



**Report of the individual review of the annual submission of the  
United Kingdom of Great Britain and Northern Ireland submitted in 2012**

**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 2012 was published on 16 July 2013. 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 decision 4/CMP.4), the report is considered received by the secretariat on the same date. This report, FCCC/ARR/2012/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  
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\* In the symbol for this document, 2012 refers to the year in which the inventory was submitted, and not to the year of publication.

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## I. Introduction and summary

1. This report covers the in-country review of the 2012 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 17 to 22 September 2012 in London, United Kingdom, and was conducted by the following team of nominated experts from the UNFCCC roster of experts: generalist – Ms. Helen Plume (New Zealand); energy – Mr. Joost Huurman (the Netherlands); industrial processes – Ms. Marisol Bacong (the Philippines); agriculture – Mr. Marcelo Rocha (Brazil); land use, land-use change and forestry (LULUCF) – Mr. Sandro Federici (San Marino); and waste – Ms. Mayra Rocha (Brazil). Ms. Plume and Mr. Rocha were the lead reviewers. The review was coordinated by Ms. Sylvie Marchand and Mr. Javier Hanna (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.

3. In 2010, the main greenhouse gas (GHG) in the United Kingdom was carbon dioxide (CO<sub>2</sub>), accounting for 84.4 per cent of total GHG emissions<sup>1</sup> expressed in carbon dioxide equivalent (CO<sub>2</sub> eq), followed by methane (CH<sub>4</sub>) (7.1 per cent) and nitrous oxide (N<sub>2</sub>O) (5.9 per cent). Hydrofluorocarbons (HFCs), perfluorocarbons (PFCs) and sulphur hexafluoride (SF<sub>6</sub>) collectively accounted for 2.5 per cent of the overall GHG emissions in the country. The energy sector accounted for 84.8 per cent of total GHG emissions, followed by the agriculture sector (7.8 per cent), the industrial processes sector (4.5 per cent) and the waste sector (3.0 per cent). Total GHG emissions amounted to 599,105.48 Gg CO<sub>2</sub> eq and decreased by 22.7 per cent between the base year<sup>2</sup> and 2010. The main contributors to the decreasing emissions trend are the fuel switch from coal to natural gas and the reduction in the energy intensity of the national economy; the downward trend in livestock numbers and the reduction in fertilizer use in the agriculture sector; and the introduction of abatement technologies in adipic acid and halocarbon production in the industrial processes sector.

4. Tables 1 and 2 show GHG emissions from 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, Article 3, paragraph 4, of the Kyoto Protocol (KP-LULUCF), by gas and by sector and activity, respectively. In table 1, CO<sub>2</sub>, CH<sub>4</sub> and N<sub>2</sub>O emissions included in the rows under Annex A sources do not 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. Tables 3–5 provide information on the most important emissions and removals and accounting parameters that will be included in the compilation and accounting database.

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<sup>1</sup> In this report, the term “total GHG emissions” refers to the aggregated national GHG emissions expressed in terms of CO<sub>2</sub> eq excluding LULUCF, unless otherwise specified.

<sup>2</sup> “Base year” refers to the base year under the Kyoto Protocol, which is 1990 for CO<sub>2</sub>, CH<sub>4</sub> and N<sub>2</sub>O, and 1995 for HFCs, PFCs and SF<sub>6</sub>. The base year emissions include emissions from Annex A sources only.

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<sup>a</sup> to 2010<sup>b</sup>**

