 (57 per cent) and N_2O (54 per cent) emissions in 1999. Time series for CH_4 and CO_2 from all the source categories were estimated for 1990–1999.

B. Key sources

1. Cement production – CO_2[15]

48. Recalculations for the entire time series are performed in the 2002 submissions for CO_2 emissions from cement production due to refinements in the methodology. In 2000, the tier 2 method and the IPCC good practice guidance have been applied, that is, the estimated accounts for cement kiln dust (CKD) (2 per cent) and country-specific clinker lime (CaO) content (63 per cent) provided by the industry association were used which led to a 2.5 per cent reduction in the emission factor used.

[15] Identified as a key source only by the key source analysis of the UNFCCC secretariat.

2. Nitric acid production – N_2O

49. The reporting of some nitric acid production together with the adipic acid production of one plant for the years 1990–1993 leads to time series inconsistencies. The United Kingdom should make an effort to disaggregate the N_2O emissions attributable to adipic acid production and nitric acid production for these years. The United Kingdom also indicates in its NIR (appendix 4, section 8) that figures for emissions of N_2O since 1994 are based mainly on plant capacity data and thus may overestimate true nitric acid production levels and associated emissions.

50. The draft 2002 S&A report observed sharp fluctuations in N_2O emissions from nitric acid production as follows: –30.2 per cent (1995), +15.2 per cent (1998), +43 per cent (1999), and –8.4 per cent (2000). As is explained in the NIR, these fluctuations were due to plant closures between 1990–1993, but the loss of production from these plants was partly offset by the reporting of an additional nitric acid facility in 1994, which also reported nitric acid together with adipic acid production for the years 1990–1993; consequently, reported production for these years remained fairly constant. An additional plant closure caused the decrease in emissions in 2000. The reduction in emissions from 1994 to 1995 is explained as being due to the installation of N_2O abatement measures at a nitric acid plant. Finally, the installation of a nitrogen oxide (NO_x) abatement system in a plant in 1999 increased N_2O emissions.

3. Adipic acid – N_2O[16]

51. Emissions from adipic acid production in the United Kingdom are rapidly decreasing because of abatement measures. As a result of the strong declining trend, the secretariat's tier 1 trend key source assessment identified this source category as a key source, while the national key source analysis did not identify this sector as a key source, which is acceptable since the trend is a strong decrease. The draft 2002 S&A report observed that the IEF for N_2O (0.3 t/ t) is low, especially for 1999 (0.015 t/t), relative to the IPCC default value (0.26–0.3 t/t). The United Kingdom explains the development of the N_2O IEF as indicated in the paragraph above.

4. Aluminium production – tetrafluoride (CF_4) and carbon hexafluoride (C_2F_6)

52. Individual chemical species of PFC emissions from this source are reported in an aggregate way as CF_4. Emissions have decreased by 90 per cent from 1990–2000. The United Kingdom attributes the decline to significant improvements in process control technology and an increase in aluminium recycling. This is comparable to PFCs reductions recorded in New Zealand (90.6 per cent), and Norway (70.3 per cent). Across the Parties, PFCs reduction ranged from 40–90 per cent.

5. Consumption of halocarbons and SF_6 (HFCs, PFCs and SF_6)[17]

53. The draft 2002 S&A report observed that potential emissions of HFC-23 for 2000 (10,732 Gg CO_2 equivalent) are the second highest of all reporting Parties. The United Kingdom ascribes this to the country-specific methodology (the result is consistent with the IPCC Guidelines), which accounts for (a) emissions from fluid in products (e.g. refrigerators and air-conditioning, aerosols, fire extinguishers and electrical equipment) on the assumption that halocarbons and SF_6 fluid leaking from such banks or storage in products is replaced, and (b) inclusion of activity data on disposal of fluids.[18]

54. Emissions are not reported by chemical species to preserve confidentiality. The United Kingdom does report emissions disaggregated by sub-sources, which allows for a review of emission factors by stage of life. Although the NIR indicates that for aerosols it is assumed that all the fluid is emitted in the year of manufacture, the IEF for product life is less than 100 per cent (97 per cent).

