Advance Version

COMPLIANCE COMMITTEE **CC/ERT/ARR/2014/29**
3 July 2014

Report of the individual review of the annual submission of the United Kingdom of Great Britain and Northern Ireland submitted in 2013

Note by the secretariat

The report of the individual review of the annual submission of the United Kingdom of Great Britain and Northern Ireland submitted in 2013 was published on 1 July 2014. For purposes of rule 10, paragraph 2, of the rules of procedure of the Compliance Committee (annex to decision 4/CMP.2, as amended by decisions 4/CMP.4 and 8/CMP.9), the report is considered received by the secretariat on the same date. This report, FCCC/ARR/2013/GBR, contained in the annex to this note, is being forwarded to the Compliance Committee in accordance with section VI, paragraph 3, of the annex to decision 27/CMP.1.

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Report of the individual review of the annual submission of the United Kingdom of Great Britain and Northern Ireland submitted in 2013*

* In the symbol for this document, 2013 refers to the year in which the inventory was submitted, and not to the year of publication.

Contents

I. Introduction and summary

1. This report covers the review of the 2013 annual submission of the United Kingdom of Great Britain and Northern Ireland, coordinated by the UNFCCC secretariat, in accordance with decision 22/CMP.1. The review took place from 9 to 14 September 2013 in Bonn, Germany, and was conducted by the following team of nominated experts from the UNFCCC roster of experts: generalists – Ms. Anke Herold (Germany) and Mr. Tinus Pulles (Netherlands); energy – Mr. Ali Can (Turkey), Ms. Rianne Dröge (Netherlands), Mr. Takashi Morimoto (Japan) and Mr. Ioannis Sempos (Greece); industrial processes and solvent and other product use – Mr. Kakhaberi Mdivani (Georgia), Ms. Emilija Poposka (the former Yugoslav Republic of Macedonia) and Mr. Koen Smekens (Belgium); agriculture – Mr. Amnat Chidthaisong (Thailand) and Mr. Steen Gyldenkærne (Denmark); land use, land-use change and forestry (LULUCF) – Mr. Kumeh Assaf (Liberia), Mr. Valentin Bellassen (France) and Mr. Matthew Searson (Australia); and waste – Mr. Gabor Kis-Kovacs (Hungary) and Ms. Sirinthornthep Towprayoon (Thailand). Mr. Smekens and Ms. Towprayoon were the lead reviewers. The review was coordinated by Ms. Lisa Hanle (UNFCCC secretariat).

2. In accordance with the "Guidelines for review under Article 8 of the Kyoto Protocol" (decision 22/CMP.1) (hereinafter referred to as the Article 8 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, into this final version of the report. All encouragements and recommendations in this report are for the next annual submission, unless otherwise specified. The expert review team (ERT) notes that the 2012 annual review report of the United Kingdom was published after the submission of the 2013 annual submission.

3. In 2011, the main greenhouse gas (GHG) in the United Kingdom was carbon dioxide (CO_2), accounting for 81.9 per cent of total GHG emissions[1] expressed in CO_2 equivalent (CO_2 eq), followed by methane (CH_4) (9.1 per cent) and nitrous oxide (N_2O) (6.2 per cent). Hydrofluorocarbons (HFCs), perfluorocarbons (PFCs) and sulphur hexafluoride (SF_6) collectively accounted for 2.7 per cent of the overall GHG emissions in the country. The energy sector accounted for 82.1 per cent of total GHG emissions, followed by the agriculture sector (9.1 per cent), the industrial processes sector (4.7 per cent) and the waste sector (4.1 per cent). In the solvent and other product use sector, not occurring ("NO") was reported for some categories and not estimated ("NE") was reported for others. Total GHG emissions amounted to 567,390.77 Gg CO_2 eq and decreased by 27.3 per cent between the base year[2] and 2011. The ERT concludes that the description in the national inventory report (NIR) of the trends for the different gases and sectors is reasonable.

4. Tables 1 and 2 show GHG emissions from sources included in Annex A to the Kyoto Protocol (hereinafter referred to as Annex A sources), emissions and removals from the LULUCF sector under the Convention and emissions and removals from activities under Article 3, paragraph 3, and, if any, elected activities under Article 3, paragraph 4, of the Kyoto Protocol (KP-LULUCF), by gas and by sector and activity, respectively. In table 1, CO_2, CH_4 and N_2O emissions included in the rows under Annex A sources do not

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

[2] "Base year" refers to the base year under the Kyoto Protocol, which is 1990 for CO_2, CH_4 and N_2O, and 1995 for HFCs, PFCs and SF_6. The base year emissions include emissions from sources included in Annex A to the Kyoto Protocol only.

include emissions and removals from the LULUCF sector, and also do not include the emissions from deforestation that were included in the United Kingdom's initial report under the Kyoto Protocol for the base year and subsequently used for the calculation of the assigned amount.

5. Additional background data on recalculations by the United Kingdom in the 2013 annual submission, as well as information to be included in the compilation and accounting database, can be found in annex I to this report.

Table 1

Greenhouse gas emissions from Annex A sources and emissions/removals from activities under Article 3, paragraphs 3 and 4, of the Kyoto Protocol, by gas, base year[a] to 2011[b]

			Gg CO_2 eq								*Change (%)*
		Greenhouse gas	*Base year[a]*	*1990*	*1995*	*2000*	*2008*	*2009*	*2010*	*2011*	*Base year–2011*
Annex A sources		CO_2	590 475.08	590 475.08	553 007.77	555 324.36	537 720.28	487 198.47	504 228.19	464 653.69	–21.3
		CH_4	104 577.37	104 577.37	97 331.48	78 316.58	57 840.96	55 635.11	53 029.41	51 827.07	–50.4
		N_2O	68 840.67	68 840.67	58 522.24	47 044.67	37 806.21	35 743.98	36 342.80	35 323.31	–48.7
		HFCs	15 327.78	11 385.62	15 327.78	9 342.35	13 686.61	14 033.29	14 388.34	14 653.91	–4.4
		PFCs	461.81	1 401.60	461.81	460.55	203.93	145.03	220.62	325.31	–29.6
		SF_6	1 239.30	1 029.95	1 239.30	1 798.48	711.77	661.55	689.58	607.48	–51.0
KP-LULUCF	Article 3.3[c]	CO_2					–2 103.43	–2 169.24	–2 436.88	–2 526.11	
		CH_4					19.10	21.14	15.61	15.74	
		N_2O					4.63	4.55	3.09	3.65	
	Article 3.4[d]	CO_2	NA				–10 782.04	–9 809.11	–7 536.14	–7 268.49	NA
		CH_4	NA				6.64	6.51	4.34	5.77	NA
		N_2O	NA				41.95	41.75	39.81	40.60	NA

Abbreviations: Annex A sources = sources included in Annex A to the Kyoto Protocol, KP-LULUCF = land use, land-use change and forestry emissions and removals from activities under Article 3, paragraphs 3 and 4, of the Kyoto Protocol, NA = not applicable.

[a] "Base year" for Annex A sources refers to the base year under the Kyoto Protocol, which is 1990 for CO_2, CH_4 and N_2O, and 1995 for HFCs, PFCs and SF_6. The base year for cropland management, grazing land management and revegetation under Article 3, paragraph 4, of the Kyoto Protocol is 1990. For activities under Article 3, paragraph 3, of the Kyoto Protocol and forest management under Article 3, paragraph 4, only the inventory years of the commitment period must be reported.

[b] This table does not reflect the adjusted estimates for one category in the waste sector (see chapter II.H below) after the adjustment procedures under decision 20/CMP.1 were applied. It reflects the estimates contained in the Party's submission of 28 October 2013, which was subject to the said adjustment. The adjustment led to an increase in the estimate of total greenhouse gas emissions for 2011 of 3,199.223 Gg CO_2 eq.

[c] Activities under Article 3, paragraph 3, of the Kyoto Protocol, namely afforestation and reforestation, and deforestation.

[d] Elected activities under Article 3, paragraph 4, of the Kyoto Protocol, including forest management, cropland management, grazing land management and revegetation.

Table 2
Greenhouse gas emissions by sector and activity, base year[a] to 2011

			Gg CO_2 eq							*Change (%)*
		Sector	*Base year[a]*	*1990*	*1995*	*2000*	*2008*	*2009*	*2010*	*2011*	*Base year–2011*
Annex A		Energy	610 820.35	610 820.35	567 406.70	560 714.89	536 244.94	489 497.81	505 474.14	465 978.02	–23.7
		Industrial processes	57 632.93	54 421.20	46 617.41	31 838.11	31 503.78	26 132.59	27 668.98	26 490.35	–54.0
		Solvent and other product use	NE, NO	NE, NO	NE, NO	NE, NO	NE, NO	NE, NO	NE, NO	NE, NO	NA
		Agriculture	65 099.56	65 099.56	63 912.75	60 917.53	52 357.44	51 528.04	51 921.46	51 882.01	–20.3
		Waste[b]	47 369.15	47 369.15	47 953.52	38 816.47	27 863.59	26 258.98	23 834.38	23 040.38	–51.4
		LULUCF	NA	4 022.20	3 282.86	424.60	–3 788.08	–3 815.85	–3 665.43	–3 309.36	NA
		Total (with LULUCF)	**NA**	**781 732.47**	**729 173.24**	**692 711.60**	**644 181.66**	**589 601.58**	**605 233.53**	**564 081.41**	**NA**
		Total (without LULUCF)	**780 922.00**	**77 7710.27**	**725 890.38**	**692 287.00**	**647 969.74**	**593 417.43**	**608 898.96**	**567 390.77**	**–27.3**
		Other[c]	NA	NA	NA	NA	NA	NA	NA	NA	NA
KP-LULUCF	Article 3.3[d]	Afforestation and reforestation					–2 668.61	–2 797.77	–2 971.60	–3 058.81	
		Deforestation					588.91	654.21	553.42	552.09	
		Total (3.3)					**–2 079.70**	**–2 143.55**	**–2 418.18**	**–2 506.72**	
	Article 3.4[e]	Forest management					–10 733.45	–9 760.85	–7 491.99	–7 222.12	
		Cropland management	NA				NA	NA	NA	NA	NA
		Grazing land management	NA				NA	NA	NA	NA	NA
		Revegetation	NA				NA	NA	NA	NA	NA
		Total (3.4)	**NA**				**–10 733.45**	**–9 760.85**	**–7 491.99**	**–7 222.12**	**NA**

Abbreviations: KP-LULUCF = LULUCF emissions and removals from activities under Article 3, paragraphs 3 and 4, of the Kyoto Protocol, LULUCF = land use, land-use change and forestry, NA = not applicable, NE = not estimated, NO = not occurring.

[a] "Base year" for sources included in Annex A to the Kyoto Protocol refers to the base year under the Kyoto Protocol, which is 1990 for CO_2, CH_4 and N_2O, and 1995 for HFCs, PFCs and SF_6. The base year for cropland management, grazing land management and revegetation under Article 3, paragraph 4, of the Kyoto Protocol is 1990. For activities under Article 3, paragraph 3, of the Kyoto Protocol and forest management under Article 3, paragraph 4, only the inventory years of the commitment period must be reported.

[b] This table does not reflect the adjusted estimates for one category in the waste sector (see chapter II.H below) after the adjustment procedures under decision 20/CMP.1 were applied. It reflects the estimates contained in the Party's submission of 28 October 2013, which was subject to the said adjustment. The adjustment led to an increase in the estimate of total greenhouse gas emissions for 2011 of 3,199.223 Gg CO_2 eq.

[c] Emissions/removals reported in the sector other (sector 7) are not included in Annex A to the Kyoto Protocol and are therefore not included in national totals.

[d] Activities under Article 3, paragraph 3, of the Kyoto Protocol, namely afforestation and reforestation, and deforestation.

[e] Elected activities under Article 3, paragraph 4, of the Kyoto Protocol, including forest management, cropland management, grazing land management and revegetation.

II. Technical assessment of the annual submission

A. Overview

1. Annual submission and other sources of information

6. The 2013 annual inventory submission was submitted on 15 April 2013; it contains a complete set of common reporting format (CRF) tables for the period 1990–2011 and an NIR. The United Kingdom also submitted the information required under Article 7, paragraph 1, of the Kyoto Protocol, including information on: activities under Article 3, paragraphs 3 and 4, of the Kyoto Protocol, accounting of Kyoto Protocol units, changes in the national system and in the national registry, and the minimization of adverse impacts in accordance with Article 3, paragraph 14, of the Kyoto Protocol. The standard electronic format (SEF) tables were submitted on 15 April 2013.

7. The United Kingdom officially submitted revised emission estimates on 28 October 2013 in response to the list of potential problems and further questions raised by the ERT (see paras. 33, 37, 48, 54, 57, 59, 61, 66, 68 and 95 below). The values used in this report are those submitted by the United Kingdom on 28 October 2013.

8. The full list of materials used during the review is provided in annex II to this report.

2. Overall assessment of the inventory

9. Table 3 contains the ERT's overall assessment of the annual submission of the United Kingdom. For recommendations for improvements related to cross-cutting issues for specific categories, please see the paragraphs cross-referenced in the table.

Table 3
The expert review team's overall assessment of the annual submission

		General findings and recommendations
The expert review team's (ERT's) findings on completeness of the 2013 annual submission		
Annex A sources[a]	Complete	Mandatory: none
		Non-mandatory: "NE" is reported for CO_2, CH_4 and N_2O emissions from multilateral operations; N_2O emissions from glass production, asphalt production and fletton brick production under other (mineral products); N_2O emissions from ammonia production; CH_4 emissions from aluminium production; CO_2 emissions from food and drink; potential emissions of HFCs and PFCs from import/export; CO_2 and N_2O emissions from paint application; CO_2 and N_2O emissions from degreasing and dry cleaning; CO_2 and N_2O emissions from chemical products, manufacture and processing; CO_2 and N_2O emissions from other (solvent and other product use); CH_4 indirect emissions from agricultural soils; CO_2 emissions from managed waste disposal on land; N_2O emissions from domestic and commercial wastewater (sludge); and CO_2 and N_2O emissions (accidental fires) and CH_4 emissions (chemical) from other (waste incineration)

		General findings and recommendations
Land use, land-use change and forestry[a]	Not complete	Mandatory: "NE" is reported for the carbon stock changes in living biomass in overseas territories for forest land converted to wetlands
		Non-mandatory: "NE" is reported for the carbon stock changes in living biomass and dead organic matter for on-site emissions from peat production (wetlands remaining wetlands); CH_4 emissions from drainage of soils and wetlands; and CH_4 and N_2O emissions from harvested wood products
KP-LULUCF	Complete	See paragraph 109 below
The ERT's findings on recalculations and time-series consistency in the 2013 annual submission	Generally consistent	For category-specific recommendations, please see paragraphs 38, 42, 43 and 76 below
The ERT's findings on verification and quality assurance/quality control procedures in the 2013 annual submission	Sufficient	For category-specific recommendations, please see paragraphs 20, 23, 27, 35, 44, 45, 70 and 91 below
The ERT's findings on the transparency of the 2013 annual submission	Generally sufficient	For category-specific recommendations, please see paragraphs 30, 42, 43, 45, 50, 77e, 79, 84, 87, 89, 90, 93, 102, 107, and 108 below

Abbreviations: Annex A sources = sources included in Annex A to the Kyoto Protocol, KP-LULUCF = land use, land-use change and forestry emissions and removals from activities under Article 3, paragraphs 3 and 4, of the Kyoto Protocol, NE = not estimated.

[a] The assessment of completeness by the ERT considers only the completeness of reporting of mandatory categories (i.e. categories for which methods and default emission factors are provided in the Intergovernmental Panel on Climate Change (IPCC) *Revised 1996 IPCC Guidelines for National Greenhouse Gas Inventories*, the IPCC *Good Practice Guidance and Uncertainty Management in National Greenhouse Gas Inventories*, or the IPCC *Good Practice Guidance for Land Use, Land-Use Change and Forestry*).

3. Description of the institutional arrangements for inventory preparation, including the legal and procedural arrangements for inventory planning, preparation and management

Inventory planning

10. The NIR described the national system for the preparation of the inventory. The designated single national entity with overall responsibility for the national inventory is the Department of Energy and Climate Change (DECC). The national inventory agency under contract to DECC is Ricardo-AEA Ltd, which is responsible for the inventory compilation, development, quality management, documentation, archiving and reporting, as well as for the submission of the NIR and CRF tables. Ricardo-AEA is directly responsible for producing the emission estimates for the energy, industrial processes, solvent and other product use, and waste sectors. The agriculture sector emission estimates are provided by Rothamsted Research, under contract to the Department for Environment, Food and Rural Affairs (DEFRA), and the emission estimates for the LULUCF sector are managed by the United Kingdom Centre for Ecology and Hydrology (CEH), under a separate contract to the Climate, Energy, Science and Analysis Division of DECC. The National Inventory Steering Committee is responsible for considering and approving the national inventory prior to its submission to the UNFCCC.

Inventory preparation

11. Table 4 contains the ERT's assessment of the United Kingdom's inventory preparation process. For improvements related to specific categories, please see the paragraphs cross-referenced in the table.

Table 4
Assessment of inventory preparation by the United Kingdom

		General findings and recommendations
Key category analysis		
Was the key category analysis performed in accordance with the Intergovernmental Panel on Climate Change (IPCC) *Good Practice Guidance and Uncertainty Management in National Greenhouse Gas Inventories* (hereinafter referred to as the IPCC good practice guidance) and the IPCC *Good Practice Guidance for Land Use, Land-Use Change and Forestry* (hereinafter referred to as the IPCC good practice guidance for LULUCF)?	No	See paragraph 12 below
Approach followed?	Tier 2	See paragraph 12 below
Were additional key categories identified using a qualitative approach?	Yes	CO_2 emissions from cement production were also identified as key. In response to a recommendation made in the previous review report, the United Kingdom has clarified in annex I to the NIR that it uses the following criteria for its qualitative analysis: mitigation techniques and technologies; high expected emission growth; high uncertainty; and unexpectedly low or high emissions
Has the United Kingdom identified key categories for activities under Article 3, paragraphs 3 and 4, of the Kyoto Protocol following the guidance on establishing the relationship between the activities under the Kyoto Protocol and the associated key categories in the UNFCCC inventory?	Yes	
Does the United Kingdom use the key category analysis to prioritize inventory improvements?	Yes	
Are there any changes to the key category analysis in the latest submission?	Yes	CO_2 emissions from gas and diesel oil consumed in navigation has become a key category in the latest key category analysis
Assessment of uncertainty analysis		
Approach followed?	Both tier 1 and tier 2	
Was the uncertainty analysis carried out in accordance with the IPCC good practice guidance and the IPCC good practice guidance for LULUCF?	Yes	The tier 2 analysis was only carried out including LULUCF; therefore, the values presented below reflect a tier 2 uncertainty analysis (including LULUCF) and a tier 1 uncertainty analysis (excluding LULUCF). For category-specific

	General findings and recommendations
	recommendations, see paragraph 77 below
Quantitative uncertainty (including LULUCF)	Level = 17% Trend = 2 to 3%
Quantitative uncertainty (excluding LULUCF)	Level = 21.0% Trend = 3.2%

Abbreviations: LULUCF = land use, land-use change and forestry, NIR = national inventory report.