	Greenhouse gas	Gg CO <sub>2</sub> eq								Change Base year–2010 (%)
		Base year <sup>a</sup>	1990	1995	2000	2005	2008	2009	2010	
Annex A sources	CO <sub>2</sub>	591 158.76	591 158.76	554 170.37	555 442.50	559 954.81	538 715.42	487 888.50	505 727.86	–14.5
	CH <sub>4</sub>	99 029.31	99 029.31	85 519.52	65 659.80	48 708.10	44 667.47	43 404.88	42 704.02	–56.9
	N <sub>2</sub> O	67 556.77	67 556.77	57 107.85	45 739.94	40 704.71	36 969.68	34 976.67	35 449.06	–47.5
	HFCs	15 327.65	11 385.62	15 327.65	9 321.55	12 062.05	13 620.81	13 965.23	14 314.07	–6.6
	PFCs	461.81	1 401.60	461.81	464.94	258.81	205.83	144.50	220.47	–52.3
	SF <sub>6</sub>	1 239.30	1 029.95	1 239.30	1 798.48	1 110.38	711.77	661.80	689.99	–44.3
KP-LULUCF	Article 3.3 <sup>c</sup>	CO <sub>2</sub>					–1 815.64	–2 261.33	–2 248.77	
		CH <sub>4</sub>					28.47	16.63	22.29	
		N <sub>2</sub> O					5.15	3.73	4.36	
	Article 3.4 <sup>d</sup>	CO <sub>2</sub>	NA				–10 721.70	–9 790.73	–7 497.56	NA
		CH <sub>4</sub>	NA				11.60	7.41	6.32	NA
		N <sub>2</sub> O	NA				1.18	0.75	0.64	NA

*Abbreviations:* 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.

<sup>a</sup> “Base year” for Annex A sources refers to the base year under the Kyoto Protocol, which is 1990 for CO<sub>2</sub>, CH<sub>4</sub> and N<sub>2</sub>O, and 1995 for HFCs, PFCs and SF<sub>6</sub>. The “base year” for activities under Article 3, paragraphs 3 and 4, of the Kyoto Protocol is 1990.

<sup>b</sup> The table does not reflect the adjusted estimates for road transportation in the energy sector (see chapter II.G below) after adjustment procedures under decision 20/CMP.1 were applied. It reflects the estimates contained in the Party’s submission of 5 November 2012 that was subject to these adjustments. The adjustments lead to an increase in total greenhouse gas emissions of 318.22 Gg CO<sub>2</sub> eq for 2008, of 282.12 Gg CO<sub>2</sub> eq for 2009 and of 309.12 Gg CO<sub>2</sub> eq for 2010.

<sup>c</sup> Activities under Article 3, paragraph 3, of the Kyoto Protocol, namely afforestation and reforestation, and deforestation. Only the inventory years of the commitment period must be reported.

<sup>d</sup> Elected activities under Article 3, paragraph 4, of the Kyoto Protocol, including forest management, cropland management, grazing land management and revegetation. For cropland management, grazing land management and revegetation, the base year and the inventory years of the commitment period must be reported.

Table 2

Greenhouse gas emissions by sector and activity, base year<sup>a</sup> to 2010<sup>b</sup>