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16 Identified as a key source only by the key source analysis of the UNFCCC secretariat.

17 Identified as a key source only by the key source analysis of the UNFCCC secretariat.

18 Ref. appendix 4 – industrial processes, section 16.2.

C. Non-key sources

1. Iron and steel production – CO_2

55. The draft 2002 S&A report observed a wide difference between steel production data in the CRF and the United Nations data set (298 per cent difference). The analysis suggests that this could be due to the difference in the definition of the activities (the United Nations data most likely report the total sum of pig iron production and crude steel production).

56. From total crude steel production (15,155 kt) and reported CO_2 emissions (2,717 kt) the aggregate IEF for CO_2 was calculated as 0.18 kt CO_2/kt total steel production. Similar to the comment in the 2001 S&A report, the CO_2 IEF value is the lowest of the reporting Parties and also lower than the IPCC default emission factor (1.6 kt CO_2/kt steel production). The United Kingdom explains in chapter 12 of the NIR that the apparently low IEF can be attributed to the revision of the methodology in line with IPCC tier 2, which takes into account carbon sources and sinks in iron making, steel making and electric arc furnaces. The ERT notes that improvements in the methodology for estimating CO_2 from iron and steel production could be made more transparent if the United Kingdom reported the activity data for basic oxygen furnace steel production separately from the activity data for blast furnace steel.

2. Ammonia production – CO_2

57. The draft 2002 S&A report and the 2001 S&A report observed that the IEFs for CO_2 of 30.03 t/t (in 2000) and 26.29 t/t (in 1999) are very high compared to the IPCC default (0.79–0.91 t/t) and other Parties. A critical analysis of the activity data for ammonia production in CRF table 2(I).A–G indicates that United Kingdom emissions estimation is based on natural gas consumption in petajoules (PJ). Estimation of CO_2 emissions in the CRF table 2(I)A-Gs2 (i.e. 46.266 PJ•30.02 Kt CO_2/PJ = 1,389 Gg CO_2), implies that the CO_2 IEF should be in kt/PJ or t/TJ. Thus the large difference is attributable to the different units for the IEF adopted by the United Kingdom. This is, however, consistent with the methodological choice elaborated in section 7 of appendix 4. The ERT notes that for the purposes of the automated generation of S&A tables the United Kingdom should try to stick to the specified units as requested by the CRF tables (t/t) in order to facilitate cross-country comparison.

58. The 2000 and 2001 S&A reports also noted that CO_2 sequestration in methanol and acetic acid production in an integrated ammonia production plant should reduce the IEF compared to the theoretical emission factor based on the reaction stochiometry of steam reforming of natural gas. A detailed analysis of the method indicates that the reported 30.03 t/TJ (kt CO_2/PJ) is lower than the stochiometric emission factor (43.28 kt/PJ). This explains the effect of the downstream sequestration of carbon in methanol and acetic acid production as observed in the 2000 S&A report.

IV. AGRICULTURE

A. Sector overview

59. Agricultural emissions of CH_4 and N_2O contributed 7.5 per cent (48,609 Gg) to total emissions in 2000 expressed as CO_2 equivalents. Between 1990 and 2000 there has been a decline in emissions associated with enteric fermentation (4.9 per cent), manure management (5.2 per cent) and agricultural soils (11.6 per cent). Total sector emissions have declined by 9.3 per cent from 53,618 Gg in 1990.

60. Emission reporting in the agricultural sector in the CRF is complete; however, FOR some source categories report zero emissions are reported, while reporting of a notation key NE (not estimated), NO (not occurring), NA (not applicable) may be more appropriate.

61. Information about activity data, methodologies and emission factors, QA/QC procedures and uncertainty is provided in the NIR. The United Kingdom's submission includes an Excel file containing agricultural background data and information on assumptions used in developing country-specific emission factors. In order to improve transparency, information from the background data file,

particularly the parameters and assumptions for estimating N_2O emissions from manure management, should be provided in the NIR.