12. The 2013 NIR of the United Kingdom describes the method applied for the key category analysis in detail in annex 1. A summary is provided in section 1.5 of the NIR. Upon reviewing the key category analysis, the ERT asked the Party to clarify whether the key category analysis was performed at the level at which individual emission factors (EFs) are specified. In response to the question raised by the ERT during the review, the Party confirmed that the tables in annex 1 of the NIR reflect the actual aggregation level of the Party's key category analysis, which was performed at the level of the main fuel types. The ERT noted that for some of these categories this aggregation is not in line with Intergovernmental Panel on Climate Change (IPCC) *Good Practice Guidance and Uncertainty Management in National Greenhouse Gas Inventories* (hereinafter referred to as the IPCC good practice guidance), which states that the analysis should be performed at the level of the individual IPCC categories (section 7.2). The IPCC good practice guidance proposes the aggregation of categories where the same EF, based on common assumptions, is used. The aggregation used by the Party is not in accordance with the IPCC good practice in a number of cases, including (in the terminology used by the Party) CO_2 emissions from "(stationary) oil" and "auto fuel" and CH_4 emissions from "enteric fermentation". As is shown in the Eurostat energy statistics for the United Kingdom, there are several petroleum-derived fuels used in stationary combustion, including diesel oil, kerosene, fuel oil and liquefied petroleum gas, each with its own EF. A similar situation occurs for enteric fermentation, where separate EFs are applied for different animal types. The ERT concludes that the key category analysis, as performed by the United Kingdom, is not in accordance with the IPCC good practice guidance. Since the Party does apply higher-tier methods in a vast majority of categories, this situation does not influence the quality of the inventory. Nevertheless, the ERT recommends that the United Kingdom perform a key category analysis following the IPCC good practice guidance at an aggregation level where individual EFs are used.

Inventory management

13. The United Kingdom has an archiving system, which includes the archiving of disaggregated EFs and activity data (AD), and documentation on how these factors and data have been generated and aggregated for the preparation of the inventory. The archived information also includes internal documentation on quality assurance/quality control (QA/QC) procedures, external and internal reviews, and documentation on annual key categories and key category identification and planned inventory improvements. The archiving system is mostly centralized where the inventory agency archives all material associated with the annual submission; this is supplemented by archiving at Rothamsted Research and CEH. The NIR explains that, at the end of each reporting cycle, all the database files, spreadsheets, online manuals, electronic source data, records of communications, paper source data, and output files representing all calculations for the full time series are archived by the inventory agency. Some components of the archive that are not available electronically, such as scientific papers and industry correspondence, are also

kept in hard copy. Recommendations made in the previous review report included that the United Kingdom briefly describe the role that Rothamsted Research and CEH (which coordinate the compilation of the agriculture and LULUCF sector inventories, respectively) have with respect to archiving in the NIR. As additional information has not been provided in the 2013 annual submission, the ERT reiterates the recommendation made in the previous review report that the United Kingdom provide this information. The United Kingdom was able to provide the archived documents requested by the ERT during the review, including confidential data according to national procedures.

4. Follow-up to previous reviews

14. Section 1.2.2.5 and chapter 10 of the NIR together present a clear overview of all the improvements that the United Kingdom has implemented in the 2013 annual submission. These improvements are steered by a formal inventory improvement programme that is, among others, based on the observations, recommendations and encouragements made in the previous review reports. The ERT commends the United Kingdom for this clear and transparent way of dealing with the results of previous reviews.

15. The ERT noted that, in accordance with paragraph 4 of the annex to decision 15/CMP.1, each Party included in Annex I to the Convention shall describe in its annual inventory any steps taken to improve the emission estimates in areas that were previously adjusted. The ERT noted that the United Kingdom has not provided sufficient information in its NIR in this regard. The Party does not explicitly mention in its 2013 annual submission that the CH_4 and N_2O emissions from gasoline and diesel oil used in road transportation were adjusted in the 2012 annual review report (see para. 36 below). The ERT strongly reiterates the recommendation made in the 2011 and 2012 annual review reports that the United Kingdom include explicit information in the NIR whenever adjustments have been applied to the inventory, explaining how the Party has responded to the adjustments in the subsequent inventory, or at the latest, in the inventory submission following publication of the annual review report containing the adjustment.

5. Areas for further improvement identified by the expert review team

16. During the review, the ERT identified a number of areas for improvement, including some related to specific categories. These are listed in the relevant chapters of this report and in table 10 below.

B. Energy

1. Sector overview

17. The energy sector is the main sector in the GHG inventory of the United Kingdom. In 2011, emissions from the energy sector amounted to 465,978.02 Gg CO_2 eq, or 82.1 per cent of total GHG emissions. Since 1990, emissions have decreased by 23.7 per cent. The key drivers for the fall in emissions are the switch from solid fuels to gaseous fuels; the reduced energy intensity of the economy (i.e. the switch from industrial production to services); and the economic crisis of recent years. Within the sector, 38.7 per cent of the emissions were from energy industries, followed by 24.9 per cent from transport and 18.6 per cent from other sectors. Manufacturing industries and construction accounted for 14.7 per cent and fugitive emissions from fuels accounted for 2.5 per cent. The remaining 0.6 per cent were from other (military use).

2. Reference and sectoral approaches

18. Table 5 provides a review of the information reported under the reference approach and the sectoral approach, as well as comparisons with other sources of international data. Issues identified in table 5 are more fully elaborated in paragraphs 19–25 below.

Table 5
Review of reference and sectoral approaches

		Paragraph cross-references
Difference between the reference approach and the sectoral approach	Energy consumption: –74.23 PJ, –1.14% CO_2 emissions: 4,385.60 Gg CO_2 eq, 0.98%	
Are differences between the reference approach and the sectoral approach adequately explained in the NIR and the CRF tables?	No	19
Are differences with international statistics adequately explained?	Yes	22
Is reporting of bunker fuels in accordance with the UNFCCC reporting guidelines?	Yes	
Is reporting of feedstocks and non-energy use of fuels in accordance with the UNFCCC reporting guidelines?	Yes	24

Abbreviations: CRF = common reporting format, NIR = national inventory report, UNFCCC reporting guidelines = "Guidelines for the preparation of national communications by Parties included in Annex I to the Convention, Part I: UNFCCC reporting guidelines on annual inventories".

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

19. Although the difference between the reference approach and the sectoral approach is less than 2 per cent for the entire time series (1990–2011), the ERT noted that the difference in energy consumption of solid fuels between the two approaches, as well as the associated CO_2 emissions for solid fuels, ranges from 3.3 to 7.3 per cent and from –3.5 to 1.8 per cent, respectively, during the years 1990–2011; in 2011, the difference between the two approaches is 5.9 per cent and 1.5 per cent, respectively. No explanation for these differences was provided in the NIR. In response to questions raised by the ERT during the review, the United Kingdom indicated that it calculates the emission estimates using mass-based AD and EFs and that there are more types of solid fuel (with different calorific values) than those reported in the reference approach. The Party also indicated that the conversion between mass and energy is not as simple as the method shown in the reference approach. The ERT is of the view that, in order for the Party's response to justify the difference between the two approaches, it has to be accompanied by quantitative data. The United Kingdom explained that it is planning to review the approach it uses for the reference approach for the 2014 annual submission in order to make it more comparable to the national energy statistics (the Digest of United Kingdom Energy Statistics (DUKES)) compiled by DECC, and also to improve the explanation of any differences between the

two approaches in the NIR. The ERT commends the United Kingdom for its planned improvements, and recommends that the Party describe the outcomes of these efforts in the NIR, in particular those relating to the difference between the two approaches for solid fuels.

20. The ERT noted that the fractions of carbon oxidized used by the Party in the reference approach were mainly the same as the IPCC default fractions, with the exception of anthracite, peat, brown coal briquettes (BKB) and patent fuel, and coke oven/gas coke. The fractions of carbon oxidized for these fuels were reported as 0.95 for anthracite and peat, and 0.97 for BKB and patent fuel, and coke oven/gas coke. Further, the fraction of carbon oxidized for solid biomass was reported as 1.98, due to an error in the compilation of the CRF tables (the fraction of carbon oxidized must be lower than 1). In response to questions raised by the ERT during the review, the United Kingdom explained that the unoxidized carbon faction was calculated as the difference between the carbon content (derived from analysis) and a carbon EF. The ERT is of the view that the fraction of carbon oxidized is estimated by measuring the carbon retention in ash and not by comparing the carbon EF with the carbon content. The ERT recommends that the United Kingdom review these fractions and report them accordingly in the NIR.

21. The ERT notes that in response to a recommendation made in the previous review report the United Kingdom now uses the notation key "NO" as opposed to the notation key "NA" (not applicable) in CRF table 1.A(b) for fuels that have not occurred in the country. The ERT welcomes this improvement, which is consistent with the use of notation keys as outlined in 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".

International bunker fuels

22. The United Kingdom uses a bottom-up approach based on detailed flight information and shipping movement data to separate the fuel used for domestic and for international aviation and navigation, respectively. The AD and associated emissions from shipping in inland waterways, military aviation and shipping, fishing outside United Kingdom waters and shipping movements to and from the overseas territories (OTs) are included under the national total and allocated in the CRF tables under the categories navigation, mobile (other), agriculture, forestry and fisheries, and navigation, respectively. The ERT noted that the DUKES data on aviation and navigation are different from those reported in the CRF tables. For example, the differences in fuel consumption for residual fuel for national navigation and marine bunkers is are 521.9 per cent and –33.4 per cent, respectively. In response to questions raised by the ERT during the review, the United Kingdom explained that the higher-tier methodologies applied to aviation and shipping in the inventory lead to a different domestic/international split in the allocation of fuel use for aviation and marine fuels compared with the allocation according to the DUKES data and the submissions to the International Energy Agency (IEA)/Eurostat. The ERT encourages the United Kingdom to explore the potential incorporation of the fuel split reported in the CRF tables into DUKES, so that the data submitted to IEA and the UNFCCC are the same.

23. The ERT identified discrepancies between CRF tables 1.C and 1.A(b) concerning jet kerosene (international aviation) and residual fuel oil and diesel oil (marine bunkers). In 2011, the differences between the fuel consumption reported in CRF tables 1.A(b) and 1.C were –2.6 per cent, 5.2 per cent and 0.7 per cent for jet kerosene, residual fuel oil and diesel oil, respectively. In response to questions raised by the ERT during the review, the United Kingdom explained that the sectoral approach (CRF table 1.C) includes fuel use from the OTs, and the reference approach (CRF table 1.A(b)) is based on DUKES, which does not extend to the OTs. Further, the United Kingdom explained that for international aviation, the discrepancy in the energy-based AD is also due to an error, whereby the calorific value for aviation spirit was applied to the AD for aviation turbine fuel in the sectoral approach

CRF tables. This error did not affect the estimated GHG emissions but only the reported AD. The ERT recommends that the United Kingdom rectify this error in the reported AD.

Feedstocks and non-energy use of fuels

24. In response to a recommendation made in the previous review report, the United Kingdom has improved the section of the NIR related to feedstocks by providing the references for the carbon storage fractions and the anticipated final use of almost all feedstocks used in the United Kingdom. The ERT commends the United Kingdom for these efforts. However, the ERT noted that the fractions of carbon stored and the final uses in 2011 of the following amounts of non-energy use of fuels are not adequately explained in the NIR: 10,724.99 TJ of coal tar, 5,413.47 TJ of gas/diesel oil and 9,850.57 TJ of petroleum coke (see also para. 28 below). Furthermore, no associated emissions were reported for these amounts of fuels in any of the CRF tables. In response to questions raised by the ERT during the review, the United Kingdom explained that the overall energy balance for each fuel is known to a high degree of certainty (therefore, these amounts are used somewhere), but it has no evidence that any of these feedstocks are used in emissive applications. Further, the United Kingdom explained that although it cannot identify the non-energy use of these fuels with certainty, it has commissioned a specific study to review the classification of non-energy use and the findings from that study will feed into improvements in the United Kingdom's 2014 annual submission. The ERT commends the United Kingdom for its efforts and strongly recommends that the Party include any identified emissive sources of feedstocks and their exact final end use, as identified by this study, in the NIR and the CRF tables.

25. The ERT is of the view that in cases where the final use of these fuels is not known, the reporting of no associated emissions for that fuel could result in a potential underestimation of emissions. In cases where a non-energy use cannot be defined with certainty, the ERT strongly recommends that the United Kingdom report the associated emissions of the respective fuel in an appropriate category under the energy or industrial processes sectors (if a specific category is not known, reporting could occur under other (energy) or other (industrial processes)) under the assumption that it is fully oxidized. The ERT reiterates the recommendation made in the previous review report that the United Kingdom review the allocation of fuels to non-energy uses within DUKES,[3] in order to identify any misallocations of fuels to non-energy uses that may lead to an underestimation of emissions in the United Kingdom's GHG inventory.

Country-specific issues

26. As part of its geographical coverage, the United Kingdom includes the OTs and crown dependencies (CDs) in its Kyoto Protocol obligations. DUKES does not include energy use pertaining to the OTs and also does not separate energy use in the CDs from energy use in the United Kingdom. However, the DUKES data are supplemented by the inventory agency, which contacts the appropriate agencies in each territory to gather all available AD. A description of the procedures followed by the United Kingdom to cope with the difficulties in obtaining regular, complete AD (i.e. for the entire time series and across all categories) is provided in the NIR. In response to questions raised by the ERT during the review, the United Kingdom explained that the consideration of improvements regarding the AD for the OTs and CDs is included in the Party's list of planned improvements, and certain tasks may be implemented to improve the collection of AD from the OTs and CDs, depending on resources and the improvement priorities across the inventory. The ERT commends the United Kingdom for its approach to dealing with this issue and encourages the Party to continue its efforts to further improve the collection of these AD.

[3] FCCC/ARR/2012/GBR, paragraph 55.

3. Key categories

Stationary combustion: solid, liquid and gaseous fuels – CO_2

27. The ERT identified large inter-annual changes in the CO_2 implied emission factor (IEF) for solid fuels for all subcategories, except iron and steel, under manufacturing industries and construction and the subcategories commercial/institutional and agriculture/forestry/fisheries (other sectors) between 2010 and 2011. For example, for the subcategories under manufacturing industries and construction (except iron and steel), the CO_2 IEF decreased by 3.1 per cent in 2011 (88.75 t/TJ) compared to 2010 (91.58 t/TJ). By examining the additional information submitted with the United Kingdom's NIR,[4] the ERT identified a possible error in the reporting in the CRF tables of the AD (i.e. for fuel combustion) related to all fuel combustion activities. This error resulted in a low IEF for 2011 compared to previous years of the time series. In response to further questions raised by the ERT during the review, the United Kingdom explained that an error in the gross calorific values (GCVs) used to calculate the AD for 2011 on an energy basis occurred during the upload to the CRF Reporter. The United Kingdom also explained that this error does not affect the inventory emissions. Further, the Party stated that it has developed a new method for use in the 2014 annual submission which will include additional quality checks and will minimize the manual transposition of data across multiple data spreadsheets. In response to a follow-up question raised by the ERT during the review, the United Kingdom provided the correct AD (i.e. for fuel combustion) to the ERT for all activities related to fuel combustion. The ERT confirmed that there was no underestimation of emissions. However, the ERT recommends that the United Kingdom implement its planned efforts in this regard, including the improvement of the QA/QC procedures, to avoid errors in the CRF tables.

28. The ERT noted that there is no reference in the NIR for the "fraction of carbon oxidized" applied for the estimation of CO_2 emissions under the sectoral approach. In response to questions raised by the ERT during the review, the United Kingdom provided information on the applied factors of carbon oxidized. The ERT is of the view that the majority of the factors were adequately justified (e.g. based on plant-specific data derived from the reporting under the European Union Emissions Trading System (EU ETS)). However, the fractions of carbon oxidized used for the following solid fuels were not adequately justified: coal – other (0.97); coal – domestic (0.94); coke – power (0.97); coke – other (0.97); and anthracite – domestic (0.947). The United Kingdom explained that these factors are based on the study entitled *Review of Carbon Emission Factors in the UK Greenhouse Gas Inventory*.[5] This study was provided to the ERT during the review, but there is no justification for the use of these factors in the study. It is only mentioned in the study that these oxidation factors are assumed to have the above-mentioned values. The ERT strongly recommends that the United Kingdom either justify these fractions of carbon oxidized that deviate from the IPCC default values or apply the IPCC default value of 0.98 from the *Revised 1996 IPCC Guidelines for National Greenhouse Gas Inventories* (hereinafter referred to as the Revised 1996 IPCC Guidelines).

Road transportation: liquid fuels – CO_2

29. The ERT noted that the CO_2 EF used for gasoline for road transportation (70.08 t/TJ in 2011) is among the lowest of all reporting Parties (ranging from 68.00 t/TJ to 76.07 t/TJ) and 4.0 per cent lower than the IPCC default value (73.00 t/TJ). In response to questions raised by the ERT during the review, the United Kingdom explained that it used a constant mass-based EF (t CO_2/t fuel) for gasoline for the entire time series, reflecting a lack of new data to challenge the existing EF supplied by the United Kingdom Petroleum Industry

[4] Spreadsheet file entitled "energy_background_data_uk_2013.xls" submitted with the NIR.

[5] DEFRA. 2004. *Review of Carbon Emission Factors in the UK Greenhouse Gas Inventory*. Available at <http://naei.defra.gov.uk/reports/reports?report_id=417>.

Association (UKPIA) and the fact that UKPIA has not raised any concerns regarding the continuing use of its EF. The United Kingdom also considers that a review of its data would be appropriate. The ERT strongly recommends that the United Kingdom perform a review of this EF in cooperation with UKPIA and include this information in the NIR.

Oil and natural gas: natural gas – CH_4

30. The United Kingdom has reported in the NIR that the natural gas network operators use a common industry leakage model to derive the annual estimates of fugitive emissions from natural gas transmission and distribution systems. In response to questions raised by the ERT during the review, the United Kingdom provided the ERT with a technical description of the United Kingdom National Grid leakage model. However, the ERT identified that this model contains information on the estimation of emissions for the low- and medium-pressure transmission/distribution systems, but not for the high-pressure part of the natural gas transmission system. In response to a follow-up question raised by the ERT during the review, the Party explained that fugitive emissions from the high-pressure part of the natural gas transmission system are based on fugitive emissions surveys conducted for the National Transmission System (NTS) compressor stations and terminals, and provided the respective data and information to the ERT. The ERT confirmed that the reporting of fugitive emissions from the high-pressure part of the NTS in the Party's annual submission is correct. However, the ERT recommends that the United Kingdom improve the transparency of the description of the methodology followed for the estimation of fugitive emissions from natural gas transmission and distribution systems in the NIR.

31. The United Kingdom has reported in CRF table 1.B.2 that the CH_4 emissions from natural gas transmission and distribution for 2011 are 6.92 Gg CH_4 and 177.77 Gg CH_4, respectively. The ERT noted that the CH_4 emissions per length of pipeline should be higher for gas transmission compared to gas distribution. According to table 2.16 of the IPCC good practice guidance, the CH_4 EF in Gg CH_4 per length of gas network pipeline is one order of magnitude higher for transmission compared to distribution. However, the ERT considers that the difference observed in the United Kingdom may be justified by the considerably greater length of the distribution network pipelines compared to the transmission network pipelines. In response to questions raised by the ERT during the review, the United Kingdom explained that the length of the gas network pipelines is not used as a primary input for the emission estimates calculated by the inventory compilers, and is therefore not available. The ERT recommends that the United Kingdom perform the following exercise in order to verify the emission estimates obtained by the high-tier model applied: calculate the emissions from natural gas transmission and distribution by applying the tier 1 EFs included in table 2.16 of the IPCC good practice guidance and compare those emission estimates with the estimates obtained from the United Kingdom National Grid leakage model, and provide the conclusions of this comparison in the NIR.