Sector	Gg CO <sub>2</sub> eq								Change	
	Base year <sup>d</sup>	1990	1995	2000	2005	2008	2009	2010	Base year–2010 (%)	
Annex A	Energy	612 006.02	612 006.02	569 423.54	562 506.91	561 023.64	537 918.33	490 808.78	507 746.13	–17.0
	Industrial processes	57 360.18	54 148.57	46 438.11	31 677.02	30 618.80	30 801.45	25 478.06	26 821.89	–53.2
	Solvent and other product use	NE, NO	NE, NO	NE, NO	NE, NO	NE, NO	NE, NO	NE, NO	NE, NO	NA
	Agriculture	57 949.45	57 949.45	56 510.84	53 341.88	50 648.30	46 937.85	46 254.60	46 647.04	–19.5
	Waste	47 457.96	47 457.96	41 454.01	30 901.40	20 508.12	19 233.34	18 500.15	17 890.42	–62.3
	LULUCF	NA	3 893.01	2 465.48	377.26	–2 944.91	–3 882.43	–4 207.83	–3 842.40	NA
<b>Total (with LULUCF)</b>	<b>NA</b>	<b>775 455.01</b>	<b>716 291.98</b>	<b>678 804.48</b>	<b>659 853.95</b>	<b>631 008.54</b>	<b>576 833.76</b>	<b>595 263.08</b>	<b>NA</b>	
<b>Total (without LULUCF)</b>	<b>774 773.61</b>	<b>771 562.00</b>	<b>713 826.50</b>	<b>678 427.22</b>	<b>662 798.86</b>	<b>634 890.97</b>	<b>581 041.58</b>	<b>599 105.48</b>	<b>–22.7</b>	
Other <sup>c</sup>	NA	NA	NA	NA	NA	NA	NA	NA	NA	
KP-LULUCF	Article 3.3 <sup>d</sup>	Afforestation and reforestation					–2 660.44	–2 802.77	–2 956.10	
		Deforestation					878.43	561.80	733.97	
		<b>Total (3.3)</b>					<b>–1 782.01</b>	<b>–2 240.97</b>	<b>–2 222.13</b>	
	Article 3.4 <sup>e</sup>	Forest management					–10 708.92	–9 782.57	–7 490.60	
		Cropland management	NA				NA	NA	NA	NA
		Grazing land management	NA				NA	NA	NA	NA
		Revegetation	NA				NA	NA	NA	NA
<b>Total (3.4)</b>	<b>NA</b>					<b>–10 708.92</b>	<b>–9 782.57</b>	<b>–7 490.60</b>	<b>NA</b>	

*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.

<sup>a</sup> “Base year” for Annex A sources refers to the base year under the Kyoto Protocol, which is 1990 for CO<sub>2</sub>, CH<sub>4</sub> and N<sub>2</sub>O, and 1995 for HFCs, PFCs and SF<sub>6</sub>. The “base year” for activities under Article 3, paragraphs 3 and 4, of the Kyoto Protocol is 1990.

<sup>b</sup> The table does not reflect the adjusted estimates for road transportation in the energy sector (see chapter II.G below) after adjustment procedures under decision 20/CMP.1 were applied. It reflects the estimates contained in the Party’s submission of 5 November 2012 that was subject to these adjustments. The adjustments lead to an increase in total GHG emissions of 318.22 Gg CO<sub>2</sub> eq for 2008, of 282.12 Gg CO<sub>2</sub> eq for 2009 and of 309.12 Gg CO<sub>2</sub> eq for 2010.

<sup>c</sup> 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 the national totals.

<sup>d</sup> Activities under Article 3, paragraph 3, of the Kyoto Protocol, namely afforestation and reforestation, and deforestation. Only the inventory years of the commitment period must be reported.

<sup>e</sup> Elected activities under Article 3, paragraph 4, of the Kyoto Protocol, including forest management, cropland management, grazing land management and revegetation. For cropland management, grazing land management and revegetation, the base year and the inventory years of the commitment period must be reported.

Table 3  
**Information to be included in the compilation and accounting database in t CO<sub>2</sub> eq for the year 2010, including the commitment period reserve**

	<i>As reported</i>	<i>Revised estimates</i>	<i>Adjustment<sup>a</sup></i>	<i>Final<sup>b</sup></i>
<b>Commitment period reserve</b>	3 070 872 567	2 995 527 381		2 997 072 992
<b>Annex A emissions for current inventory year</b>				
CO <sub>2</sub>	502 383 205	505 727 865		505 727 865
CH <sub>4</sub>	41 418 306	42 704 023	9 922	42 713 945
N <sub>2</sub> O	34 995 458	35 449 058	299 200	35 748 259
HFCs	14 314 070			14 314 070
PFCs	220 472			220 472
SF <sub>6</sub>	689 988			689 988
<b>Total Annex A sources</b>	<b>594 021 499</b>	<b>599 105 476</b>	<b>309 122</b>	<b>599 414 598</b>
<b>Activities under Article 3, paragraph 3, for current inventory year</b>				
3.3 Afforestation and reforestation on non-harvested land for current year of commitment period as reported	-2 956 101			-2 956 101
3.3 Afforestation and reforestation on harvested land for current year of commitment period as reported		NO		NO
3.3 Deforestation for current year of commitment period as reported	733 973			733 973
<b>Activities under Article 3, paragraph 4, for current inventory year<sup>c</sup></b>				
3.4 Forest management for current year of commitment period	-7 490 599			-7 490 599
3.4 Cropland management for current year of commitment period				
3.4 Cropland management for base year				
3.4 Grazing land management for current year of commitment period				
3.4 Grazing land management for base year				
3.4 Revegetation for current year of commitment period				
3.4 Revegetation in base year				

*Abbreviation:* NO = not occurring.