62. The IPCC Guidelines methodologies and default emission factors are used to estimate CH_4 emissions, except for those relating to cattle, lambs and deer. The IPCC tier 2 methodology is used to estimate emissions from cattle. Both IPCC and country-specific information is used to estimate N_2O emissions.

63. Recalculations of previous inventories have been made following minor revisions to the animal population data and changes in the allocation of wastes to different manure management systems.

B. Key sources

1. Enteric fermentation – CH_4

64. It would be more appropriate for emissions from poultry to be reported as NE rather than 0.0 Gg. The United Kingdom indicates that emission factors are based on the IPCC defaults. The IPCC Guidelines default emission factor for poultry is "not estimated" and not 0 kg CH_4/head.

65. Large fluctuations in IEFs for cattle were identified in the draft 2002 S&A report. These fluctuations are due to changes in the age structure of the herd as different emission factors are used for animals of different ages.

2. Agricultural soils – direct N_2O emissions

N-fixing crops

66. There appears to be a typographical error in the quantity of dry pulses and soy beans produced (672,082,000 kg dry biomass/year) reported in table 4.D for the year 2000. The value has jumped drastically compared with the year 1999 (39,173,520 kg dry biomass/year) and this causes an anomaly in the IEF as the emissions do not increase by a similar amount. In its response to the draft desk review report, the United Kingdom clarified that the error seems to have been in 1999 and that latest recalculation use values 651,688,000 kg dry biomass/year for 1999 and 672,082,000 for 2000.

Cultivation of histosols

67. There is an error in the area of cultivation of histosols reported in table 4.D. In the 1990–1999 CRF tables the area is reported as 392,000 ha with an IEF of 0.5 kg N_2O-N/ha, while in 2000 the area is reported a 39,200 with an IEF of 5 kg N_2O-N/ha. Values for all years should be checked.

3. Manure management – N_2O[19]

68. The nitrogen excretion factors for animals in the United Kingdom are based on country-specific data (balances developed by Smith, 1998). As this information is sourced as a personal communication, the NIR should provide additional information on the approach used to develop these country-specific factors, that is, explaining whether they are based on experimental measurements or calculated through an IPCC tier 2 mass balance approach. If the latter is the case, the assumptions should be documented in the NIR.

69. The background data tables provided to reviewers indicate that the live weights used to estimate enteric CH_4 emissions from dairy cattle are also used as a basis for calculating the nitrogen excretion estimates. For transparency this should be documented in the NIR.

C. Non-key sources

1. Manure management – CH_4

[19] Identified as a key source only by the key source analysis of the United Kingdom.

70. Emissions from anaerobic lagoons are currently reported as zero. This source category should be reported as NO, as the NIR indicates that this treatment is not used in the United Kingdom.

71. Large fluctuations in IEFs, excretion rates and emissions were identified in the draft 2002 S&A report. As with enteric fermentation, fluctuations in age structure are the cause for these trends.

2. Agricultural soils – CH_4

72. Emissions of CH_4 are currently reported in the CRF as zero. This source category should be reported as NE with an appropriate explanation in table 9.

V. LAND-USE CHANGE AND FORESTRY

A. Sector overview

73. The LUCF sector constitutes a net source of 0.5 per cent of equivalent GHG emissions for the United Kingdom. From 1990 to 2000, total CO_2 removals from the sector increased by 18.5 per cent, the CO_2 emissions decreased by 17.7 per cent and the overall sectoral net CO_2 emissions decreased by 61.8 per cent. The changes are driven mainly by reduced CO_2 emissions from soil and increased removals in forest and other woody biomass stocks.

74. GHG emissions and removals are calculated from 1990 to 2000. The United Kingdom has used national methods to account for 5.A Changes in forest and other woody biomass stocks, 5.D CO_2 emissions and removals from soil, and 5.E Other GHG sources and sink categories. CRF sectoral table 5 provides an overall report for the LUCF sector. Tables 5.A to 5.D have not been completed due to the use of country-specific methods.[20] Their use is documented in the NIR, in CRF summary 3, and in the documentation boxes to CRF tables 5.A and 5.D. The notation keys were used appropriately in the CRF.