4. Non-key categories

Civil aviation: liquid fuels – CO_2, CH_4 and N_2O

32. The ERT noted that the 2013 NIR of the United Kingdom suggests that there may be a slight underestimation of emissions for jet kerosene, as the Party assumes that a flight that travels, for example, from Glasgow to Birmingham (both within the United Kingdom) to Paris, is all international (NIR, pp. 137–138). According to table 2.9 of the IPCC good practice guidance (p. 2.61), the emissions from the domestic segment of flights that "[d]epart in one country, stop in the same country and drop and pick up passengers or freight, then depart finally arriving in another country" should be reported under civil aviation and included in the national GHG emissions total. In response to questions raised by the ERT during the review, the United Kingdom explained that it uses bottom-up data (tier 3), by which international flights containing a domestic segment can be identified, but the Party cannot identify which of the international flights with a domestic segment include

drop-off and pick-up of passengers and/or freight, which is required in order to be classified as domestic civil aviation. The ERT considered that by excluding the domestic segment of international flights, the reported GHG emissions from domestic civil aviation are underestimated and the ERT included this issue in its list of potential problems and further questions raised by the ERT.

33. In response to the list of potential problems and further questions raised by the ERT, the United Kingdom provided a revised time series of GHG emission estimates for civil aviation, revising the assumption regarding international flights that have an intermediate stop at a domestic airport. The revised time series now assumes that all international flights with a domestic stop include the drop-off and pick-up of passengers and/or freight and, therefore, the emission estimates for the initial domestic leg of the journey are included under civil aviation, rather than as part of the international flight. The revision resulted in an increase in emissions of 20.65, 15.69, 16.71 and 15.05 Gg CO_2 eq for the years 2008, 2009, 2010 and 2011, respectively. The ERT agrees with the recalculated emission estimates.

34. The ERT noted that the CO_2 EF used for jet kerosene for civil aviation (69.92 t/TJ) is the lowest among reporting Parties (ranging from 69.92 to 74.93 t/TJ) and lower than the IPCC default (72.80 t/TJ). In response to questions raised by the ERT during the review, the United Kingdom replied that it uses a constant mass-based EF (t CO_2/t fuel) for jet kerosene for the entire time series, reflecting a lack of new data to challenge the existing EF supplied by UKPIA and the fact that UKPIA has not raised any concerns regarding the continuing use of its EF. The United Kingdom also considers that a review of the data would be appropriate. The ERT strongly recommends that the Party perform a review of this EF in cooperation with UKPIA and include this information in its NIR.

35. The United Kingdom uses a tier 3 model to estimate the GHG emissions from aviation. The Party has reported in the NIR that the total modelled fuel use is normalized to the total obtained from DUKES. The total according to DUKES includes all flights originating from the United Kingdom and the CDs; therefore, flights from the OTs are additional to this total and are excluded from the normalization. By analysing the fuel reconciliation procedure described on page 142 of the NIR, the ERT concluded that the aggregate fuel consumption of the domestic and international aviation reported in the CRF tables should be greater than the fuel consumption reported to DUKES and IEA, due to the fact that flights departing from the OTs are not included in the fuel consumption reported in DUKES. However, the ERT noted that the total aggregated fuel consumption from national and international aviation reported to DUKES and IEA is lower than that reported in the CRF tables, with the exception of 2011 (e.g. the difference between the CRF tables and the IEA data was 1.0, 0.5, 1.7 and –0.1 per cent for 2008, 2009, 2010 and 2011, respectively). In response to questions raised by the ERT during the review, the United Kingdom explained that the discrepancy with the IEA data may be due to the error identified in the GCVs used to calculate the AD on an energy basis for use in the CRF tables (see para. 27 above). The ERT is of the view that this explanation cannot justify the discrepancy because the CO_2 IEFs for 2011 are identical to the CO_2 IEFs for 2010 in the 2013 annual submission. In response to a follow-up question, the United Kingdom provided a spreadsheet containing detailed data which show the reconciliation between the DUKES data and the fuel consumption data reported in the CRF tables. However, the ERT noted that the fuel consumption data for civil aviation provided to the ERT in response to questions raised during the review resulted in CO_2 IEFs that are about 2–3 per cent higher than the IEFs for the rest of the time series (1990–2010). The ERT recommends that the United Kingdom rectify the reporting error regarding the AD for civil aviation (national and international) and improve the QA/QC procedures performed during the compilation of the CRF tables.

Road transportation: liquid fuels – CH_4 and N_2O

36. The ERT noted that the estimated fuel consumption for road transportation calculated using a bottom-up approach differs from the estimated fuel consumption according to the DUKES data. For example, for 2011, the bottom-up method underestimates petrol and diesel consumption by 4.5 and 1.2 per cent, respectively. In order to calculate the CO_2 emissions, the United Kingdom scales the AD for fuel consumption to the quantity of fuel sold in the country in accordance with the Revised 1996 IPCC Guidelines and the IPCC good practice guidance. However, the ERT identified that the United Kingdom does not scale the AD for fuel consumption to estimate the corresponding CH_4 and N_2O emissions. Therefore, the AD reported for road transportation in the CRF tables (i.e. amount of fuel sold) have no direct relation to the emission estimates for these gases. This issue was also identified in the 2012 annual review report. An adjustment was ultimately applied for this category and accepted by the United Kingdom. In response to questions raised by the ERT during the review of the 2013 annual submission, the United Kingdom explained that the 2012 draft annual review report was received on 10 May 2013 and published on 15 July 2013; in both cases after the Party's 2013 inventory was submitted. The United Kingdom also explained that it would make the required changes for the 2014 annual submission. The ERT is of the view that the rationale for the scaling of fuel consumption for the estimation of the CO_2 emissions also applies to the estimation of the CH_4 and N_2O emissions, because the data on sales are more reliable as they are provided by statistically reliable data sources, thus ensuring the full coverage of all activities and related emissions under this category. The ERT considered that the approach used by the United Kingdom led to an underestimation of emissions and therefore included this issue in its list of potential problems and further questions.

37. In response to the list of potential problems and further questions raised by the ERT, the United Kingdom submitted a revised time series of CH_4 and N_2O emission estimates by applying the scaling of fuel consumption calculated by the model to the amount of fuel sold according to the energy balance. As a result, the emission estimates for road transportation increased by 7.97, 0.69, 9.30 and 12.34 Gg CO_2 eq for the years 2008, 2009, 2010 and 2011, respectively. The ERT agrees with the revised emission estimates and commends the United Kingdom for its efforts to increase the accuracy of its inventory.

Railways: solid fuels – CO_2, CH_4 and N_2O

38. The ERT noted that the United Kingdom reports as "NO" solid fuel consumption and the associated emissions from railways for the years prior to 2005, while for the rest of the time series (2005–2011) solid fuel consumption and the respective associated emissions were reported (ranging from 10.74 to 50.47 Gg CH_4 during that period). In response to questions raised by the ERT during the review, the United Kingdom explained that no solid fuel consumption is included in the DUKES data for the years prior to 2005. However, the Party acknowledged that the correct notation key for the years prior to 2005 for this category should be "NE". The ERT recommends that the United Kingdom improve the completeness and time-series consistency of its estimates of railway emissions by estimating the AD and associated GHG emissions from solid fuel consumption. In case the necessary AD are not available, the ERT recommends that the United Kingdom estimate them by using one of the estimation techniques described in section 7.3.2.2 of the IPCC good practice guidance.

Coal mining and handling: solid fuels – CH_4

39. The United Kingdom has reported in its NIR (p. 222) that the CH_4 EF for coal storage and transport (post-mining activities) is only applied to deep-mined coal production. The Party has also reported in CRF table 1.B.1 that the associated emissions from post-mining activities of surface mines are reported as included elsewhere ("IE"), and are included in the post-mining activities of underground mines. The ERT considers that

because CH_4 emissions from post-mining activities related to underground mines were estimated by applying an EF for deep-mined coal production, and not for total coal production (so that coal production from surface mines was included), the post-mining emissions from surface mines might have been underestimated. In response to questions raised by the ERT during the review, the United Kingdom explained that the notes in the CRF tables and the text in the NIR are not transparent with regard to this matter. The Party confirmed that the reported emissions from mining activities of surface mines include post-mining emissions. The ERT finds that this is consistent with the IPCC good practice guidance (p. 1.111), which states that, where country-specific data are used, as in the case of the United Kingdom, "[i]n most cases, if the tier 2 approach is used to estimate methane emissions from surface mines, post-mining emissions from surface-mined coals are assumed to be zero". The ERT agreed with the approach used by the United Kingdom, but recommends that the Party revise the note on the use of the notation key "IE" in CRF table 1.B.1 accordingly.

40. The ERT welcomes the improvement made by the Party in the transparency and comparability of its inventory in response to the recommendations made in the previous review report by reporting CH_4 emissions from closed mines separately under other (fugitive emissions from solid fuels).

C. Industrial processes and solvent and other product use

1. Sector overview

41. In 2011, emissions from the industrial processes sector amounted to 26,490.35 Gg CO_2 eq, or 4.7 per cent of total GHG emissions. The United Kingdom has reported estimates of GHG emissions from the solvent and other product use sector, as either "NO" or "NE", depending on the categories. Since the base year, emissions have decreased by 54.0 per cent in the industrial processes sector. The key drivers for the fall in emissions in the industrial processes sector are the reduction in N_2O emissions from nitric and adipic acid production due to the closure of some plants and the installation of high-performance N_2O abatement techniques and the reduction in HFC emissions from the production of halocarbons due to the closure of the two HCFC-22 production plants. Further reductions can be attributed to the decreases in CO_2 emissions from mineral products (36.2 per cent), the chemical industry (14.5 per cent) and metal production (40.1 per cent) and the decreases in SF_6 emissions from metal production (82.5 per cent) and consumption of halocarbons and SF_6 (34.5 per cent). These reductions were partially offset by a substantial increase in HFC emissions from consumption of halocarbons (981.4 per cent, since 1995). Within the industrial processes sector, 57.3 per cent of the emissions were from consumption of halocarbons and SF_6, followed by 25.2 per cent from mineral products, 10.7 per cent from the chemical industry and 6.2 per cent from metal production. The remaining 0.6 per cent were from production of halocarbons and SF_6.

42. Although the NIR is comprehensive in terms of coverage of categories and gases and contains information on the methodologies (including AD and EFs applied) uncertainty, recalculations and QA/QC procedures per category, the ERT considers that there is still room for improvement with regard to its transparency, consistency and completeness. For example, the ERT noted that for some categories the methodology applied is not always consistent over the entire time series due to the varying availability of data sources. In order to improve the transparency of the NIR, the ERT recommends that the Party provide additional tables containing time-series overviews of the data sources, AD and methodologies applied (e.g. nitric acid production, see para. 43 below) as has already been done for some categories (e.g. cement production). The ERT also noted that recalculations are reported for the categories affected, but the rationale provided for the recalculations is not transparent. The ERT recommends that the United Kingdom report on

the rationale for and impact of all recalculations undertaken in the NIR and in CRF table 8(b).

2. Key categories

Nitric acid production – N_2O

43. The ERT noted that the United Kingdom has implemented a recommendation made in the previous review report by providing a table containing the time series of AD and EFs used to estimate the emissions from nitric acid production. However, the transparency of the description of the methodology used could be improved, given the fact that the time-series information on the data sources and method used is not consistent. The ERT reiterates the recommendation made in the previous review report that the Party enhance the transparency of its reporting by providing information on the methods used by the plant operators to estimate the N_2O emissions from nitric acid production and ensure the consistency of the data reported across the entire time series.

Consumption of halocarbons and SF_6 – HFCs, PFCs and SF_6

44. The ERT commends the United Kingdom for updating its tier 2 country-specific model to estimate emissions from consumption of halocarbons in refrigeration and air-conditioning equipment. The update includes an expansion of the number of end uses using bottom-up information on charge quantities, lifetimes and EFs. For the other subcategories, the Party also uses a bottom-up model, introduced following recommendations made in previous review reports. The ERT noted some inconsistencies in the AD and/or emissions reported (e.g. the disposal reported is larger than the initial charge or is being reported as being disposed of before the reported lifetime) and recommends that the Party continue to review the assumptions and methodologies applied to the model(s) used. The United Kingdom also included in its 2013 annual submission for the first time the emissions from this category for its OTs and CDs, using appropriate scaling factors based on macroeconomic drivers (e.g. population, gross domestic product). The ERT commends the United Kingdom for doing so.

45. The NIR is transparent in relation to the methodological description and (summaries of) underlying key assumptions for the estimates of actual emissions, but lacks a description of how the potential emissions are estimated. The ERT recommends that the Party include in its NIR a description of the methodology applied to estimate the potential emissions. Further, the Party did not report on the potential emissions from foam blowing (the relevant cell was left blank), but the Party stated that this was due to a malfunction in the CRF Reporter. The ERT recommends that the Party improve its QA/QC procedures for the final reporting in the NIR and the CRF tables prior to their submission.

46. In response to a recommendation made in the previous review report, the United Kingdom has disaggregated the actual emissions from the unspecified mix of HFCs into the various substances; the ERT commends the United Kingdom for doing so. The ERT further encourages the Party to investigate whether the potential HFC emissions from production, import and export can also be disaggregated, by substance.

3. Non-key categories

Lime production – CO_2

47. The NIR states that emissions from lime production in sugar refineries are excluded from the reported CO_2 emissions for this category. The explanation given is that the Party assumes that all produced lime recarbonates during the sugar-refining process to limestone and hence no CO_2 is emitted in the process. However, scientific literature (including the IPCC good practice guidance and the *2006 IPCC Guidelines for National Greenhouse Gas Inventories* (hereinafter referred to as the 2006 IPCC Guidelines)) suggest that in sugar

refineries not all calcium oxide (CaO) is recarbonated to limestone in the refining process. This means that the foam/scum waste after the refining process may contain CaO (up to 24 per cent of the input has been reported by other reporting Parties), indicating potential CO_2 emissions in this particular category that were not reported. Furthermore, the United Kingdom did not include the limestone-containing waste from sugar refineries under the relevant soil liming categories (i.e. cropland and grassland) of the LULUCF sector (section A3 6.6.1 of the NIR). If those emissions were to have been included under the LULUCF sector, it would result in an emissions allocation issue, but still leading to an underestimation of emissions from lime production. The ERT concluded that the Party had underestimated the CO_2 emissions from lime production and included this issue in its list of potential problems and further questions.

48. In response to the list of potential problems and further questions raised by the ERT, the Party initially provided background information on the EU ETS, in which it was stated that the emissions from lime production in sugar refineries could be assumed to be zero. As this statement was not supported by any evidence, the ERT rejected the assumption that no CO_2 is emitted during lime production in sugar refineries. In response, the Party changed its methodology and accepted the assumption that 24 per cent of the CaO used in the sugar-refining process remains unconverted and revised its emission estimates for this category accordingly. As a result of this revision, the Party's estimates of CO_2 emissions from lime production for 2011 increased from 1,134.92 Gg CO_2 eq to 1,155.28 Gg CO_2 eq (a 1.8 per cent increase). The ERT agrees with the revised estimates. The ERT encourages the United Kingdom to investigate further the amount of unconverted CaO in its sugar mills and to report thereon in its annual submission.

Ammonia production – CO_2

49. The previous ERT noted in the 2012 annual review report that it suspected that emissions from ammonia (NH_3) production might only be estimated for two of the three NH_3 production plants. The current ERT notes that in response to the observation made in the previous review report the United Kingdom has provided in the NIR additional detail on the structure of this category and an explanation of the low overall IEF, which is due to the fact that one of the production plants uses hydrogen as a feedstock and not natural gas. The ERT further noted a variable IEF, ranging from 1.12 to 1.40 t CO_2/t NH_3, from the data provided in the NIR. This is lower than the IPCC default value of 1.5 t CO_2/t NH_3. As the United Kingdom does not report carbon monoxide (CO) emissions from this category separately, the ERT cannot determine whether these CO emissions could account for the missing carbon in the CO_2 IEF. In response to questions raised by the ERT during the review, the United Kingdom could not provide an explanation for this low IEF, except that it is based on data provided by the plant operators and, as stated in the NIR, it includes all CO_2, including the amount sold to adjoining facilities. The ERT strongly recommends that the Party further investigate the origin of this low IEF and report thereon in its NIR.

50. Further examination of the information provided in response to the questions raised by the ERT during the review of the energy sector, regarding the use of natural gas feedstock for NH_3 production, revealed that there was an inconsistency between the amounts of gas reported in the NIR for this category and the data contained in the energy sector tables. According to the figures provided in CRF table 1.A(d), 19,301 TJ (net calorific value (NCV)) is used, while the NIR reports only 12,592 TJ for natural gas feedstock use in 2011. In response to this observation, the Party acknowledged that the values in the tables for the energy sector were not correct, as the figures given for NH_3 feedstocks included natural gas for acetic acid production. The ERT recommends that the Party use a correct allocation of energy uses across categories and applications. The ERT concludes that the reporting of this category in the NIR is not transparent and consistent with the information reported under the energy sector: in the industrial processes sector, the GCV is used for both the AD and EF for natural gas, while in the energy sector, the NCV is

used. The ERT recommends that the Party improve the transparency and consistency of its NIR by using the same units for the AD and EF across the sectors.

D. Agriculture

1. Sector overview

51. In 2011, emissions from the agriculture sector amounted to 51,882.01 Gg CO_2 eq, or 9.1 per cent of total GHG emissions. Since 1990, emissions have decreased by 20.3 per cent. The key driver for the fall in emissions is the general reduction in the number of animals (especially the decrease in the pig population by 41.2 per cent since 1990) and the decrease in fertilizer consumption. Within the sector, 52.2 per cent of the emissions were from agricultural soils, followed by 29.7 per cent from enteric fermentation and 18.0 per cent from manure management. Other (agriculture) was responsible for the remaining 0.1 per cent. The United Kingdom reports the notation keys "NA" and "NO" for rice cultivation.

2. Key categories

Enteric fermentation – CH_4

52. Emissions from enteric fermentation for dairy and non-dairy cattle were estimated using the IPCC tier 2 method with country-specific data (e.g. cattle weight, milk production, fat content, feed digestibility and percentage of time spent grazing). For other animal categories, the United Kingdom applied the IPCC tier 1 method. Following a recommendation made in the previous review report, the United Kingdom has provided in the NIR additional information to justify the use of the country-specific parameters, such as the digestible energy value (DE). In the original 2013 annual submission, the United Kingdom revised its estimate of the DE for dairy cattle from 73.88 per cent in the 2012 annual submission to 75 per cent. The IPCC good practice guidance indicates a range of 60–75 per cent for the DE. The current DE used by the United Kingdom is thus within the upper range for cattle fed with forage. This update, which was made for the entire time series in the 2013 annual submission, reduced the CH_4 emissions from enteric fermentation and manure management (see para. 57 below).

53. In the NIR (p. 348), the United Kingdom provided some information on how the DE of 75 per cent was estimated for cattle. Specifically, the NIR states that it "is based on typical diets for cows over the lactating and non-lactating period". In response to questions raised by the ERT during the review, the United Kingdom provided more detailed data on the different types of commonly used feeding stuffs and their proportion in the total cattle diet for a typical dairy cow, where the overall diets are based on expert judgement. However, the ERT identified errors and inconsistencies in the received data, as subsequently acknowledged by the United Kingdom. Based on this, the ERT concluded that the data received during the review week were insufficient to support the Party's view that the country-specific DE reflects the actual feeding conditions across the United Kingdom. As the United Kingdom was not able to provide sufficient documentation during the review week to support the use of the high DE rate in its estimation of CH_4 emissions from enteric fermentation, the ERT concluded that there was a potential underestimation of emissions and included this issue in the list of potential problems and further questions raised by the ERT.