<sup>a</sup> "Adjustment" is relevant only for Parties for which the expert review team has calculated one or more adjustment(s).



<sup>b</sup> “Final” includes revised estimates, if any, and/or adjustments, if any.

<sup>c</sup> Activities under Article 3, paragraph 4, are relevant only for Parties that elected one or more such activities.

Table 4  
**Information to be included in the compilation and accounting database in t CO<sub>2</sub> eq for the year 2009**

	<i>As reported</i>	<i>Revised estimates</i>	<i>Adjustment<sup>a</sup></i>	<i>Final<sup>b</sup></i>
<b>Annex A emissions for 2009</b>				
CO <sub>2</sub>	484 724 796	487 888 497		487 888 497
CH <sub>4</sub>	42 107 455	43 404 883	10 135	43 415 018
N <sub>2</sub> O	34 523 244	34 976 668	271 984	35 248 653
HFCs	13 965 230			13 965 230
PFCs	144 501			144 501
SF <sub>6</sub>	661 804			661 804
<b>Total Annex A sources</b>	<b>576 127 030</b>	<b>581 041 584</b>	<b>282 119</b>	<b>581 323 702</b>
<b>Activities under Article 3, paragraph 3, for 2009</b>				
3.3 Afforestation and reforestation on non-harvested land for 2009 as reported	-2 802 767			-2 802 767
3.3 Afforestation and reforestation on harvested land for 2009 as reported		NO		NO
3.3 Deforestation for 2009 as reported	561 798			561 798
<b>Activities under Article 3, paragraph 4, for 2009<sup>c</sup></b>				
3.4 Forest management for 2009	-9 782 567			-9 782 567
3.4 Cropland management for 2009				
3.4 Cropland management for base year				
3.4 Grazing land management for 2009				
3.4 Grazing land management for base year				
3.4 Revegetation for 2009				
3.4 Revegetation in base year				

*Abbreviation:* NO = not occurring.

<sup>a</sup> “Adjustment” is relevant only for Parties for which the expert review team has calculated one or more adjustment(s).

<sup>b</sup> “Final” includes revised estimates, if any, and/or adjustments, if any.

<sup>c</sup> Activities under Article 3, paragraph 4, are relevant only for Parties that elected one or more such activities.

Table 5  
**Information to be included in the compilation and accounting database in t CO<sub>2</sub> eq for  
the year 2008**

	<i>As reported</i>	<i>Revised estimates</i>	<i>Adjustment<sup>a</sup></i>	<i>Final<sup>b</sup></i>
<b>Annex A emissions for 2008</b>				
CO <sub>2</sub>	535 627 026	538 715 416		538 715 416
CH <sub>4</sub>	43 151 728	44 667 465	16 613	44 684 079
N <sub>2</sub> O	36 514 614	36 969 681	301 611	37 271 291
HFCs	13 620 813			13 620 813
PFCs	205 825			205 825
SF <sub>6</sub>	711 768			711 768
<b>Total Annex A sources</b>	<b>629 831 775</b>	<b>634 890 968</b>	<b>318 224</b>	<b>635 209 192</b>
<b>Activities under Article 3, paragraph 3, for 2008</b>				
3.3 Afforestation and reforestation on non-harvested land for 2008 as reported	-2 660 438			-2 660 438
3.3 Afforestation and reforestation on harvested land for 2008 as reported		NO		NO
3.3 Deforestation for 2008 as reported	878 430			878 430
<b>Activities under Article 3, paragraph 4, for 2008<sup>c</sup></b>				
3.4 Forest management for 2008	-10 708 920			-10 708 920
3.4 Cropland management for 2008				
3.4 Cropland management for base year				
3.4 Grazing land management for 2008				
3.4 Grazing land management for base year				
3.4 Revegetation for 2008				
3.4 Revegetation in base year				

*Abbreviation:* NO = not occurring.