75. United Kingdom reports changes in forest and other woody biomass stocks (category 5.A), CO_2 emissions and removals from soils (category 5.D), and other GHG sources and sink categories (category 5.E). Forest and grassland conversion (category 5.B), abandonment of managed lands (category 5.C), and emissions of non-CO_2 gases are not reported in the NIR and CRF, because these activities are not occurring or contribution to total net carbon fluxes is negligible.

76. In 1999, the inventory was updated to reflect corrections to peat extraction and emissions from soil. The changes were consistently applied to all years from 1990 to 2000.

77. The NIR provides detailed uncertainty assessment for activity data and estimates. Key source analysis in accordance with the IPCC good practice guidance for other sectors is described in the NIR for all LUCF source and sink categories of the United Kingdom GHG inventory. LUCF source and sink categories are also covered in the national key source analysis reported by the United Kingdom in the NIR.

B. Sink and source categories

1. Changes in forest and other woody biomass stocks

78. Changes in forest and other woody biomass stocks offset 1.3 per cent of the total GHG emissions of the United Kingdom. From 1990 to 2000, CO_2 removals increased by 13.8 per cent. The United Kingdom has used a carbon accounting model to estimate CO_2 emissions and removals due to changes in forests and other woody biomass. The data on standing trees, litter, soil and harvested wood in forest plantations are used for the estimation together with country-specific factors for carbon content in above- and belowground biomass and default carbon fraction in wood. The values are given in the NIR with appropriate references.

[20] According to the UNFCCC reporting guidelines on annual inventories, these tables should be filled in only by Parties that which use IPCC default methodologies.

79. CO_2 emissions from wood harvesting are included in the general accounting for CO_2 from this category. DEFRA and the Forestry Commission (a non-departmental public body) provide the activity data for estimates. Sitka spruce and beech are assumed to be the only species that constitute forest plantations. However, it is not clear from the NIR what factors have been used to account for CO_2 removals in wood products, how the assumptions made correspond to actual species composition in forest plantations or what part of harvested wood is accounted for as CO_2 emissions and what is sequestered in harvested wood products. The ERT encourages the United Kingdom to include in the NIR a description of how the assumptions made correspond to actual species composition in forest plantations or what part of carbon is emitted from wood harvesting and accumulated in wood products. This will allow for more complete reporting on GHG emissions and removals in the LUCF sector.

80. According to the draft 2002 S&A report, CO_2 removals changed by more than 10 per cent for the period from 1990 to 1999. Apparently this results from changes in age structure of stands but the NIR provides no explanation for this.

2. Emissions and removals from soils – CO_2

81. CO_2 emissions and removals from soils are a net source representing 1.8 per cent of total GHG emissions of the United Kingdom. From 1990 to 2000, the emissions decreased by 27.2 per cent. CO_2 emissions are reported for changes in soil carbon due to land-use change, set aside and liming. Land-use data are provided by the Centre for Ecology and Hydrology, while the British Geological Survey reports on limestone, chalk and dolomite use. The United Kingdom has used a national method to account for emissions due to changes in soil carbon stocks. It is based on a land matrix approach. CO_2 emissions from liming have been estimated following the IPCC Guidelines. The United Kingdom has used country-specific factors to report on CO_2 emissions and removals from soils. It is not clear from the NIR what emission factors have been used to account for CO_2 emissions and removals due to land-use change and set aside.

3. Other greenhouse gas source and sink categories

82. CO_2 removals in crop biomass and emissions from drainage of upland deep peat and lowland wetlands and peat extraction are reported under this category. Together they comprise a net sink representing 0.04 per cent of GHG emissions. From 1990 to 2000, this decreased by 7.9 per cent. The United Kingdom has used a country-specific approach to account for CO_2 removals under this category. However, it is not clear from the NIR how the estimates have been made. The sources of activity data are scientific publications and agricultural censuses published by DEFRA. Country-specific factors have been used to estimate CO_2 removals in crop biomass and emissions from drainage and peat extraction. Their values are provided in the NIR. The ERT encourages the United Kingdom to include more detailed explanation of the methodology used in the NIR to account for emissions from drainage and peat extraction.