54. In response to the list of potential problems and further questions raised by the ERT, the United Kingdom stated that "[it] accepts that further improvements can be made and a more detailed approach is anticipated in the current improvement plan" and submitted revised emission estimates for enteric fermentation using a DE of 74.52 per cent for dairy cattle. This revision has resulted in an increase in CH_4 emissions from dairy cattle of

0.8 per cent for 2011 (from 201.34 Gg CH_4 to 203.01 Gg CH_4). The ERT accepts the revised estimates submitted by the Party. However, the ERT strongly recommends that the United Kingdom continue its efforts to improve the information available in terms of feeding types, amounts and digestibility rates and include this in the NIR, to ensure that the Party appropriately demonstrates that the currently used feeding plans and estimated feed consumption are representative of the actual feeding conditions in the United Kingdom.

55. The NIR indicates that a tier 2 approach is used for all eight cattle subcategories (pp. 348–349). In annex 3 to the NIR some background data are provided for four cattle subcategories, but not a comprehensive list of data for all eight subcategories. Further, in the additional information box in CRF table 4.A for non-dairy cattle in the 2012 annual submission, the United Kingdom reported that a DE of 65.0 per cent was used. In the 2013 annual submission, this value has been changed to "NE". For all other cattle categories, "zero" is reported. In response to questions raised by the ERT during the review, the United Kingdom explained that for the other cattle categories default DEs are used without country-specific data relating to feedstuffs "as per [the] IPCC Guidelines". The ERT notes that neither the Revised 1996 IPCC Guidelines nor the IPCC good practice guidance provide recommendations for a specific DE.[6] During the review, the ERT also requested feeding plans and feed data for all cattle categories in conjunction with the issue raised in paragraph 54 above. In response to the questions raised by the ERT during the review, the data were not provided; the United Kingdom indicated that its inventory improvement programme includes plans to move to a tier 2 method for all cattle categories with enhanced system descriptions, including typical feeding practices, in 2015. The ERT notes that the outcome of the IPCC tier 2 model for enteric fermentation is very sensitive to the choice of DE. It is the opinion of the ERT that the United Kingdom has not fully validated the assumptions used in the application of the tier 2 model and the ERT therefore strongly recommends that the Party document its national feeding conditions, taking into account the seasonal variation in feeding quality for the all-year grazing animals and the election of a DE of 65.0 per cent for non-dairy cattle. In addition, the ERT recommends that comprehensive data be provided for all cattle categories in the NIR.

56. For sheep, a recalculation has been made in the 2013 annual submission for the estimation of CH_4 emissions from enteric fermentation due to the development of an updated model for the estimation of total sheep production.[7] The new model uses the number of breeding sheep in the national census combined with an estimate of the additional emissions from producing lambs. For the producing lambs, a simple model was developed where the emissions from one lamb amount to 40 per cent of an adult breeding sheep combined with a reduction factor for the average lifetime of a producing lamb (8.1 months). The United Kingdom uses the default value of 8 kg CH_4/breeding sheep/year from the IPCC good practice guidance (and therefore estimates CH_4 emissions of 2.16 kg CH_4/produced lamb). The ERT commends the efforts made by the United Kingdom regarding this issue. However, the default EF of 8 kg CH_4/breeding sheep/year is based on average emissions from both mature sheep and lambs and is probably not representative as an average for mature breeding sheep. The ERT therefore strongly recommends that the United Kingdom document the national circumstances in order to justify the use of the tier 1 methodology for mature breeding sheep only and the related reduction factor for producing lambs. The ERT also strongly recommends that the United Kingdom apply the IPCC tier 2 model for sheep, and collect proper feeding data and data on feed digestibility,

[6] According to the Revised 1996 IPCC Guidelines, the recommended DE for non-dairy cattle ranges from 50 to 60 per cent for rangeland and from 60 to 70 per cent for good pasture. The IPCC good practice guidance specifically mentions that "[d]igestibility data should be based on measured values for the dominant feeds or forages being consumed, considering seasonal variations" (p. 4.13).

[7] Model based on a model/investigation by: Wheeler K, Wright N and Phillips K. 2012. *More Robust Evidence on the Average Age of UK Lambs at Slaughter*. ADAS report to DEFRA.

taking into account the actual feeding conditions in scrubland, rangeland, lowlands and highlands throughout the year.

Manure management – CH_4

57. The United Kingdom uses the IPCC tier 2 methodology to estimate the amount of organic matter in manure and the subsequent CH_4 emissions from manure management for cattle. The use of an overestimated DE for the feed (see paras. 53–55 above) in combination with the tier 2 methodology from the IPCC good practice guidance yields a low amount of volatile solids (VS) in the excreted manure. Given the potential underestimation of CH_4 emissions from manure management for dairy cattle stemming from the high DE, the ERT included this issue in the list of potential problems and further questions raised by the ERT. In response to the list of potential problems and further questions raised by the ERT during the review, the United Kingdom submitted revised emission estimates with the excretion rate of VS from dairy cattle increasing from 3.52 kg VS/head/day to 3.61 kg VS/head/day. The ERT accepts the revised emission estimates; however, it recommends that the United Kingdom continue its efforts to improve the VS excretion rate.

58. In the 2013 annual submission, the United Kingdom assumes that a high percentage of animal manure is applied to land on a daily basis (25–40 per cent of the total amount of manure, depending on the animal type). In practical terms, these assumptions would translate into approximately every third farm in the United Kingdom, including England, Wales, Scotland and Northern Ireland, applying manure to its fields on a daily basis in both winter and summer. The methane conversion factor (MCF) for daily spread is 0.1 per cent and for stored manure the MCF is up to 39 per cent for cool climates depending on the management system. During the review, the ERT asked for a verification of the amount of daily spread manure, and how this is applied on the farms, as well as documentation that this practice is in accordance with the national environmental legislation in the United Kingdom. In response to the questions raised by the ERT during the review, the ERT received information from a 1997 census, but no information on the environmental legislation on manure application in the United Kingdom was provided by the Party. Based on the information provided, the ERT concluded that the United Kingdom has not been able to document that this practice of daily manure spreading is currently taking place and, therefore, the ERT concludes that the manure must be stored for some period of time. As storage would lead to higher CH_4 emissions, the ERT is of the opinion that this leads to a potential underestimation of the CH_4 (and N_2O, see para. 66 below) emissions from manure management. This issue was included in the list of potential problems and further questions raised by the ERT.

59. In response to the list of potential problems and further questions raised by the ERT, the United Kingdom re-evaluated the criteria previously used for categorizing manure management as "daily spread" and the proportions of excreta currently assigned to this manure management subcategory for the different livestock types. The United Kingdom informed the ERT that it does have relevant country-specific information, based on a number of surveys that have been conducted. For cattle, only slurry systems reporting "little or no storage" are now classified as "daily spread" as a result of this re-evaluation. For deep litter manure, the Party has acknowledged that manure removed from buildings was mistakenly equated with the "daily spread" manure management subcategory. This revision has been applied to all types of cattle. For pigs, the Party has agreed that there is no basis for a "daily spread" system associated with pig production systems in the United Kingdom; therefore, the share of "daily spread" for pigs has been revised to "NO". For poultry, the previously used values were based on survey responses indicating "no storage", but it is now understood that these mostly refer to the export of manure from poultry farms, which will almost certainly then be stored elsewhere. The United Kingdom has therefore agreed that there is no basis for a "daily spread" system associated with poultry production

systems, and has submitted revised emission estimates, where the value for "daily spread" for poultry manure was revised to "NO".

60. The United Kingdom assumes that all manure excreted as solid manure is collected and stored in bulk before disposal. According to the IPCC good practice guidance, the MCF for such practice in cool climates is 1 per cent, which was also used in the original 2013 annual submission. During the review, the ERT requested that the United Kingdom provide a detailed explanation of how "solid storage and dry lot" was managed for all animal categories. In response to the questions raised by the ERT during the review, the Party explained that for cattle, the majority of systems are deep litter with infrequent manure removal (once or twice per year) and that the United Kingdom currently has no data on the relative proportions of such systems. According to the IPCC good practice guidance, such systems should be classified as "deep litter" and where the accumulated waste is removed with intervals of >1 month an MCF of 39 per cent should be used for cool climates. The ERT was therefore of the opinion that although the United Kingdom does not have information on the split between solid storage systems and deep litter systems, the Party has potentially underestimated the associated emissions. The ERT included this issue in the list of potential problems and further questions raised by the ERT during the review.

61. In response to the list of potential problems and further questions raised by the ERT during the review, the United Kingdom submitted revised CH_4 emission estimates for all cattle and sheep categories for the entire time series assuming that all straw bedding systems are treated as "deep litter" and applied an MCF of 39.0 per cent. The United Kingdom assumes that this is a conservative approach. The ERT welcomes this update and accepts the revised emission estimates but encourages the Party to continue to improve the accuracy of these estimates so as to achieve an estimate that neither overestimates nor underestimates the emissions as far as can be judged.

62. As mentioned in paragraph 56 above, the ERT strongly recommends that the United Kingdom document its national circumstances in order to justify the use of the model for sheep which uses tier 1 default EFs from the 1996 Revised IPCC Guidelines and the reduction factor applied to producing lambs. The default VS excretion rate for cool climates is 0.19 kg VS/head/day. The IEF provided in the inventory is 0.12 kg VS/head/day because of the reduction parameters developed by Wheeler et al. (2012). The ERT strongly recommends that the Party verify the assumption behind this correction factor for producing lambs, as described in paragraph 56 above, and its implication for the CH_4 emissions from manure management.

3. Non-key categories

Manure management – N_2O

63. The nitrogen excretion (Nex) rates for all animals are based on a model developed by DEFRA (2004). In the NIR, there is no information on the references for this model, how the model is updated and who is responsible for the annual update. The ERT strongly recommends that the United Kingdom include additional information on the Nex model in the NIR and its linkage to the NH_3 emissions inventory submitted to the European Monitoring and Evaluation Programme (EMEP) and European Union (EU) directive 2001/81/EC on national emission ceilings for certain atmospheric pollutants (see paras. 65 and 69 below for examples of inconsistencies identified).

64. The Nex rates for sheep and lambs have been revised in the 2013 annual submission based on new data on the distribution between sheep and lambs and their ages. As mentioned in paragraphs 56 and 61 above, and in response to questions raised by the ERT and the responses provided by the Party during the review regarding CH_4 emissions from enteric fermentation and manure management, the ERT found that the United Kingdom has not justified the use of its lamb model. The ERT therefore strongly recommends that the

United Kingdom include additional information in the NIR on the assumptions used to derive the model by Wheeler et al. (2012) and how this model has been implemented in the inventory of the United Kingdom.

65. In the 2013 annual submission, the Nex for dairy cattle has been estimated as 121 kg/dairy cow/year for 2011. However, the ERT noted that, in the reporting to EMEP/European Environment Agency under the EU national emission ceilings directive a Nex of 123.5 kg/dairy cow/year was reported. In response to questions raised by the ERT during the review regarding the provision of a rationale for the difference in the reporting to these two organizations, the United Kingdom acknowledged that there was an error in the reporting for 2011 in the 2013 annual submission and that it would be corrected in the 2014 annual submission. The Party did not provide a revised Nex in response to the questions raised by the ERT. Based on the information provided, the ERT concluded that there was a potential underestimation of N_2O emissions and included this issue in the list of potential problems and further questions raised by the ERT during the review.

66. In response to the list of potential problems and further questions raised by the ERT during the review, the United Kingdom submitted revised estimates for N_2O emissions from manure stores. This has resulted in an increase in N_2O emissions of 3.33 Gg N_2O for dairy cattle for 2011 (representing an increase of 62.8 per cent). The ERT agrees with the revised emission estimates.

Agricultural soils – N_2O

67. The potential underestimation of the Nex for dairy cattle described in paragraph 65 above also led to a potential underestimation of N_2O emissions from agricultural soils, specifically, direct emissions from animal manure applied to soils and pasture, range and paddock and indirect emissions from atmospheric deposition and leaching and run-off. These issues were also included in the list of potential problems and further questions raised by the ERT during the review.

68. In response to the list of potential problems and further questions raised by the ERT during the review, the United Kingdom submitted revised estimates of N_2O emissions from these categories. In total, this has resulted in an increase in N_2O emissions from agricultural soils of 0.20 Gg N_2O for 2011 (representing an increase of 0.2 per cent). The ERT agrees with the revised emission estimates.

69. The indirect N_2O emissions from atmospheric deposition of evaporated NH_3 and nitrogen oxide (NO_X) from agricultural soils are estimated using the default tier 1 methodology from the IPCC good practice guidance. The amount of NH_3 reported to the UNFCCC (311 Gg NH_3-N) differs from the NH_3 emissions officially reported under the Convention on Long-range Transboundary Air Pollution (LRTAP) and under the EU national emission ceilings directive (250 Gg NH_3). In response to questions raised by the ERT during the review, the United Kingdom explained that a more detailed nitrogen flow methodology with country-specific EFs was used in the NH_3 emissions inventory reported under the EU directive and LRTAP and that this methodology was not adopted for the national GHG inventory reported to the UNFCCC based on discussions during previous reviews. The current ERT concludes that reporting Parties should use the best available knowledge in their national GHG inventories. The ERT encourages the United Kingdom to strive for the highest accuracy. The United Kingdom inventory team has informed the ERT that it is seeking to unify the approaches to the reporting of NH_3 and NO_X losses between the two inventories and is hoping to achieve this through a GHG research and development platform, which will be completed in 2015. The ERT recommends that the Party implement the best available estimates in its future submissions.

70. The amount of sewage sludge applied to soils reported in the NIR in the waste sector and the agriculture sector differs for 2011 (1,407 kt dry solids and 1,167 kt dry solids, respectively). In response to a question raised by the ERT during the review, the United

Kingdom acknowledged that there were disparities in the different data sets used for the emission estimates for the agriculture and waste sectors. The United Kingdom informally provided updated AD during the review week. In its submission of revised emission estimates, the United Kingdom did not make any changes to the estimated N_2O emissions from sewage sludge applied to soils. The ERT strongly recommends that the Party use the revised AD for the 2014 annual submission in order to maintain consistency between the agriculture and waste sectors and to ensure that the emissions are accurately estimated. The ERT also recommends that the United Kingdom enhance its QA/QC procedures and coordinate the data exchange processes between the waste sector and the agriculture sector.

E. Land use, land-use change and forestry

1. Sector overview

71. In 2011, net removals from the LULUCF sector amounted to 3,309.36 Gg CO_2 eq. Since 1990, net removals have increased by 182.3 per cent. The key drivers for the rise in removals are the sustained conversion of cropland to grassland and the decrease in the conversion from grassland to cropland. The degree of forest planting achieved between the 1950s and the 1980s is still responsible for large removals in forest land, but the net removals from this category have been steadily decreasing since 1990. Within the sector, forest land was responsible for net removals of 10,151.26 Gg CO_2 eq, followed by net removals of 8,460.28 Gg CO_2 eq from grassland. Net emissions of 11,973.00 Gg CO_2 eq were from cropland, followed by net emissions of 6,327.78 Gg CO_2 eq from settlements and net emissions of 403.18 Gg CO_2 eq from wetlands. Harvested wood products (reported under other (LULUCF)) accounted for net removals of 3,401.78 Gg CO_2 eq.

72. The ERT commends the United Kingdom for its improvements to the completeness of the inventory for the LULUCF sector, including the provision for the first time of an emissions estimate for wildfires on non-forested land and a full representation of the land areas under deforestation, including Northern Ireland, the OTs and the CDs for the entire time series.

73. The ERT also commends the United Kingdom for its attention to verification, in particular regarding the area under peatland extraction, the changes in soil carbon and the national total using atmospheric measurements. The ERT encourages the United Kingdom to use the results of these verification exercises more intensively, for example by investigating any differences between the verification method and the method used in the inventory.

74. Following a recommendation made in the previous review report, the United Kingdom also provided a flow chart for each land category to explain the calculation steps. The ERT commends the Party for these improvements in transparency. The ERT encourages the United Kingdom to provide a similar flow chart for the calculation of the land area for each subcategory and activity under Article 3, paragraphs 3 and 4, of the Kyoto Protocol, in particular highlighting how the different data sources are prioritized or reconciled.

75. The ERT notes that transparency of the calculations and parameters could at times be improved by supplementing or replacing text with equations and descriptions of variables. For example, even if the United Kingdom uses a tier 3 method, describing it with reference to the different components of the tier 1 equations, or naming the parameters of the model according to their standard counterpart as provided in the IPCC *Good Practice Guidance for Land Use, Land-Use Change and Forestry* (hereinafter referred to as the IPCC good practice guidance for LULUCF) (e.g. f_{BL} for the fraction of biomass left to decay in the forest, A_{Nrich} for the area of nutrient rich organic soils converted to peat extraction and $EF_{Drainage}$ for the EF for CO_2 emissions from drained organic forest soils)

would improve transparency. Therefore, the ERT encourages the United Kingdom to refer, as often as possible, to the equations and variable names contained in the IPCC good practice guidance for LULUCF.

76. To build its land representation time series, the United Kingdom combines different sources of data for forest land and for other land-use categories. The previous review report noted that the total area of the country is not constant over time. In response to questions raised by the ERT during the previous review, the United Kingdom clarified that it was in the process of implementing a data assimilation process to resolve these inconsistencies. This process is scheduled to be implemented in time for the 2014 annual submission. The ERT reiterates the recommendation made in the previous review report that the United Kingdom prioritize this work and reiterates the encouragement that the Party consider the suggestions listed in the 2012 annual review report in this respect[8] (i.e. revising the boundaries of the land-use categories with the aim of making them homogenous and using a time series of accurate data on land-use changes in order to build a set of constraints, and compiling data on the likelihood of sequences of the land-use changes of units of land).

77. The assumptions embedded in the models used for the tier 3 reporting may be a large source of uncertainty. However, only the uncertainty of the input data and parameters is accounted for in the uncertainty analysis. In response to questions raised by the ERT during the review, the United Kingdom acknowledged that the uncertainty of the model structure was not taken into consideration. The ERT recommends that the United Kingdom consider the uncertainty of the modelling assumptions in its uncertainty analysis.

2. Key categories

Forest land – CO_2

78. The United Kingdom reports this category using a tier 3 method, namely a model named C-Flow. The ERT identified several issues with this method, listed below (some of these were also identified in the previous review report). In response to questions raised by the ERT during the review, the United Kingdom acknowledged these issues related to the current model and informed the ERT that it was developing a new model named CARBINE which would replace the C-Flow model and resolve these issues. The CARBINE model is scheduled to be used for the next annual submission. The ERT commends the United Kingdom for this planned improvement but strongly recommends that the Party include in its NIR an explanation and any supporting documentation on how the CARBINE model addresses and resolves the following issues that currently exist with the C-Flow model:

(a) Although the use of the C-Flow model has been referenced in the peer-reviewed scientific literature, there is no evaluation against independent data provided for in the C-Flow model, as recommended by the report of the IPCC Expert Meeting on Use of Models and Measurements in GHG Inventories.[9] In response to questions raised by the ERT during the review, the United Kingdom explained that some informal checks against age distributions and harvest statistics showed that the comparisons were reasonable and confirmed that data evaluation was being undertaken for the CARBINE model;

(b) The C-Flow model relies on the assumption that rotation lengths are fixed per species, and are therefore independent of wood demand or other factors. This is an important, yet undocumented, assumption. In response to questions raised by the ERT during the review, the United Kingdom acknowledged that market drivers were important

[8] FCCC/ARR/2012/GBR, paragraphs 102 and 103.