VI. WASTE

A. Sector overview

83. The waste sector contributed 26,045 and 16,026 Gg CO_2 equivalents (3.5 and 2.5 per cent, respectively) to the net emissions of the United Kingdom in 1990 and 2000, respectively. It is the third largest component of total CH_4 emissions in the country with a share of 28.7 per cent (mainly from landfills –27.2 per cent). Since 1990, emissions in the sector have dropped by 38 per cent due to the implementation of CH_4 recovery systems and reduced CO_2 emissions from waste incineration, which largely compensate for moderate increases in CH_4 and N_2O from waste-water handling.

84. The inventory in the waste sector is mostly complete in terms of emission, source and geographical coverage. Estimates of industrial and commercial waste are based on a survey that was incomplete at the time of finalising the model estimates. The inventory is well documented with clear explanations of the assumptions and methodologies used. In some categories, however, although the

sources are referenced, the necessary information facilitating replication and assessment of the inventory is not provided in the NIR and the CRF. This situation can be exemplified in the key source, solid waste disposal on land, where there is not sufficient information about the characteristics and coverage of the surveys developed in relationship to the solid waste disposal sites. This also applies to the study developed to determine the degradable organic carbon (DOC) value used. No information has been provided on the emission factor used for the determination of N_2O emissions from human sewage.

85. Quantitative uncertainties are provided for each of the major source categories. Recalculations in the CH_4 and N_2O emissions from solid waste disposal and wastewater management have been made in order to ensure consistency of the time series.

B. Key sources

1. Solid waste disposal on land – CH_4

86. According to the NIR, uncertainties for this key source are great, and the overall CH_4 estimates from landfills may be subject to revision as more information becomes available. The United Kingdom used the first order decay (FOD) model to estimate the emissions. The NIR states that the waste composition data are based on various data sources, but the CRF explains that the model uses assumptions, not measured data. According to the CRF, the fraction of waste disposed of to managed sites is less than 1 (0.82). No explanation is submitted regarding the fraction not disposed of at managed sites. The Party indicated in the NIR that the DOC has been estimated based on a national study. The values used were based on expert opinion. The NIR does not provide information and references on this study and its characteristics. No information is provided as to whether different DOC values have been used for wastes with different half-lives. The fraction of CH_4 recovered is derived from estimates and not from measured data. Minor inconsistencies in the use of NA and 0 are registered in tables 6 and 6.A.

2. Emissions from human sewage – N_2O[21]

87. There is inconsistency in the reporting of protein consumption in the NIR (range 8.28–8.65 kg/person/year) and the CRF table 6.B (3.42 kg/person/year). The IEF (0.07 kg N_2O-N/kg sewage N produced) is the highest of all reporting Parties, but still within the range provided by the IPCC good practice guidance. The ERT recommends the Party to provide information on the assumptions made.

C. Non-key sources

1. Waste-water handling – CH_4

88. The United Kingdom uses a country-specific methodology which diverges from the IPCC default in several aspects. The NIR does not provide information regarding the validation of this methodology as recommended in the in-country review report 2000.[22] In the CRF the overall parameters used are reported, but most of the specific parameters and emission factors used are not provided, although the source is referenced in the NIR. This important reference was not available to the reviewers.[23] Emissions from private industrial treatment plants were not estimated and are not reported consistently in tables 6.B and 6. It is recommended that the notation key NE is used for CH_4 emissions from industrial waste water in table 6. No information is included in the NIR as to whether the contribution of this source was analysed in greater depth, according to the recommendation of the in-country review report

[21] Identified as a key source only by the key source analysis of the United Kingdom.

[22] See document FCCC/WEB/IRI/2000/GBR.

[23] The referenced document: *Control Measures to Limit Methane Emissions from Sewage and Sludge Treatment and Disposal*, WRc , Report No DOE 4118 (Hobson, J., Palfrey, R., Sivil, D., Palfrey, E., Day, M., (1996)), was provided to the review team of the in-country review, but has not been used, as that report was not part of this desk review.