[9] Eggleston HS, Srivastava N, Tanabe K, Baasansuren J and Fukuda M. 2011. *Use of Models and Facility-Level Data in Greenhouse Gas Inventories* (Report of the IPCC Expert Meeting on Use of Models and Measurements in GHG Inventories, 9–11 August 2010, Sydney, Australia). Japan: Intergovernmental Panel on Climate Change. Available at <http://www.ipcc-nggip.iges.or.jp/meeting/pdfiles/1008_Model_and_Facility_Level_Data_Report.pdf>.

and could lead to variable rotation lengths. However, the United Kingdom also pointed out that the Forestry Commission deliberately privileged the continuity of wood supply over profits, which lessens the influence of market drivers;

(c) The C-Flow model assumes that forests planted before 1921 – "pre-1920 forests" in the NIR – have reached an equilibrium and are neither sources of emissions nor sources of removals. Due to the influence of market drivers on wood harvest and given that the age distribution of these forests is unlikely to be uniform, this assumption is probably unjustified. In response to questions raised by the ERT during the review, the United Kingdom clarified that the CARBINE model would more explicitly cover emissions and removals in pre-1920 forests;

(d) The C-Flow model uses a value of 0.05 for the fraction of above-ground biomass which is left on-site after harvest (f_{BL}). This is much lower than the default value of 0.1 provided in the IPCC good practice guidance for LULUCF, and lower than other values published in peer-reviewed journals.[10] In response to questions raised by the ERT during the review, the United Kingdom clarified that this parameter would be revised in the CARBINE model;

(e) The C-Flow model is not transparent with regard to whether below-ground biomass is included. In response to questions raised by the ERT during the review, the United Kingdom explained that the C-Flow model does not include below-ground biomass; however, this explanation is inconsistent with several statements in the NIR (e.g. annex 3, pp. 633–634) and with use of the notation key "IE" in the CRF tables. As a result, it is not clear as to whether or not below-ground biomass has been accounted. The ERT strongly recommends that the Party report below-ground biomass separately as the best way of clarifying this issue;

(f) The C-Flow model does not assign a portion of the estimated harvested wood to fuel wood use, and this portion of harvested wood is consequently estimated to equal zero. More generally, the parameters governing the use of harvested wood and, hence, the half-life of wood products, are not documented.

79. The United Kingdom reported unusually large EFs for soil carbon changes to and from forest land. These EFs have implications on all of the key categories for the LULUCF sector. For example, the relative changes in equilibrium soil carbon from grassland to forest land range from +24 per cent in Wales to +63 per cent in Northern Ireland, while the IPCC good practice guidance for LULUCF proposes 0 per cent. These values are also higher than other values published in peer-reviewed journals[11] and quoted in the NIR (relative change in equilibrium soil carbon from grassland to forest ranging from –10 per cent to +3 per cent, see p. 390). In response to questions raised by the ERT during the review, the United Kingdom clarified that these EFs were explained by the high occurrence of deep and organic soils in the country and are based on a peer-reviewed publication.[12] However, this publication does not explicitly provide the soil carbon content simultaneously separated per soil type and per land use. During the review, the ERT asked for these detailed values but the Party did not provide them. It is therefore possible that the high EFs result from the fact that the soil type and land use are not simultaneously separated (e.g. whether forests occur predominantly on carbon-rich soils while grassland occurs predominantly on carbon-poor

[10] Lippke B, Oneil E, Harrison R, Skog K, Gustavsson L and Sathre R. 2011. Life cycle impacts of forest management and wood utilization on carbon mitigation: knowns and unknowns. *Carbon Management*. 2: pp. 303–333.

[11] Poeplau C, Don A, Vesterdal L, Leifeld J, van Wesemael B, Schumacher J and Gensior A. 2011. Temporal dynamics of soil organic carbon after land-use change in the temperate zone – carbon response functions as a model approach. *Global Change Biology*. 17: pp. 2415–2427.

[12] Bradley RI, Milne R et al. 2005. A soil carbon and land use database for the United Kingdom. *Soil Use and Management*. 21(004): pp. 363–369.

soils). The ERT strongly recommends that the United Kingdom document these high EFs, in particular by providing more detailed tables which simultaneously distinguish the soil type and land use.

80. In addition to the high value of the EF for the changes in soil carbon following land-use change discussed in paragraph 79 above, the long soil carbon transition times chosen by the United Kingdom (50–750 years) result in large removals from soil carbon in forest land remaining forest land. As pointed out in the NIR, this contradicts the direct measurements published in Bellamy et al. (2005)[13] which find that soil carbon in forest land is a net source of emissions for England and Wales. In response to questions raised by the ERT during the review, the United Kingdom mentioned that the transition to the CARBINE model may provide the opportunity to assess these contradictions. The ERT further encourages the United Kingdom to assess the resulting estimates against the actual measurements quoted in the NIR.

Cropland and grassland – CO_2

81. As identified in the previous review report, the United Kingdom does not report the soil organic matter carbon stock changes due to changes in management practices in the cropland and grassland land-use categories. The ERT acknowledges the United Kingdom's planned improvement to implement methods for the estimation of the carbon stock changes associated with changes in management practices for inclusion in its 2014 annual submission and recommends that the Party implement the proposed changes.

82. With the exception of land conversions to forest land (see para. 79 above), the United Kingdom does not differentiate between mineral and organic soils when reporting land conversions to cropland and grassland and from cropland and grassland to other land uses. To estimate the carbon stock changes associated with these conversions, the United Kingdom uses an exponential model that accounts for the relative areas of four different soil types in each country (England, Wales, Scotland and Northern Ireland). In response to questions raised by the ERT during the review, the United Kingdom clarified that it lacked the adequate AD to explicitly separate land-use changes occurring on organic soils from land-use changes occurring on mineral soils. In particular, the Party explained that a separation would imply a variation in soil type over time, as some organic soils are drained, and would therefore introduce an inconsistency with the national soil database. However, the United Kingdom further explained that the results of an ongoing study on the impacts of land management practices may provide the adequate AD. The ERT recommends that the Party report on the progress of this ongoing study.

83. The United Kingdom reported that orchards had been included by mistake in the forest land remaining forest land category instead of the cropland remaining cropland category and that this would be corrected. In addition, in response to questions raised by the ERT during the review, the United Kingdom clarified that changes in biomass from the increases or decreases in the area of orchards had not been estimated. The ERT recommends that the United Kingdom specify in its forest definition whether it includes orchards. Given that the area of orchards has been steadily declining since 1990 according to Eurostat, the ERT further recommends that the United Kingdom estimate the changes in biomass in orchards.

84. The United Kingdom reports large removals from soil carbon for this category (4,750.61 Gg CO_2 eq). The ERT considers that the method used by the Party is mostly in line with the IPCC good practice guidance for LULUCF, with the possible exception of the documentation on the EF (see para. 79 above). The United Kingdom refers to several studies in the inventory that are based on direct measurements as verification for the soil

[13] Bellamy PH, Loveland, PJ, Bradley RI, Lark RM and Kirk GJD. 2005. Carbon losses from all soils across England and Wales 1978–2003. *Nature*. 437: pp. 245–248.

carbon changes (Bellamy et al., 2005, Kirk and Bellamy, 2010[14]). These studies find that, contrary to the national inventory estimates, grassland is a large source of CO_2. As no information is provided in the NIR to explain this contradiction, the ERT recommends that the United Kingdom provide an explanation for this apparent contradiction and that the Party attempt to reconcile these two estimates.

Land converted to settlements – CO_2

85. The United Kingdom reports large decreases of carbon in several pools in some land-use changes (132.90 Gg C and 857.32 Gg C for biomass in cropland and grassland converted to settlements, respectively) and small increases in others (0.01 Gg C and 13.8 Gg C for soils in cropland and grassland converted to settlements, respectively) for 2011. The ERT considers these opposite trends to be contradictory, as biomass is the main carbon input to the soil. In response to questions raised by the ERT during the review, the United Kingdom clarified its calculation, as follows:

(a) In total, 54 per cent of urban areas are green space (e.g. parks and gardens);

(b) Green space tends to have more trees and shrubs than cropland and grassland, and hence more biomass;

(c) The losses in soil carbon from cropland and grassland converted to settlements are likely to be overestimated.

86. The ERT recommends that the United Kingdom include these explanations in the NIR. The ERT further encourages the United Kingdom to revisit and investigate the large losses in soil carbon from cropland and grassland converted to settlements, and in particular their consistency with the changes in biomass for the same land-use transitions.

3. Non-key categories

Biomass burning – CO_2, CH_4 and N_2O

87. The reporting of emissions from wildfires is inconsistent between CRF table 5(V), where all emissions are reported in the forest land remaining forest land category, and KP-LULUCF table 5(KP-II)5 where the emissions are split between the afforestation/reforestation and forest management activities. In response to questions raised by the ERT during the review, the Party explained that the split was mandatory for the KP-LULUCF reporting only and that, for policy reasons, it did not want to replicate it in the Convention reporting. The ERT encourages the United Kingdom to split reporting of emissions under the Convention in order to improve transparency.

F. Waste

1. Sector overview

88. In 2011, emissions from the waste sector amounted to 23,040.38 Gg CO_2 eq, or 4.1 per cent of total GHG emissions. Since 1990, emissions have decreased by 51.4 per cent. The key driver for the fall in emissions is the reduction in the amount of waste landfilled, in accordance with the EU directive 1999/31/EC on the landfill of waste, and the increase in gas recovery from landfills. Within the sector, 86.1 per cent of the emissions were from solid waste disposal on land, followed by 12.4 per cent from wastewater handling and 1.5 per cent from waste incineration. Other (waste) was reported as "NA".

[14] Kirk GJD and Bellamy PH. 2010. Analysis of changes in organic carbon in mineral soils across England and Wales using a simple single-pool model. *European Journal of Soil Science*, 61(3): pp. 406–411.

89. The ERT found a lack of transparency in the NIR regarding the assumptions used to derive AD and methods used to estimate emissions for a number of categories, including:

(a) Methane recovery, flaring and consumption of gas in electricity production in solid waste disposal on land (see para. 93 below);

(b) The share of industrial wastewater in wastewater handling systems (see para. 102 below);

(c) The estimation of emissions from sewage sludge application to compost and farmland (see para. 70 above);

(d) The detailed explanation of emission estimates for the OT and CDs.

90. The ERT reiterates the recommendation made in the previous review report that the United Kingdom improve the transparency of this sector, in particular that the Party provide the assumptions used to derive the parameters listed in paragraph 89 above.

91. The ERT identified numerous inconsistencies between the main chapters of the NIR and the annexes. For example, the overview table on key categories in the NIR lists CO_2 emissions from solid waste disposal on land as a key category, while the annexes note that it is actually CH_4 emissions from solid waste disposal on land that is a key category. Also, annex 7 to the NIR refers to table A7.6.5; however, this table does not exist and it should read table A7.5.1. In response to questions raised by the ERT during the review, the United Kingdom acknowledged the errors. The ERT recommends that the United Kingdom improve the QC checks in, and between, the main text of the NIR and the annexes, as well as within the CRF tables, in order to ensure consistency.

2. Key categories

Solid waste disposal on land – CH_4

92. The United Kingdom uses the first-order decay method with country-specific parameters to estimate CH_4 emissions from solid waste disposal on land. In the 2013 NIR, the United Kingdom reported that the CH_4 captured was estimated based on a gas collection efficiency averaged over modern and closed landfills with a recovery rate of 75 per cent (based on expert judgement and agreed by peer reviewers in the United Kingdom).[15]

93. The ERT noted a lack in transparency in the NIR regarding methods used to quantify CH_4 recovery. According to the NIR (page 453), "Data on utilisation is available and of good quality, but data on flaring for years prior to 2009 is available but not easily accessible". In response to questions raised by the ERT during the review on the methods used to estimate CH_4 recovery, the United Kingdom submitted detailed information showing how the amount of landfill gas collected was estimated based on data on consumption of landfill gas for electricity generation, as included in the energy statistics. This amount corresponded to 1,222 kt CH_4 recovery from landfills. The remaining CH_4 recovered was determined to be flared and derived based on operator data from landfills permitted under the EU integrated pollution prevention and control (IPPC) directive (directive 2008/1/EC)". The NIR states, on page 429, that data on flaring are generally scarce and of poor quality and that further work has been commissioned to gain greater confidence in the data on the amount of CH_4 flared. The NIR further indicated that this information will be taken into account, when available.

94. According to the IPCC good practice guidance (p. 5.10) "[r]eporting based on metering of all gas recovered for energy utilisation and flaring is consistent with *good practice*. The use of undocumented estimates of landfill gas recovery potential is not

[15] Oonk H. 2012. Efficiency of landfill gas collection for methane emission reduction. *Greenhouse Gas Measurement and Management*. 2(2–3): pp. 129–145.

appropriate, as such estimates tend to overestimate the amount of recovery". The ERT considers that CH_4 recovery for power generation, for which a methodology has been provided in the 2013 annual submission, is based on monitoring; therefore, these data can be considered in the estimate of CH_4 recovery. Based on the information provided by the United Kingdom during the review, the ERT concluded that the IPCC good practice guidance was not followed in the estimation of the amount of CH_4 recovered and flared and the ERT considered that there was a potential overestimation of the amount of CH_4 recovered and an underestimation of the corresponding emissions. The ERT therefore included this issue in the list of potential problems and further questions raised by the ERT.

95. In response to the list of potential problems and further questions raised by the ERT, the United Kingdom provided additional information on the practice of CH_4 recovery and flaring at landfills and submitted revised emission estimates. The revised emission estimates made use of available operator-supplied data on landfill CH_4 flaring at modern permitted landfills for the years 2009–2011, replacing the previously assumed landfill gas recovery factor. The CH_4 flared at older permitted landfills prior to 2008 and the CH_4 flared at local authority controlled closed sites (i.e. older permitted landfills) for the full time series were calculated based on third-party studies and data, applying assumptions related to, for example, the presence of flares and the landfill gas composition. The revised estimates resulted in an increase in CH_4 emissions from solid waste disposal on land of 5,677.73 Gg CO_2 eq, or 40.1 per cent for 2011.

96. Based on the information provided by the Party, the ERT did not consider the potential problem resolved. Two key questions were left unanswered in the United Kingdom's response to the list of potential problems and further questions raised by the ERT:

(a) In its response, the United Kingdom noted that operator-supplied data on recovery and flaring were available for the years 2009–2011. As the Party did not indicate whether these data were based on monitoring or calculations, the ERT further requested that the United Kingdom provide documentation indicating which parameters were monitored (e.g. the flared gas quantities) and for which years these monitoring data exist;

(b) The ERT requested that the Party clarify whether the CH_4 recovery estimates for non-operational sites that are based on third-party studies and data were included in the total CH_4 recovery reported for the years 2009–2011. The ERT also requested that the United Kingdom explain how such estimates were derived and provide the actual amounts of CH_4 flared from non-operational sites.

97. In response to the additional questions raised by the ERT, the United Kingdom indicated that since 2009 operators of landfills permitted under the EU IPPC directive (2008/1/EC) have been required to report the annual quantity of CH_4 flared at operational sites (i.e. modern permitted landfill sites) based on measured data. In addition, the Party provided details of the methods used to estimate landfill gas flaring from older permitted landfills and local authority controlled closed sites for England and Wales and for landfills in Scotland and Northern Ireland. Specifically, the Party indicated that data were collected for the various types of landfills as follows:

(a) Modern permitted landfills: a database was assembled of operator data on the volumes of landfill gas combusted in flares and engines at 233 landfill sites with up-to-date permit conditions in England and Wales during 2009, 2010 and 2011. The gas flow to the flare is measured continuously or periodically;

(b) Older permitted sites: the average volumes of landfill gas flared at modern permitted landfills with and without engines in 2009, 2010 and 2011 were used to estimate the quantities of gas flared at older permitted landfills, on the basis that the volume of landfill gas flared per site is the same as the average volume flared at modern permitted

landfills. The quantity of CH_4 flared was calculated by multiplying the average volumes of flared amounts of landfill gas at modern permitted landfills by the number of older permitted landfills and the CH_4 content;

(c) Local authority controlled closed sites (i.e. historical landfills): the annual quantity of landfill gas potentially available for flaring at these sites was estimated as equivalent to the average quantity of landfill gas flared at modern permitted landfills sites equipped with flares but not with engines for energy use of landfill gas, based on the operator database. The United Kingdom assumed that 50 per cent of historical landfills were equipped with active gas control and flares. It was also assumed that flares run continuously at 33 per cent of sites equipped with flares. At the remaining sites equipped with flares, it was assumed that non-continuous flares would operate for 25 per cent of the time;

(d) The CH_4 amounts flared at landfill sites in Scotland and Northern Ireland were extrapolated from the quantities flared in England and Wales based on population data.

98. The documentation provided by the United Kingdom in response to the list of potential problems and further questions raised by the ERT confirmed that metering data were not used to quantify the amount of landfill gas captured and flared at all landfill sites. The amount of landfill gas flared at modern permitted landfills, determined for 2009, 2010 and 2011, and which is based on metering data, was determined to be in line with the IPCC good practice guidance. The ERT noted that although measured data were reported for the years 2009, 2010 and 2011 only, these landfills provided an appropriate sample from which assumptions could be developed and CH_4 recovery estimated for modern permitted landfills for 2008.

99. The information provided by the United Kingdom for older permitted landfills, local authority controlled closed landfills and landfills in Scotland and Northern Ireland confirmed that metering data were not used to quantify the amount of landfill gas captured at these sites, but rather assumptions based on data on the average metering value of landfill gas recovered between 2009 and 2011 at modern permitted landfills were applied to represent the amount of gas flared in other landfills. The ERT finds that these assumptions are not appropriate because landfill gas generation is based on several parameters, including the quantity of waste in place, waste composition, physical structure of the landfill (e.g. the landfill site geometry, landfill cover type, cover thickness and cover maintenance), site-specific temporal effects (years when the landfills were filled, different years of closure, the point in time when the landfills were equipped with gas collection systems), temperature, humidity and meteorological conditions. Also, the amount of gas generated and the CH_4 composition of landfill gas at operational sites increase and decline over time. The recovery of gas (either for energy purposes or for flaring) is generally dependent upon objectives and plans at each operational and closed landfill site and the landfill gas volumes depend on the site conditions and on the operation and management conditions for each site. Therefore, CH_4 gas recovery is site-specific both in terms of quantity and in terms of the composition of landfill gas and it is inappropriate to multiply the number of older permitted landfills without monitored data with the average volumes of gas collected from modern landfill sites. The ERT concludes that the type of documentation provided by the Party to support the estimation of CH_4 recovery from all landfills, except modern permitted landfills, is not consistent with that required by the IPCC good practice guidance, and that CH_4 recovery from older permitted landfills, local authority controlled closed landfills and landfills in Scotland and Northern Ireland may be overestimated, and therefore emissions underestimated. Therefore, the ERT decided to calculate and recommend adjustments for the estimate of CH_4 recovery from solid waste disposal sites (see paras. 121–133 below) at older permitted landfills, local authority controlled closed landfills and landfills in Scotland and Northern Ireland for 2011.

100. The ERT recommends that the United Kingdom acquire additional historical CH_4 recovery data for older permitted landfills and local authority controlled closed landfills in Scotland and Wales, and for landfills in Scotland and Northern Ireland. The most accurate method for the estimation of CH_4 recovery from these landfills would be a periodic collection of the amounts of CH_4 flared from all of these landfills. In particular, the ERT noted that for all landfills included in the estimation of CH_4 recovery, including those in Scotland and Northern Ireland, there should be sufficient evidence that these landfills are equipped with gas collection systems (the current approach assumes that 50 per cent of the local authority controlled closed landfills (324 historic landfills) are equipped with active gas control and flares). Any estimation of the CH_4 recovered and flared would be based on evidence that these old landfills are actually equipped with active gas control and flares.

101. Alternatively, the ERT recommends that the Party first categorize all landfills, except modern permitted landfills, that were identified as being equipped with gas collection systems and flares into categories with homogenous historical conditions related to the amounts and waste types landfilled, the waste density and humidity, the design of the well system and its maintenance, the landfill site geometry, the landfill cover type, the cover thickness and cover maintenance, the age and operating condition, the date of closure and the point in time when the landfills were equipped with a gas recovery system. Further, the ERT recommends that the Party survey and investigate the gas recovery systems and amounts of CH_4 flared for a representative sample of landfills in the categories "older permitted landfills", "local authority controlled closed landfills" and landfills in Scotland and Northern Ireland. Lastly, the ERT recommends that the Party extrapolate the amounts of CH_4 recovered from the representative sample of landfills to the remaining landfills with similar operating and management conditions and size. During the review, the United Kingdom confirmed that the quality-checking of the volumes of landfill gas flared is ongoing in the Environment Agency but not yet finalized. The ERT welcomes these efforts.

Wastewater handling – CH_4 and N_2O[16]

102. The United Kingdom estimates and reports CH_4 emissions from domestic and commercial wastewater handling together with sludge. In response to recommendations made in the previous review report, the United Kingdom has provided a detailed description of the EFs for treatment, digestion, composting and farmland. As noted in the previous review report, the EFs are based on data from approximately six companies and those data are used to estimate the emissions for the entire time series and for all 12 wastewater handling companies in the United Kingdom. During the review, the ERT requested additional detail on how the EFs for composting and digestion were derived from the wastewater handling companies. The Party responded that the methods used in the calculations conducted by each wastewater handling company are not fully transparent. Noting that the country-specific EFs continue to be based only on a fraction of the total number of companies in the country, the ERT strongly reiterates the recommendation made in the previous review report that the United Kingdom improve the accuracy and transparency of the applied EFs to ensure that they are fully representative of the activity and emissions for the entire United Kingdom.

103. The United Kingdom has made significant improvements to the reporting of CH_4 emissions from industrial wastewater treatment plants in response to the recommendations made in the previous review report. The Party has developed a new time series of CH_4 emission estimates using default EFs from the IPCC good practice guidance and AD from relevant industries, primarily in food and drink and chemical production. The ERT welcomes these efforts, noting the potential impact on transparency identified in the NIR (p. 435) due to the fact that the United Kingdom is of the view that there may now be some

[16] Not all emissions related to all gases under this category are key categories, particularly CH_4 emissions. However, since the calculation procedures for issues related to this category are discussed as a whole, the individual gases are not assessed in separate sections.

double counting of these CH_4 emissions in the inventory. In response to questions raised by the ERT during the review regarding the assumption used for wastewater handling technology (30 per cent aerobic and 70 per cent anaerobic), the Party explained that the assumption of 70 per cent was derived from the Revised 1996 IPCC Guidelines. The ERT encourages the Party to undertake research to determine the representative shares of the different wastewater handling technologies in order to improve the accuracy of its reporting.

104. The United Kingdom has reported N_2O emissions using a country-specific protein consumption value (28.69 kg/person/year) for the entire time series which is lower than the value provided for the United Kingdom by the Food and Agriculture Organization of the United Nations (FAO). In response to questions raised during the review of the 2012 annual submission, the Party provided a detailed explanation of the country-specific value used. Specifically, the United Kingdom noted that the data are derived from a household survey, in which households recorded actual purchases. A detailed analysis of the individual types of food purchased is provided in the NIR; the ERT welcomes this improvement. According to the NIR, however, the survey data may not represent all food consumption due to purchases of some food items not being included in the diary of the survey participants. The Party further explained that it nevertheless considers the data to be more representative of protein consumption per capita than the FAO estimate. The ERT encourages the Party to continue to identify opportunities to improve the survey used to derive the AD in order to improve the accuracy of this country-specific value and to appropriately reflect any changes in the time series.

3. Non-key categories

Waste incineration – CO_2, CH_4 and N_2O

105. In response to a recommendation made in the previous review report, the United Kingdom has applied default EFs from the IPCC good practice guidance to estimate N_2O emissions from chemical waste incineration and non-biogenic CO_2 emissions from incineration of municipal solid waste, without energy recovery. The ERT welcomes the Party's plan to improve the data on emissions from flaring of chemical waste and recommends that the Party determine and report only on the recovery of emissions that is based on metered data.

G. Supplementary information required under Article 7, paragraph 1, of the Kyoto Protocol

1. Information on activities under Article 3, paragraphs 3 and 4, of the Kyoto Protocol

Overview

106. Table 6 provides an overview of the information reported and parameters selected by the United Kingdom under Article 3, paragraphs 3 and 4, of the Kyoto Protocol.

Table 6
Supplementary information reported under Article 3, paragraphs 3 and 4, of the Kyoto Protocol

		Findings and recommendations
Has the United Kingdom reported information in accordance with the requirements in paragraphs 5–9 of the annex to decision 15/CMP.1?	Sufficient	Clarify the accounting of below-ground biomass (see para. 109 below)
Identify any elected activities under Article	Activities elected:	

		Findings and recommendations
3, paragraph 4, of the Kyoto Protocol	forest management Years reported: 2008–2011	
Identify the period of accounting	Commitment period accounting	
Assessment of the United Kingdom's ability to identify areas of land and areas of land-use change	Sufficient	The improvement of consistency between the forest definition and the land identification method is still under way with regard to the percentage of forest cover (see para. 108 below)

107. The issues identified in the LULUCF chapter of this report regarding the C-Flow model and the inconsistencies in the land areas (see paras. 78 and 79 above) impact all activities under Article 3, paragraphs 3 and 4, of the Kyoto Protocol and are not repeated here. The ERT strongly recommends that the Party include in its NIR an explanation and supporting documentation on how the CARBINE model addresses and resolves the issues identified in paragraphs 78 and 79 above for the C-Flow model, as applied to lands under Article 3, paragraphs 3 and 4 of the Kyoto Protocol.

108. The previous review report noted that the consistency between the national forest definition and the land-related information was not transparently explained.[17] In the 2013 annual submission, the United Kingdom clarified that an inconsistency persisted regarding the minimal percentage of forest cover: 20 per cent according to the forest definition and 25 per cent according to the Countryside Survey used to detect deforestation. A specific study determined that the spatial overlap between the Countryside Survey and the National Inventory of Woodland and Trees was 70 per cent with no obvious bias. In response to questions raised by the ERT during the review, the United Kingdom further clarified that the Countryside Survey was also consistent with the minimal area of 0.1 ha because the surveyors fully map each 1 km² survey square. The ERT commends the United Kingdom for these clarifications and encourages the Party to include this discussion in section 11.2 of the NIR.

109. The C-Flow model is not transparent with regard to whether below-ground biomass is included. In response to questions raised by the ERT during the review, the United Kingdom explained that the C-Flow model does not include below-ground biomass; however, this explanation is inconsistent with several statements in the NIR (e.g. annex 3, pp. 633–634) and with use of the notation key "IE" in the CRF tables. As a result, it is not clear as to whether or not below-ground biomass has been accounted. The ERT strongly recommends that the Party report below-ground biomass separately as the best way of clarifying this issue.

Activities under Article 3, paragraph 3, of the Kyoto Protocol

Afforestation and reforestation – CO_2

110. In CRF table 5(KP-I)A.1.1, the carbon losses in above-ground biomass per area (e.g. –3.07 Mg C/ha for England) are larger than the biomass carbon density in cropland (e.g. 1.50 Mg C/ha for England), grassland (e.g. 1.20 Mg C/ha for England) and settlements (e.g. 2.80 Mg C/ha for England) as reported in the NIR (table A 3.6.18, p. 649). Because these are apparently default values applied for all lands in the relevant category, the aforementioned losses cannot come from the loss of biomass present on the former land use. Equally, they cannot all come from losses from fire, because only 12,791 tonnes/ dry

[17] FCCC/ARR/2012/GBR, paragraph 142.

matter burn every year under afforestation/reforestation compared with 308.60 kha reported under afforestation/reforestation: this equates to approximately 0.02 Mg C/ha of losses from fires on average in this activity. In response to questions raised by the ERT during the review, the United Kingdom could not provide an explanation for these differences. The ERT recommends that the United Kingdom provide such an explanation in the NIR.

Deforestation – CH_4 and N_2O

111. The calculation of emissions from wildfires is based on all wildfires wider than 25 ha, at least for non-forest fires. This calculation does not account for between 10 per cent (in Scotland) and 50 per cent (in Wales) of the area affected by fire, and could therefore be an underestimation of the area of deforested land affected by wildfires. In response to questions raised by the ERT during the review, the United Kingdom clarified that it had only analysed two years of data and that an extrapolation to estimate the wildfire emissions on areas smaller than 25 ha would not be robust until the analysis of five years of data is achieved. Whether the same problem occurs for forest fires, and therefore for the area of land in the afforestation/reforestation and forest management activities is unclear. The ERT acknowledges that this is not a key category and that a refined estimate may not be a priority. However, the ERT does note that this could lead to a potential underestimation of biomass burning emissions in the deforestation activity at the end of the commitment period. Accordingly, the ERT recommends that the United Kingdom provide an estimate for wildfires smaller than 25 ha.

Activities under Article 3, paragraph 4, of the Kyoto Protocol

Forest management – CO_2

112. No problems were identified beyond those related to the C-Flow model discussed above (see paras. 78 and 79 above). The issues and recommendations in these two paragraphs are nevertheless significant and the ERT strongly recommends that the Party provide additional documentation in the NIR, consistent with the recommendations made in paragraphs 78 and 79 above, as applied to forest management.

2. Information on Kyoto Protocol units

Standard electronic format and reports from the national registry

113. The United Kingdom has reported information on its accounting of Kyoto Protocol units in the required SEF tables, as required by decisions 15/CMP.1 and 14/CMP.1. The ERT took note of the findings and recommendations included in the standard independent assessment report (SIAR) on the SEF tables and the SEF comparison report.[18] The SIAR was forwarded to the ERT prior to the review, pursuant to decision 16/CP.10. The ERT reiterated the main findings and recommendations contained in the SIAR.

114. Information on the accounting of Kyoto Protocol units has been prepared and reported in accordance with decision 15/CMP.1, annex, chapter I.E, and reported in accordance with decision 14/CMP.1 using the SEF tables. However, the United Kingdom did not report information on any discrepancies identified by the international transaction log (ITL) pursuant to decision 13.CMP.1, annex, paragraph 43, and decision 5/CMP.1, annex, paragraph 54, specifying whether the relevant transactions were completed or terminated and, in the case where transactions were not terminated, the transaction number(s) and serial numbers and quantities of emission reduction units, certified emission reductions, temporary certified emission reductions, long-term certified emission reductions, assigned amount units and removal units concerned. The ERT recommends that the United Kingdom include in its next annual submission the information required by

[18] The SEF comparison report is prepared by the international transaction log (ITL) administrator and provides information on the outcome of the comparison of data contained in the Party's SEF tables with corresponding records contained in the ITL.

decision 22/CMP.1, annex, paragraph 88, on any discrepancies identified by the ITL. Three discrepancies have been identified by the ITL and no non-replacement has occurred. According to the SIAR, the discrepancies are not assumed to be related to the capacity of the national registry to ensure the accurate accounting of Kyoto Protocol units. The national registry has adequate procedures in place to minimize discrepancies.

Calculation of the commitment period reserve

115. The United Kingdom has reported its commitment period reserve in its 2013 annual submission. The Party reported its commitment period reserve to be 2,860,755,755 t CO_2 eq based on the national emissions in its 2009 inventory. At the time of the submission, the 2010 inventory had not yet been reviewed (the 2012 annual review report became available on 15 July 2013).The ERT notes that, based on the submission of revised emission estimates by the United Kingdom during the course of the review of the 2013 annual submission, the commitment period reserve for the United Kingdom changed, and the new commitment period reserve is reported as 2,836,953,850 t CO_2 eq. The ERT noted that, although this value is correctly calculated, taking into account the applied adjusted value for CH_4 recovery (flared) for 2011 (1,376.970 Gg CO_2 eq) and the resulting increase in total aggregated GHG emissions (excluding LULUCF) for 2011 (3,199.223 Gg CO_2 eq) (see table 8 below), the new commitment period reserve calculated by the ERT equals 2,852,949,964 t CO_2 eq.

3. Changes to the national system

116. The United Kingdom reported in its NIR that there is a change in its national system since the previous annual submission. AEA Technology plc, the former inventory agency, was acquired on 8 November 2012 as a subsidiary of Ricardo plc and Ricardo-AEA Ltd was formed. Ricardo-AEA Ltd is therefore now the inventory agency. Since this is only a formal change of ownership of the private company contracted to perform the inventory compilation, the ERT concluded that the United Kingdom's national system continues to be in accordance with the requirements of national systems outlined in decision 19/CMP.1.

4. Changes to the national registry

117. The United Kingdom reported that there are changes in its national registry since the previous annual submission. The Party described the changes, specifically due to the centralization of the EU ETS operations into a single EU registry operated by the European Commission called the Consolidated System of EU Registries (CSEUR), in its NIR (see p. 508). CSEUR is a consolidated platform which implements the national registries in a consolidated manner and was developed together with the new EU registry.

118. The ERT noted that there were recommendations in the SIAR that had not been addressed related to CSEUR, in particular recommendations related to the public availability of information on the website, the reporting of a description of the changes in database structure and the reporting of test results. In response to questions raised by the ERT during the review, the United Kingdom provided further information on the changes to the national registry, including on the public availability of information on the website, the reporting of a description of the changes in database structure and the reporting of test results.

119. The ERT concluded that, taking into account the confirmed changes in the national registry, including the additional information provided to the ERT during the review, the United Kingdom's national registry continues to perform the functions set out in the annex to decision 13/CMP.1 and the annex to decision 5/CMP.1 and continues to adhere to the technical standards for data exchange between registry systems in accordance with relevant decisions of the Conference of the Parties serving as the meeting of the Parties to the Kyoto Protocol (CMP). With respect to the provision of information related to database structure specifically, the ERT encourages the Party to provide additional information in

the NIR. The ERT recommends that the United Kingdom include all other additional information in response to the SIAR findings in its NIR in accordance with decision 15/CMP.1, annex, chapter I.G.

5. Minimization of adverse impacts in accordance with Article 3, paragraph 14, of the Kyoto Protocol

120. The 2011 and the 2012 annual review reports noted that the United Kingdom did not explicitly report on changes in its reporting of the minimization of adverse impacts and recommended that the Party report any changes in its information provided under Article 3, paragraph 14, of the Kyoto Protocol. The Party did not, however, provide information on changes in its reporting of the minimization of adverse impacts in accordance with Article 3, paragraph 14, of the Kyoto Protocol in its 2013 annual submission. However, in response to questions raised by the ERT during the review, the United Kingdom reported that there are changes in its reporting of the minimization of adverse impacts since the previous annual submission. The Party described the changes, specifically providing additional details on the Green Africa Power project and a grant to support the growth of silvopastoral systems in Colombia. Further, additional domestic projects were discussed in the NIR, including the funding of the Nationally Appropriate Mitigation Actions Facility, which supported the transition of sectors towards more low-carbon activities. The ERT concluded that, taking into account the confirmed changes in the reporting, the information provided is complete and transparent. The ERT reiterates the recommendation made in the previous review report that the Party explicitly report whether or not change(s) in its information provided under Article 3, paragraph 14, of the Kyoto Protocol have occurred.

H. Adjustments

121. The ERT identified underestimations in the emission estimates and recommended an adjustment in the waste sector for 2011.

122. The underestimation leading to the adjustment in the waste sector for 2011 includes CH_4 recovery from solid waste disposal on land (6.A.1) and is presented in table 7 below.

Table 7
Summary information on adjustments[a]

	2011	
	As reported (Gg CO_2 eq)	*Calculated by the ERT (Gg CO_2 eq)*
Waste sector-level emissions	23 040.379	26 239 601
Total Annex A sources	**567 390.770**	**570 589.933**

Abbreviations: Annex A sources = sources included in Annex A to the Kyoto Protocol, ERT = expert review team.

[a] In accordance with the "Technical guidance on methodologies for adjustments under Article 5, paragraph 2, of the Kyoto Protocol" (decision 20/CMP.1), the adjustment to the waste sector was prepared by the ERT in consultation with the United Kingdom. In addition, in accordance with the "Guidelines for review under Article 8 of the Kyoto Protocol", the ERT officially notified the United Kingdom of the calculated adjustment.

123. In its response to the draft annual review report, the United Kingdom notified the secretariat of its intention to accept the calculated adjustment.

Solid waste disposal on land – CH_4

Original estimate

124. The United Kingdom estimated CH_4 recovery at three different classifications of landfills: modern landfills, older permitted landfills and local authority controlled closed landfills, as well as landfills in Scotland and Northern Ireland (see para. 97 above). In its original 2013 annual submission, the United Kingdom reported estimates of CH_4 emissions from solid waste disposal on land of 14,171.06 Gg CO_2 eq for 2011. The Party also reported that it recovered 36,897.24 Gg CO_2 eq of CH_4 in 2011.

Underlying problem

125. As noted by the United Kingdom in the NIR (p. 429), data on CH_4 flaring are generally scarce and of poor quality and further work has been commissioned to gain greater confidence in the accuracy of the amount of CH_4 flared. During the review, the ERT posed several questions to the United Kingdom to understand how CH_4 recovery was estimated at the various classifications of landfills, for example whether it was based on measurements or expert judgement. At the end of the review week, sufficient information had not been provided to enable the ERT to ensure that the estimates were generated consistent with the IPCC good practice guidance. According to the IPCC good practice guidance (p. 5.10), "[r]eporting based on metering of all gas recovered for energy utilisation and flaring is consistent with *good practice*. The use of undocumented estimates of landfill gas recovery potential is not appropriate, as such estimates tend to overestimate the amount of recovery". The ERT considered that CH_4 recovery based on estimates of assumed flared amounts is not sufficiently documented or based on metering of gas recovery and the subtraction of this amount from the CH_4 generated is therefore not in line with the IPCC good practice guidance. As an overestimation of CH_4 recovery would lead to an underestimation of emissions, the ERT included this issue in the list of potential problems and further questions raised by the ERT.

Rationale for adjustment

126. The documentation provided by the United Kingdom in response to the list of potential problems and further questions raised by the ERT confirmed that metering data were not used to quantify the amount of landfill gas captured and flared at all landfill sites. In particular, the ERT concluded that the type of documentation provided by the Party to support the estimation of CH_4 recovery from all landfills, except modern permitted landfills, was not consistent with that required by the IPCC good practice guidance (see paras. 97–99 above). The ERT decided that, consistent with paragraph 3 of decision 20/CMP.1, adjustments shall be applied because the inventory data submitted by the United Kingdom was prepared in a way that was not consistent with the Revised 1996 IPCC Guidelines as elaborated by the IPCC good practice guidance. Further, the ERT concluded that the method used by the United Kingdom led to an overestimate of CH_4 recovery and therefore an underestimate of emissions.