2000.[24] The ERT encourages the Party to perform this analysis and to report its results in its next submission.

2. Waste incineration

89. The United Kingdom uses country-specific factors and has recalculated emissions for the period 1990–1996. From 1997 to 2000, CO_2 emissions are reported as constant. In this submission the activities clinical waste incineration and cremation are included for the first time, but in the CRF it is not clear where exactly these emissions are reported. The NIR reports that emission factors for CH_4 and N_2O have not been estimated for cremation. The NIR reports that in the estimation of CO_2 from clinical waste incineration, an emission factor from the IPCC good practice guidance have been used but in summary table 3 it is reported that the emission factor used is country specific. Information is not submitted on the derivation of carbon content and fossil carbon fraction of the clinical wastes. The ERT recommends that the Party should clarify the source of the emission factor used and provide more information on the derivation of carbon content and fossil carbon fraction of the clinical wastes.

[24] See document FCCC/WEB/IRI/2000/GBR.

Annex 1:

MATERIALS USED DURING THE REVIEW

A. Support materials on the CD-ROM and the web page for the review

The United Kingdom's GHG inventory submission (including CRF tables for the years 1990–2000, national inventory report, background data for fuel consumption (detailed fuel consumption data and gross calorific values) and background data for agriculture [unpublished].

UNFCCC secretariat. *2000 Status reports for the United Kingdom* [available at http://unfccc.int/program/mis/ghg/statrep00/gbr00.pdf].

UNFCCC secretariat. *2001 Status report for the United Kingdom* [available http://unfccc.int/program/mis/ghg/statrep01/gbr01.pdf].

UNFCCC secretariat. *2002 Status report for the United Kingdom* [available at http://unfccc.int/program/mis/ghg/statrep02/gbr02.pdf].

UNFCCC secretariat. *Synthesis and assessment report on the greenhouse gas inventories submitted in 2000*. FCCC/WEB/SAI/2000 [available at http://unfccc.int/program/mis/ghg/sai2000.pdf].

UNFCCC secretariat. *Synthesis and assessment report on the greenhouse gas inventories submitted in 2001*. FCCC/WEB/SAI/2001 [available at http://unfccc.int/program/mis/ghg/sai2001.pdf].

UNFCCC secretariat. *Draft synthesis and assessment report on the greenhouse gas inventories submitted in 2002* (Part I and Part II – the section on the United Kingdom [unpublished].

UNFCCC secretariat. *The report of the individual in-country review of the United Kingdom's GHG inventory (FCCC/WEB/IRI/2000/GBR)* [available at: http://unfccc.int/program/mis/ghg/countrep/ukincountrep.pdf.

UNFCCC secretariat. *Key source analysis for the year 2000*, [unpublished].

UNFCCC secretariat. *Handbook for review of national GHG inventories*. Draft 2002, [unpublished].

UNFCCC secretariat. *UNFCCC guidelines on reporting and review*. FCCC/CP/1999/7 [available at http://www.unfccc.int/resource/docs/cop5/07.pdf].

UNFCCC secretariat. Database search tool – *Locator* [unpublished].

IPCC.*IPCC good practice guidance and uncertainty management in national greenhouse gas inventories. 2000.* [available at http:www.ipcc-nggip.iges.or.jp/public/gp/gpgaum,htm].

IPCC/OECD/IEA. *Revised 1996 IPCC Guidelines for national greenhouse gas inventory, volumes 1–3., 1997*. [available at http:www.ipcc-nggip.iges.or.jp/public/gl/invs1.htm].

B. Additional materials provided by the Party

Responses to questions raised during the review relating to LUCF sector were received from Dr. R. Milne, Centre for Ecology & Hydrology, Penicuik, Midlothian, United Kingdom.

Simmons, T. *Peer Review of the UK Greenhouse Gas Inventory, CO_2 from Fuel Combustion 1990 – …1999*. October 2002

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