Recommendation to the United Kingdom

127. The ERT recommends that the United Kingdom acquire additional historical CH_4 recovery data for older permitted landfills and local authority controlled closed landfills in England and Wales, and for landfills in Scotland and Northern Ireland. For these landfills, the ERT recommends that the Party follow one of two approaches:

(a) Periodically measure the amount of landfill gas flared and CH_4 recovered directly for all sites, and include appropriate documentation on flare technologies installed (see para. 100 above), or;

(b) Categorize all landfills based on site-specific characteristics and periodically conduct direct measurements of CH_4 recovery at a subset of these sites and derive correlations between site-specific characteristics and CH_4 to estimate the CH_4 recovery at non-monitored landfills (if appropriate correlations could be identified (see para. 101 above).

128. Based on the data acquired applying one of the two options in para. 127 above, the ERT recommends that the Party recalculate the full time series of estimates of CH_4 recovery.

Assumptions, data and methodology used to calculate the adjustment

129. In accordance with the "Technical guidance on methodologies for adjustments under Article 5, paragraph 2, of the Kyoto Protocol" (annex to decision 20/CMP.1), the ERT calculated the adjustment at the level at which the problem was identified: the problem was identified in relation to the estimate of CH_4 recovery from older permitted landfills, local authority controlled closed landfills and landfills in Scotland and Northern Ireland. In accordance with the annex to decision 20/CMP.1, the ERT decided to calculate the adjustment using adjustment method 1: a default IPCC tier 1 method.

130. The Party provided revised data on 13 December 2013 regarding the quantity of CH_4 flared for 2009, 2010 and 2011, by classification (modern permitted landfills, older permitted landfills, local authority controlled closed landfills and landfills in Scotland and Northern Ireland). Based on these data, the ERT accepted that, in 2011, the total quantity of CH_4 captured for electricity generation (1,222 Gg CH_4) and the total quantity of CH_4 flared at modern permitted landfills (83.00 Gg CH_4) was in accordance with the IPCC good practice guidance. The remaining quantity of CH_4 recovered that had been estimated and reported by the United Kingdom in the original 2013 annual submission for 2011 (151.00 Gg CH_4) was assumed to be entirely emitted (i.e. the recovery was zero).

131. In calculating the adjustment, the ERT applied a conservativeness factor to the amount of CH_4 recovered that it concluded was calculated consistent with the IPCC good practice guidance and could therefore be reported. Table 2 of appendix III to the annex to decision 20/CMP.1 provides conservativeness factors to be applied to the years of the commitment period. The ERT noted that the conservativeness factor for AD for solid waste disposal on land in a year of the commitment period is equal to 1.21. The ERT further notes that the conservativeness factors were based on the assessment of uncertainty for the parameter,[19] and therefore represent a default range plus or minus the true value (in the case of AD for solid waste disposal on land, a value of plus or minus 21 per cent). Because applying a factor of 1.21 to removals would result in a higher estimate of removals (and would therefore not be conservative), the ERT applied a conservativeness factor of 0.79 (considering the uncertainty of plus or minus 21 per cent) to ensure that the adjusted estimate for the removals is conservative.

Adjusted estimate

132. Table 8 below shows the steps for the calculation of the adjustment.

[19] See paragraph 7 of appendix III of the annex to decision 20/CMP.1.

Table 8
Description of the calculation of adjustments for Annex A sources

Parameter/estimate	*Value*	*Unit*	*Source*
Category: solid waste disposal on land – CH_4 recovery			
The United Kingdom's estimate of: total CH_4 recovery	30 588.648	Gg CO_2 eq	CRF table 6.A (GBR-2013-2011, v.1.2) submitted on 28 October 2013
The United Kingdom's CH_4 captured for electricity generation	25 662.000	Gg CO_2 eq	Information submitted by the United Kingdom: ERT_Clarification questions_LFG Flaring_v3.docx
The United Kingdom's CH_4 recovery estimate (flared) from modern permitted landfills	1 743.000	Gg CO_2 eq	Information submitted by the United Kingdom: ERT_Clarification questions_LFG Flaring_v3.docx
The United Kingdom's CH_4 recovery estimate (flared) from older permitted landfills	1 974.000	Gg CO_2 eq	Information submitted by the United Kingdom: ERT_Clarification questions_LFG Flaring_v3.docx
The United Kingdom's CH_4 recovery estimate (flared) from local authority controlled closed landfills	651.000	Gg CO_2 eq	Information submitted by the United Kingdom: ERT_Clarification questions_LFG Flaring_v3.docx
The United Kingdom's CH_4 recovery estimate (flared) from Scotland and Northern Ireland	546.000	Gg CO_2 eq	Information submitted by the United Kingdom: ERT_Clarification questions_LFG Flaring_v3.docx
Input data/parameter for calculation of adjustment	0		IPCC good practice guidance (p. 5.10)
Calculated estimate for CH_4 recovery (flared)	1 743.000	Gg CO_2 eq	Information submitted by the United Kingdom: ERT_Clarification questions_LFG Flaring_v3.docx
Conservativeness factor	0.79	–	Complement of the factor for AD (1.21) in table 2 of appendix III to decision 20/CMP.1
Adjusted conservative estimate for CH_4 recovery (flared)	1 376.970	Gg CO_2 eq	Calculated by the ERT
Adjusted conservative estimate for CH_4 recovery (flared + CH_4 captured for electricity generation)	23 078.970	Gg CO_2 eq	Calculated by the ERT
Original estimate for solid waste disposal on land – CH_4	19 848.794	Gg CO_2 eq	CRF table 6 (GBR-2013-2011, v.1.2) submitted on 28 October 2013
Adjusted conservative estimate for solid waste disposal on land – CH_4 (taking into account that the reduced CH_4	23 048.016	Gg CO_2 eq	Calculated by the ERT

Parameter/estimate	*Value*	*Unit*	*Source*
flared increases the residual CH_4 oxidized from 105.00 to 121.54 kt CH_4 in 2011)			
Total aggregated GHG emissions (excluding LULUCF) as reported by the United Kingdom	567 390.770	Gg CO_2 eq	Summary table 2 (GBR-2013-2011, v.1.2) submitted on 28 October 2013
Total aggregated GHG emissions (excluding LULUCF) after application of adjustment	570 589.993	Gg CO_2 eq	Calculated by the ERT
Difference between original and adjusted total aggregated GHG emissions	3 199.223	Gg CO_2 eq	Calculated by the ERT
	0.6	%	Calculated by the ERT

Abbreviations: AD = activity data, Annex A sources = sources included in Annex A to the Kyoto Protocol, CRF = common reporting format, ERT= expert review team, GHG = greenhouse gas, IPCC = Intergovernmental Panel on Climate Change, IPCC good practice guidance = IPCC *Good Practice Guidance and Uncertainty Management in National Greenhouse Gas Inventories*, LULUCF = land use, land-use change and forestry.

Conservativeness of the expert review team's calculation of the adjustment

133. In line with paragraph 54 of the annex to decision 20/CMP.1, conservativeness was ensured by assuming that no flaring of CH_4 recovered occurred except for modern permitted landfills, where documentation was provided by the United Kingdom to ensure that estimates were derived consistent with the IPCC good practice guidance. Further, for modern permitted landfills a conservativeness factor of 0.79 was applied based on the fact that the conservativeness factors were derived from uncertainty values provided in the IPCC good practice guidance[20] (from table 2 of appendix III to the annex to decision 20/CMP.1) was applied to estimate the CH_4 recovery that was flared (see para. 131 above). The ERT therefore considers that the resulting adjusted values are conservative.

III. Conclusions and recommendations

A. Conclusions

134. Table 9 summarizes the ERT's conclusions on the 2013 annual submission of the United Kingdom, in accordance with the Article 8 review guidelines.

Table 9
Expert review team's conclusions on the 2013 annual submission of the United Kingdom

		Paragraph cross-references
The ERT concludes that the inventory submission of the United Kingdom is complete (categories, gases, years and geographical boundaries and contains both an NIR and CRF tables for 1990–2011)		
Annex A sources[a]	Complete	
LULUCF[a]	Not complete	
KP-LULUCF	Complete	109

[20] See paragraph 7 of appendix III of the annex to decision 20/CMP.1.

		Paragraph cross-references
The ERT concludes that the inventory submission of the United Kingdom has been prepared and reported in accordance with the UNFCCC reporting guidelines	Yes	
The submission of information required under Article 7, paragraph 1, of the Kyoto Protocol has been prepared and reported in accordance with decision 15/CMP.1	No	120
The United Kingdom's inventory is in accordance with the *Revised 1996 IPCC Guidelines for National Greenhouse Gas Inventories*, the IPCC *Good Practice Guidance and Uncertainty Management in National Greenhouse Gas Inventories* and the IPCC *Good Practice Guidance for Land Use, Land-Use Change and Forestry*	No	12, 84, 94, 98, 99, 125
The United Kingdom has reported information on Article 3, paragraphs 3 and 4, of the Kyoto Protocol	Yes	112
The United Kingdom has reported information on its accounting of Kyoto Protocol units in accordance with decision 15/CMP.1, annex, chapter I.E, and used the required reporting format tables as specified by decision 14/CMP.1	Yes	
The national system continues to perform its required functions as set out in the annex to decision 19/CMP.1	Yes	
The national registry continues to perform the functions set out in the annex to decision 13/CMP.1 and the annex to decision 5/CMP.1 and continues to adhere to the technical standards for data exchange between registry systems in accordance with relevant CMP decisions	Yes	114, 119
Did the United Kingdom provide information in the NIR on changes in its reporting of the minimization of adverse impacts in accordance with Article 3, paragraph 14, of the Kyoto Protocol?	No	120

Abbreviations: Annex A sources = sources included in Annex A to the Kyoto Protocol, CMP = Conference of the Parties serving as the meeting of the Parties to the Kyoto Protocol, CRF = common reporting format, ERT = expert review team, IPCC = Intergovernmental Panel on Climate Change, KP-LULUCF = LULUCF emissions and removals from activities under Article 3, paragraphs 3 and 4, of the Kyoto Protocol, LULUCF = land use, land-use change and forestry, NIR = national inventory report, UNFCCC reporting guidelines = "Guidelines for the preparation of national communications by Parties included in Annex I to the Convention, Part I: UNFCCC reporting guidelines on annual inventories".

[a] The assessment of completeness by the ERT considers only the completeness of reporting of mandatory categories (i.e. categories for which methods and default emission factors are provided in the Intergovernmental Panel on Climate Change (IPCC) *Revised 1996 IPCC Guidelines for National Greenhouse Gas Inventories*, the IPCC *Good Practice Guidance and Uncertainty Management in National Greenhouse Gas Inventories*, or the IPCC *Good Practice Guidance for Land Use, Land-Use Change and Forestry*).

135. The ERT concludes, based on the review of the 2013 inventory, that for the following category, solid waste disposal on land – CH_4 recovery, the parameter for CH_4 recovery is not fully in line with the IPCC good practice guidance as required by Article 5, paragraph 2, of the Kyoto Protocol. The ERT, following the review of the additional information provided by the United Kingdom during and after the review, concluded that it did not satisfactorily correct the problem through the submission of acceptable revised

estimates and decided to calculate and recommend an adjustment in accordance with the "Technical guidance on methodologies for adjustments under Article 5, paragraph 2, of the Kyoto Protocol" (decision 20/CMP.1).

136. The United Kingdom, in its communication of 20 June 2014, accepted the calculated adjustment. In accordance with the Article 8 review guidelines, the ERT applied the calculated adjustment.

B. Recommendations

137. The ERT identified the issues for improvement listed in table 10 below. All recommendations are for the next annual submission, unless otherwise specified.

Table 10
Recommendations identified by the expert review team

Sector	*Category*	*Recommendation*	*Paragraph cross-references*
Cross-cutting	Inventory preparation	Perform a key category analysis following the IPCC *Good Practice Guidance and Uncertainty Management in National Greenhouse Gas Inventories* (hereinafter referred to as the IPCC good practice guidance) at an aggregation level where individual EFs are used	12
	Inventory management	Describe in the NIR the role that Rothamsted Research and the United Kingdom Centre for Ecology and Hydrology have with respect to archiving	13
	Follow-up to previous reviews	Include explicit information in the NIR whenever adjustments have been applied to the inventory, explaining how the Party has responded to the adjustments in the subsequent inventory, or at the latest, in the inventory submission following publication of the annual review report containing the adjustment	15
Energy	Comparison of the reference approach with the sectoral approach and international statistics	Describe the outcome of the review of the reference approach, in an effort to make it more comparable to the national energy statistics, and to improve the explanation of the differences in the NIR	19
		Review the fractions of carbon oxidized for anthracite, peat, brown coal briquettes (BKB) and patent fuel, and coke oven/gas coke	20
	International bunkers	Rectify the reporting error in activity data for jet kerosene (international aviation) and residual fuel oil and diesel oil (marine bunkers) in 2011	23
	Feedstocks and non-energy use of fuels	Include any identified emissive sources of feedstocks and their exact final end use in the NIR and the CRF tables	24

Sector	*Category*	*Recommendation*	*Paragraph cross-references*
		In cases where a non-energy use cannot be defined with certainty, report the associated emissions of the respective fuel in an appropriate category under the energy or industrial processes sectors under the assumption that it is fully oxidized	25
		Review the allocation of fuels to non-energy uses within the Digest of United Kingdom Energy Statistics (DUKES), in order to identify any misallocations of fuels to non-energy uses that may lead to an underestimation of emissions	25
	Stationary combustion: solid, liquid and gaseous fuels – CO_2	Implement the additional quality checks and planned method to minimize manual transposition of data across multiple data spreadsheets	27
		Either justify the fractions of carbon oxidized applied for coal – other, coal – domestic, coke – power, coke – other and anthracite–domestic or apply the IPCC default value of 0.98 from the *Revised 1996 IPCC Guidelines for National Greenhouse Gas Inventories*	28
	Road transportation: liquid fuels – CO_2	Review the EF used for gasoline in cooperation with the United Kingdom Petroleum Industry Association (UKPIA) and include this information in the NIR	29
	Oil and natural gas: natural gas – CH_4	Improve the transparency of the description of the methodology followed for the estimation of fugitive emissions from natural gas transmission and distribution systems	30
		Conduct the verification exercise as described in paragraph 31 above	31
	Civil aviation: liquid fuels – CO_2, CH_4 and N_2O	Perform a review of the EF for jet kerosene in civil aviation in cooperation with UKPIA and include this information in its NIR	34
		Rectify the reporting error regarding the AD for civil aviation (national and international) and improve the QA/QC procedures performed during the compilation of the CRF tables	35
	Railways: solid fuels – CO_2, CH_4 and N_2O	Improve the completeness and time-series consistency of estimates of railway emissions by estimating the AD and associated GHG emissions from solid fuel consumption. In case the necessary AD are not available, estimate them by using one of the estimation techniques described in section 7.3.2.2 of the IPCC good practice guidance	38

Sector	*Category*	*Recommendation*	*Paragraph cross-references*
	Coal mining and handling: solid fuels – CH_4	Revise the note on the use of the notation key for included elsewhere in CRF table 1.B.1	39
Industrial processes and solvent and other product use	Sector overview	Provide additional tables containing time-series overviews of the data sources, AD and methodologies applied where not currently done	42
		Report on the rationale for and impact of all recalculations undertaken in the NIR and in CRF table 8(b)	42
	Nitric acid production – N_2O	Enhance the transparency of reporting by providing information on the methods used by plant operators to estimate N_2O emissions from nitric acid production and ensure the consistency of the data reported across the entire time series	43
	Consumption of halocarbons and SF_6 – HFCs, PFCs and SF_6	Continue to review the assumptions and methodologies applied to the model(s) used to estimate emissions from refrigeration and air-conditioning equipment	44
		Include in the NIR a description of the methodology applied to estimate potential emissions	45
		Improve QA/QC procedures in the NIR and the CRF tables (for example, to identify the errors such as that observed by the ERT whereby potential emissions from foam blowing were left blank in the CRF tables)	45
	Ammonia production – CO_2	Investigate the origin of the low IEF and report thereon in its NIR	49
		Correctly allocate natural gas used as a feedstock between the energy and industrial processes sectors	50
		Improve the transparency and consistency of the NIR by using the same units for the AD and EF between the energy and industrial processes sector (e.g. GCV and NCV)	50
Agriculture	Enteric fermentation – CH_4	Continue efforts to improve the information available in terms of feeding types, amounts and digestibility rates and include this in the NIR	54
		Document its national feeding conditions, taking into account the seasonal variation in feeding quality for the all-year grazing animals and the election of a digestible energy value of 65.0 per cent for non-dairy cattle	55
		Provide comprehensive data for all cattle categories in	55

Sector	*Category*	*Recommendation*	*Paragraph cross-references*
		the NIR	
		Document the national circumstances in order to justify the use of the tier 1 methodology for mature breeding sheep only and the related reduction factor for producing lambs	56, 62
		Apply the IPCC tier 2 model for sheep, and collect proper feeding data and data on feed digestibility, taking into account the actual feeding conditions in scrubland, rangeland, lowlands and highlands throughout the year	56
	Manure management – CH_4	Continue efforts to improve the volatile solids excretion rate for dairy cattle	57
		Verify the assumption for the correction for producing lambs and whether there are implications for the CH_4 emissions from manure management	62
	Manure management – N_2O	Include additional information on the Nex model in the NIR and its linkage to the NH_3 emissions inventory submitted to the European Monitoring and Evaluation Programme (EMEP) and European Union (EU) directive 2001/81/EC on national emission ceilings for certain atmospheric pollutants	63
		Include additional information in the NIR on the assumptions used to derive the model and how this model has been implemented in the inventory of the United Kingdom	64
	Agricultural soils – N_2O	Implement plans, through a research and development platform, to unify the approaches to the reporting of NH_3 and NO_X losses between the two inventories (UNFCCC and LRTAP)	69
		Use revised AD for sewage sludge applied to soils and ensure consistency between the agriculture and waste sectors	70
		Enhance QA/QC procedures and coordinate the data exchange between the waste sector and the agriculture sector	70
LULUCF	Sector overview	Prioritize work to implement a data assimilation process to resolve inconsistencies in total land area over the time series	76
		Consider the uncertainty of the model structure in the uncertainty analysis	76
	Forest land – CO_2	Include in the NIR an explanation and any supporting documentation on how the CARBINE model addresses and resolves the identified issues that	78

Sector	*Category*	*Recommendation*	*Paragraph cross-references*
		currently exist with the C-Flow model: (a) There is no evaluation against independent data provided in C-Flow; (b) The assumption that rotation lengths are fixed per species, and are therefore independent of wood demand or other factors; (c) The assumption that forests planted before 1921 – "pre-1920 forests" have reached an equilibrium and are neither sources of emissions nor sources of removals; (d) The default value of 0.05 for the fraction of above-ground biomass which is left on-site after harvest; (e) Transparency regarding whether below-ground biomass is included; (f) Parameters governing the use of harvested wood and, hence, the half-life of wood products, are not documented	
		Document the high EFs for soil carbon changes to and from forest land, in particular by providing more detailed tables which simultaneously distinguish the soil type and land use	79
	Cropland and grassland – CO_2	Implement, as proposed, methods for the estimation of the carbon stock changes associated with changes in management practices	81
		Report the results of the ongoing study related to the impacts of land management practices, particularly with respect to the ability to differentiate between mineral and organic soils when reporting land conversions to cropland and grassland and from cropland and grassland to other land	82
		Specify whether orchards are included in the forest definition	83
		Estimate the changes in biomass in orchards	83
		Provide an explanation for the apparent contradiction that the inventory reports grasslands as a source of removals, while independent studies find that grassland is a large source of CO_2 emissions	84
	Land converted to settlements – CO_2	Include clarifications provided to the ERT during the review regarding the observed trends in carbon stock changes for biomass in cropland and grassland converted to settlements and soils in cropland and grassland converted to settlements	85, 86
Waste	Sector overview	Improve the transparency of this sector, in particular: provide the assumptions used to derive the AD and	90

Sector	*Category*	*Recommendation*	*Paragraph cross-references*
		methods for CH_4 recovery; the share of industrial wastewater in wastewater handling systems; the estimation of emissions from sewage sludge application to compost and farmland; and emissions estimates for OT and CDs	
		Improve the QC checks in, and between, the main text of the NIR and the annexes, as well as in the CRF tables	91
	Solid waste disposal on land – CH_4	Acquire additional historical CH_4 recovery data for older permitted landfills and local authority controlled closed landfills in Scotland and Wales, and for landfills in Scotland and Northern Ireland by either (a) carrying out periodic collection of the amounts of CH_4 flared from all of these landfills or (b) categorize landfills based on identified characteristics and survey and investigate recovery systems and CH_4 flared for a representative sample of landfills in all categories, except modern landfills, and extrapolate the estimated amounts of CH_4 recovered from these landfills to all landfills from these categories	100–101, 127
	Wastewater handling – CH_4 and N_2O	Improve the accuracy and transparency of the applied EFs to ensure that they are fully representative of the activity and emissions for the entire United Kingdom	102
	Waste incineration – CO_2, CH_4 and N_2O	Report only on the recovery of emissions that is based on metered data	105
KP-LULUCF	Overview	Include in the NIR an explanation and supporting documentation on how the CARBINE model addresses and resolves the issues identified for the C-Flow model, as applied to lands under Article 3, paragraphs 3 and 4 of the Kyoto Protocol	107
		Report below-ground biomass separately	109
	Afforestation and reforestation – CO_2	Provide an explanation for why the carbon losses in above-ground biomass per area are larger than the biomass carbon density in cropland, grassland and settlements	110
	Deforestation – CO_2	Provide an estimate for wildfires smaller than 25 hectares	111
	Forest management – CO_2	Provide additional documentation in the NIR, consistent with the recommendations made in paragraphs 78 and 79 above, as applied to forest management	112
Information on Kyoto Protocol	Standard electronic format and	Include the information required by decision 22/CMP.1, annex, paragraph 88, on any discrepancies	114

Sector	*Category*	*Recommendation*	*Paragraph cross-references*
units	reports from the national registry	identified by the international transaction log	
National registry		Include all other additional information in response to the Standard Independent Assessment Report findings in its NIR in accordance with decision 15/CMP.1, annex, chapter I.G	119
Article 3, paragraph 14		Explicitly report whether or not change(s) in information provided under Article 3, paragraph 14, of the Kyoto Protocol have occurred	120
Adjustments		Recalculate the full time series of estimates of CH_4 recovery in the category solid waste disposal on land	128

Abbreviations: AD = activity data, CD = crown dependency, CRF = common reporting format, EF = emission factor, ERT = expert review team, GHG = greenhouse gas, IEF = implied emission factor, IPCC = Intergovernmental Panel on Climate Change, KP-LULUCF = LULUCF emissions and removals from activities under Article 3, paragraphs 3 and 4, of the Kyoto Protocol, LULUCF = land use, land-use change and forestry, NIR = national inventory report, OT = overseas territories, QA/QC = quality assurance/ quality control.

IV. Questions of implementation

138. No questions of implementation were identified by the ERT during the review.

Annex I

Background data on recalculations and information to be included in the compilation and accounting database

Table 11
Recalculations in the 2013 annual submission for the base year and the most recent year

	1990	*2010*	*1990*	*2010*	
Greenhouse gas source and sink categories		*Value of recalculation (Gg CO_2 eq)*		*Per cent change*	*Reason for the recalculation*
1. Energy	**–1 185.67**	**–2 271.99**	**–0.2**	**–0.4**	**Change in method, EF and AD**
A. Fuel combustion (sectoral approach)	–1 245.78	–2 607.17	–0.2	–0.5	
1. Energy industries	–1 037.19	–771.35	–0.4	–0.4	
2. Manufacturing industries and construction	–168.46	257.72	–0.2	0.4	
3. Transport	–29.43	–2 114.67	–0.0	–1.8	
4. Other sectors	–10.70	67.03	–0.0	0.1	
5. Other		–45.90		–1.5	
B. Fugitive emissions from fuels	60.11	335.18	0.2	2.9	
1. Solid fuels	24.49	291.37	0.1	14.4	
2. Oil and natural gas	35.62	43.81	0.2	0.5	
2. Industrial processes	**272.63**	**773.07**	**0.7**	**6.7**	**Change in method, EF and AD**
A. Mineral products	272.63	864.69	2.7	15.8	
B. Chemical industry		–26.10		–0.6	
C. Metal production		–65.34		–3.5	
D. Other production					
E. Production of halocarbons and SF_6					
F. Consumption of halocarbons and SF_6					
G. Other					
3. Solvent and other product use					
4. Agriculture	**7 150.11**	**5 274.42**	**12.3**	**11.3**	**Change in method, EF and AD**
A. Enteric fermentation	183.60	106.46	1.0	0.7	
B. Manure management	6 792.15	5 049.98	122.5	116.2	
C. Rice cultivation					

Greenhouse gas source and sink categories	*1990*	*2010*	*1990*	*2010*	*Reason for the recalculation*
		Value of recalculation (Gg CO_2 eq)	*Per cent change*		
D. Agricultural soils	176.59	124.25	0.5	0.5	
E. Prescribed burning of savannas					
F. Field burning of agricultural residues	2.11		0.6		
G. Other	–4.34	–6.27	–4.7	–7.5	
5. Land use, land-use change and forestry	**129.19**	**176.96**	**3.3**	**–4.6**	**Change in method and AD**
A. Forest land	241.77	217.22	–2.0	–2.0	
B. Cropland	4.97	–282.33	0.0	–2.2	
C. Grassland	–17.32	73.22	0.3	–0.8	
D. Wetlands	0.00	139.61	0.0	53.0	
E. Settlements	–100.23	–2.38	–1.4	–0.0	
F. Other land					
G. Other		31.62		–0.8	
6. Waste	**–88.81**	**5 943.96**	**–0.2**	**33.2**	**Change in method and AD**
A. Solid waste disposal on land	–111.15	5 876.32	–0.3	39.8	
B. Wastewater handling	22.34	66.11	0.8	2.4	
C. Waste incineration		1.53		0.4	
D. Other					
7. Other					
Total CO_2 equivalent without LULUCF	**6 148.26**	**9 793.49**	**0.80**	**1.6**	
Total CO_2 equivalent with LULUCF	**6 277.46**	**9 970.45**	**0.81**	**1.7**	

Abbreviations: AD = activity data, EF = emission factor, LULUCF = land use, land-use change and forestry.

Table 12
Information to be included in the compilation and accounting database in t CO_2 eq for 2011, including the commitment period reserve

	As reported	*Revised estimates*	*Adjustment*[a]	*Final*[b]
Commitment period reserve	2 860 755 755	2 836 953 850	15 996 114	2 852 949 964
Annex A emissions for 2011				
CO_2	464 618 438	464 653 693		464 653 693
CH_4	42 034 891	51 827 072	3 199 223	55 026 295
N_2O	34 217 805	35 323 313		35 323 313
HFCs	14 653 907			14 653 907
PFCs	325 308			325 308
SF_6	607 476			607 476
Total Annex A sources	**556 457 826**	**567 390 770**	**3 199 223**	**570 589 993**
Activities under Article 3, paragraph 3, for 2011				
3.3 Afforestation and reforestation on non-harvested land for 2011	–3 058 810			–3 058 810
3.3 Afforestation and reforestation on harvested land for 2011	NO			NO
3.3 Deforestation for 2011	552 089			552 089
Activities under Article 3, paragraph 4, for 2011[c]				
3.4 Forest management for 2011	–7 222 124			–7 222 124
3.4 Cropland management for 2011				
3.4 Cropland management for the base year				
3.4 Grazing land management for 2011				
3.4 Grazing land management for the base year				
3.4 Revegetation for 2011				
3.4 Revegetation in the base year				

Abbreviations: Annex A sources = sources included in Annex A to the Kyoto Protocol, NO = not occurring.
[a] "Adjustment" is relevant only for Parties for which the expert review team has calculated one or more adjustment(s).
[b] "Final" includes revised estimates, if any, and/or adjustments, if any.
[c] Activities under Article 3, paragraph 4, are relevant only for Parties that elected one or more such activities.

Table 13
Information to be included in the compilation and accounting database in t CO_2 eq for 2010

	As reported	*Revised estimates*	*Adjustment*[a]	*Final*[b]
Annex A emissions for 2010				
CO_2	504 190 380	504 228 195		504 228 195
CH_4	42 991 750	53 029 414		53 029 414
N_2O	35 298 610	36 342 804		36 342 804
HFCs	14 388 342			14 388 342
PFCs	220 622			220 622
SF_6	689 583			689 583
Total Annex A sources	**556 457 826**	**608 898 961**		**608 898 961**
Activities under Article 3, paragraph 3, for 2010				
3.3 Afforestation and reforestation on non-harvested land for 2010	–2 971 599			–2 971 599
3.3 Afforestation and reforestation on harvested land for 2010	NO			NO
3.3 Deforestation for 2010	553 416			553 416
Activities under Article 3, paragraph 4, for 2010[c]				
3.4 Forest management for 2010	–7 491 986			–7 491 986
3.4 Cropland management for 2010				
3.4 Cropland management for the base year				
3.4 Grazing land management for 2010				
3.4 Grazing land management for the base year				
3.4 Revegetation for 2010				
3.4 Revegetation in the base year				

Abbreviations: Annex A sources = sources included in Annex A to the Kyoto Protocol, NO = not occurring.
[a] "Adjustment" is relevant only for Parties for which the expert review team has calculated one or more adjustment(s).
[b] "Final" includes revised estimates, if any, and/or adjustments, if any.
[c] Activities under Article 3, paragraph 4, are relevant only for Parties that elected one or more such activities.

Table 14
Information to be included in the compilation and accounting database in t CO_2 eq for 2009

	As reported	*Revised estimates*	*Adjustment*[a]	*Final*[b]
Annex A emissions for 2009				
CO_2	487 161 019	487 198 466		487 198 466
CH_4	43 686 877	55 635 107		55 635 107
N_2O	34 694 264	35 743 981		35 743 981
HFCs	14 033 291			14 033 291
PFCs	145 032			145 032
SF_6	661 552			661 552
Total Annex A sources	**556 457 826**	**593 417 429**		**593 417 429**
Activities under Article 3, paragraph 3, for 2009				
3.3 Afforestation and reforestation on non-harvested land for 2009	–2 797 767			–2 797 767
3.3 Afforestation and reforestation on harvested land for 2009	NO			NO
3.3 Deforestation for 2009	654 213			654 213
Activities under Article 3, paragraph 4, for 2009[c]				
3.4 Forest management for 2009	–9 760 849			–9 760 849
3.4 Cropland management for 2009				
3.4 Cropland management for the base year				
3.4 Grazing land management for 2009				
3.4 Grazing land management for the base year				
3.4 Revegetation for 2009				
3.4 Revegetation in the base year				

Abbreviations: Annex A sources = sources included in Annex A to the Kyoto Protocol, NO = not occurring.
[a] "Adjustment" is relevant only for Parties for which the expert review team has calculated one or more adjustment(s).
[b] "Final" includes revised estimates, if any, and/or adjustments, if any.
[c] Activities under Article 3, paragraph 4, are relevant only for Parties that elected one or more such activities.

Table 15
Information to be included in the compilation and accounting database in t CO_2 eq for 2008

	As reported	*Revised estimates*	*Adjustment*[a]	*Final*[b]
Annex A emissions for 2008				
CO_2	537 678 950	537 720 278		537 720 278
CH_4	44 991 680	57 840 957		57 840 957
N_2O	36 709 297	37 806 208		37 806 208
HFCs	13 686 606			13 686 606
PFCs	203 925			203 925
SF_6	711 768			711 768
Total Annex A sources	**556 457 826**	**647 969 743**		**647 969 743**
Activities under Article 3, paragraph 3, for 2008				
3.3 Afforestation and reforestation on non-harvested land for 2008	–2 668 608			–2 668 608
3.3 Afforestation and reforestation on harvested land for 2008	NO			NO
3.3 Deforestation for 2008	588 907			588 907
Activities under Article 3, paragraph 4, for 2008[c]				
3.4 Forest management for 2008	–10 733 450			–10 733 450
3.4 Cropland management for 2008				
3.4 Cropland management for the base year				
3.4 Grazing land management for 2008				
3.4 Grazing land management for the base year				
3.4 Revegetation for 2008				
3.4 Revegetation in the base year				

Abbreviations: Annex A sources = sources included in Annex A to the Kyoto Protocol, NO = not occurring.
[a] "Adjustment" is relevant only for Parties for which the expert review team has calculated one or more adjustment(s).
[b] "Final" includes revised estimates, if any, and/or adjustments, if any.
[c] Activities under Article 3, paragraph 4, are relevant only for Parties that elected one or more such activities.

Annex II

Documents and information used during the review

A. Reference documents

Intergovernmental Panel on Climate Change. *2006 IPCC Guidelines for National Greenhouse Gas Inventories*. Available at <http://www.ipcc-nggip.iges.or.jp/public/2006gl/index.html>.

Intergovernmental Panel on Climate Change. *Revised 1996 IPCC Guidelines for National Greenhouse Gas Inventories*. Available at <http://www.ipcc-nggip.iges.or.jp/public/gl/invs1.htm>.

Intergovernmental Panel on Climate Change. *Good Practice Guidance and Uncertainty Management in National Greenhouse Gas Inventories*. Available at <http://www.ipcc-nggip.iges.or.jp/public/gp/english/>.

Intergovernmental Panel on Climate Change. *Good Practice Guidance for Land Use, Land-Use Change and Forestry*. Available at <http://www.ipcc-nggip.iges.or.jp/public/gpglulucf/gpglulucf.htm>.

"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/2006/9. Available at <http://unfccc.int/resource/docs/2006/sbsta/eng/09.pdf>.

"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>.

"Guidelines for national systems under Article 5, paragraph 1, of the Kyoto Protocol". Decision 19/CMP.1. Available at <http://unfccc.int/resource/docs/2005/cmp1/eng/08a03.pdf#page=14>.

"Guidelines for the preparation of the information required under Article 7 of the Kyoto Protocol". Decision 15/CMP.1. Available at <http://unfccc.int/resource/docs/2005/cmp1/eng/08a02.pdf#page=54>.

"Guidelines for review under Article 8 of the Kyoto Protocol". Decision 22/CMP.1. Available at <http://unfccc.int/resource/docs/2005/cmp1/eng/08a03.pdf#page=51>.

Status report for the United Kingdom of Great Britain and Northern Ireland 2013. Available at <http://unfccc.int/resource/docs/2013/asr/gbr.pdf>.

Synthesis and assessment report on the greenhouse gas inventories submitted in 2013. Available at <http://unfccc.int/resource/webdocs/sai/2013.pdf>.

"Technical guidance on methodologies for adjustments under Article 5, paragraph 2, of the Kyoto Protocol". Decision 19/CMP.1. Available at <http://unfccc.int/resource/docs/2005/cmp1/eng/08a03.pdf>.

FCCC/ARR/2012/GBR. Report of the individual review of the annual submission of the United Kingdom of Great Britain and Northern Ireland submitted in 2012. Available at <http://unfccc.int/resource/docs/2013/arr/gbr.pdf>.

Standard independent assessment report, parts 1 and 2. Available at <http://unfccc.int/kyoto_protocol/registry_systems/independent_assessment_reports/items/4061.php>.

B. Additional information provided by the United Kingdom

Responses to questions during the review were received from Ms. Helen Champion and Ms. Julia Sussams (Department of Energy and Climate Change), including additional material on the methodologies and assumptions used. The following documents[1] were also provided by the United Kingdom:

Bradley, R.I. *et al*. 2005. *A soil carbon and land use database for the United Kingdom*. Soil Use and Management 21, 363-369.

Environment Agency. September 2004. *Guidance on the Management of Landfill Gas*. Bristol, UK: Environment Agency. Available at http://www.google.de/url?sa=t&rct=j&q=&esrc=s&frm=1&source=web&cd=1&ved=0CCwQFjAA&url=http%3A%2F%2Fwww.sepa.org.uk%2Fwaste%2Fwaste_regulation%2Fidoc.ashx%3Fdocid%3Db0b554c4-3ed3-49d0-85c5-bde23b82de60%26version%3D-1&ei=jbk6U9ieFMTQsgbTw4DACA&usg=AFQjCNFYMMVR9hkdiwGSrkXzOxaneZRDxg&sig2=Fta569Zw-X_uCkgk1p_RUg

Ministry of Agriculture, Fisheries and Food, Standing Committee on Tables of Feed Composition. 1990. *UK tables of nutritive value and chemical composition of feeding stuffs*. Aberdeen, UK: Rowett Research Services, Ltd.

Nix, J. 2009. *The John Nix Farm Management Pocketbook*. 40th Edition. Available at http://www.thepocketbook.biz/

Williams, Alan. 1993. *Methane emissions*: *Papers presented at the twenty-ninth consultative conference of the Watt Committee on Energy*. London.

[1] Reproduced as received from the Party.

Annex III

Acronyms and abbreviations

AD	activity data
BKB	brown coal briquettes
C	carbon
CaO	calcium oxide
CDs	crown dependencies
CH_4	methane
CMP	Conference of the Parties serving as the meeting of the Parties to the Kyoto Protocol
CO	carbon monoxide
CO_2	carbon dioxide
CO_2 eq	carbon dioxide equivalent
CRF	common reporting format
CSEUR	Consolidated System of EU Registries
DE	digestible energy
DM	dry matter
EF	emission factor
ERT	expert review team
EU	European Union
EU ETS	European Union Emissions Trading System
FAO	Food and Agriculture Organization of the United Nations
f_{BL}	fraction of biomass left to decay in the forest
GCV	gross calorific value
Gg	gigagram
GHG	greenhouse gas; unless indicated otherwise, GHG emissions are the sum of CO_2, CH_4, N_2O, HFCs, PFCs and SF_6 without GHG emissions and removals from LULUCF
ha	hectare
HFCs	hydrofluorocarbons
IE	included elsewhere
IEA	International Energy Agency
IEF	implied emission factor
IPCC	Intergovernmental Panel on Climate Change
ITL	international transaction log
kg	kilogram (1 kg = 1,000 grams)
km^2	kilometre squared
kt	kilotonne
KP-LULUCF	land use, land-use change and forestry emissions and removals from activities under Article 3, paragraphs 3 and 4, of the Kyoto Protocol
LRTAP	Convention on Long-range Transboundary Air Pollution
LULUCF	land use, land-use change and forestry
MCF	methane conversion factor
NH_3	ammonia
N_2O	nitrous oxide
NA	not applicable
NCV	net calorific value
NE	not estimated
Nex	nitrogen excretion rate
NIR	national inventory report
NO	not occurring

NO_X	nitrogen oxide
OTs	overseas territories
PFCs	perfluorocarbons
PJ	petajoule (1 PJ = 10^{15} joule)
QA/QC	quality assurance/quality control
SEF	standard electronic format
SF_6	sulphur hexafluoride
SIAR	standard independent assessment report
t	tonne
TJ	terajoule (1 TJ = 10^{12} joule)
UNFCCC	United Nations Framework Convention on Climate Change
VS	volatile solids