<sup>a</sup> "Adjustment" is relevant only for Parties for which the expert review team has calculated one or more adjustment(s).

<sup>b</sup> "Final" includes revised estimates, if any, and/or adjustments, if any.

<sup>c</sup> Activities under Article 3, paragraph 4, are relevant only for Parties that elected one or more such activities.

## II. Technical assessment of the annual submission

### A. Overview

#### 1. Annual submission and other sources of information

6. The 2012 annual inventory submission was submitted on 13 April 2012; it contains a complete set of common reporting format (CRF) tables for the period 1990–2010 and a national inventory report (NIR). The United Kingdom also submitted 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 13 April 2012. The annual submission was submitted in accordance with decision 15/CMP.1.

7. The United Kingdom officially submitted revised emission estimates on 5 November 2012 in response to questions raised by the expert review team (ERT) during the course of the in-country visit (see paras. 10 and 11 below). The overall impact of these revised estimates is an increase in total GHG emissions of 5,083.98 Gg CO<sub>2</sub> eq (0.9 per cent) for 2010 and an increase of 4,302.24 Gg CO<sub>2</sub> eq (0.6 per cent) for 1990. The values in this report are based on those contained in the submission of 5 November 2012.

8. The ERT also used previous years' submissions during the review. In addition, the ERT used the standard independent assessment report (SIAR), parts I and II, to review information on the accounting of Kyoto Protocol units (including the SEF tables and their comparison report) and on the national registry.<sup>3</sup>

9. During the review, the United Kingdom provided the ERT with additional information. The documents concerned are not part of the annual submission but are in many cases referenced in the NIR. The full list of materials used during the review is provided in annex I to this report.

#### Completeness of inventory

10. The inventory covers all mandatory<sup>4</sup> source and sink categories for the period 1990–2010, and is complete in terms of sectors, categories, gases and years. The ERT commends the United Kingdom for its efforts to improve the geographical coverage of the inventory with the inclusion of further information and data on the emissions and removals from the overseas territories (OTs) and crown dependencies (CDs), in response to the recommendations made in previous review reports. During the review, the ERT identified that, for some categories, there are still some small gaps in the reporting of emissions from

<sup>3</sup> The SIAR, parts I and II, is prepared by an independent assessor in line with decision 16/CP.10 (paras. 5(a), and 6(c) and (k)), under the auspices of the international transaction log administrator using procedures agreed in the Registry System Administrators Forum. Part I is a completeness check of the submitted information relating to the accounting of Kyoto Protocol units (including the SEF tables and their comparison report) and to national registries. Part II contains a substantive assessment of the submitted information and identifies any potential problem regarding information on the accounting of Kyoto Protocol units and the national registry.

<sup>4</sup> Mandatory source and sink categories under the Kyoto Protocol are all source and sink categories for which 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* and the IPCC *Good Practice Guidance for Land Use, Land-Use Change and Forestry* provide methodologies and/or emission factors to estimate GHG emissions.

the OTs and CDs, leading to an underestimation of N<sub>2</sub>O emissions from agricultural soils and of CH<sub>4</sub> emissions from solid waste disposal on land. The ERT recommended that the United Kingdom provide these estimates. In addition, the ERT identified that, in most sectors, there are some categories for which the emission estimates are not fully in line 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 *Revised 1996 IPCC Guidelines for National Greenhouse Gas Inventories* (hereinafter referred to as the Revised 1996 IPCC Guidelines), thereby leading to a potential underestimation of emissions. These identified categories are the following:

(a) In the energy sector: CO<sub>2</sub> emissions from public electricity and heat production; CO<sub>2</sub>, CH<sub>4</sub> and N<sub>2</sub>O emissions from chemicals; CH<sub>4</sub> and N<sub>2</sub>O emissions from road transportation; CO<sub>2</sub>, CH<sub>4</sub> and N<sub>2</sub>O emissions from navigation; and CO<sub>2</sub>, CH<sub>4</sub> and N<sub>2</sub>O emissions from agriculture/forestry/fisheries;

(b) In the industrial processes sector: CO<sub>2</sub> emissions from ammonia production; and CH<sub>4</sub> emissions from other (chemical industry (all));

(c) In the agriculture sector: N<sub>2</sub>O emissions from cultivation of histosols;

(d) In the waste sector: CH<sub>4</sub> emissions from industrial wastewater; and CO<sub>2</sub> and N<sub>2</sub>O emissions from waste incineration.

11. 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 these categories (see paras. 39, 72, 96 and 120 below), with the exception of CH<sub>4</sub> and N<sub>2</sub>O emissions from road transportation (see para. 63 below) and CO<sub>2</sub> emissions from ammonia production (see para. 72 below). The impact of the revised estimates is an increase in estimated total GHG emissions of 5,083.98 Gg CO<sub>2</sub> eq, or 0.8 per cent, for 2010. The ERT agreed with the revised emission estimates. However, the ERT considered that the United Kingdom did not provide clear and sufficient justification for not providing revised emission estimates for CH<sub>4</sub> and N<sub>2</sub>O emissions from road transportation. Taking this into account and in accordance with the Article 8 review guidelines, the ERT decided to recommend adjustments for CH<sub>4</sub> and N<sub>2</sub>O emissions from road transportation (see paras. 123–140 below).

12. The ERT notes that emissions from the solvent and other product use sector have been reported as not occurring (“NO”) or not estimated (“NE”) for the complete time series. The ERT therefore encourages the United Kingdom to report CO<sub>2</sub> and N<sub>2</sub>O emissions from solvent and other product use in its next annual submission.

## **2. A description of the institutional arrangements for inventory preparation, including the legal and procedural arrangements for inventory planning, preparation and management**

### Overview

13. The ERT concluded that the national system continued to perform its required functions.

14. The United Kingdom described the changes to the national system since the previous annual submission and these changes are discussed in chapter II.H below. The changes are minor and relate to the awarding of a new contract for the role of the inventory agency to a consortium led by AEA, and to the organization of the team responsible for the preparation of the inventory for the agriculture sector.

### Inventory planning

15. During the in-country review, the United Kingdom explained the national system and institutional arrangements for the preparation of the GHG inventory. The Department of Energy and Climate Change (DECC) is the designated single national entity with overall responsibility for the GHG inventory. DECC is responsible for the institutional, legal and procedural arrangements for the national system and for the strategic development of the national inventory. Within DECC, the Climate, Energy, Science and Analysis (CESA) Division administers this responsibility, coordinating expertise across government agencies and administering research contracts. Under contract to DECC, the inventory agency is a consortium led by AEA of AEA Technology plc, and, as such, is responsible for all aspects of national GHG inventory preparation, reporting and quality management. Rothamsted Research and the United Kingdom Centre for Ecology and Hydrology (CEH) are involved in the preparation of the inventory for the agriculture and LULUCF sectors (including the KP-LULUCF activities), respectively. Key data providers for the inventory include a wide range of government departments, non-departmental public bodies and government agencies, private companies and industrial trade associations. In addition, DECC is in the process of setting up data supply agreements with relevant organizations. These agreements formalize the acquisition of data and clarify the main requirements of quality, format, data security and the timely delivery of data for the national GHG inventory. At the time of the in-country review, there were three data supply agreements in place with the Scottish Environmental Protection Agency (SEPA), the Northern Ireland Environment Agency (NIEA) and the Department for Transport (DfT).

16. DECC has established a formal cross-government body, the National Inventory Steering Committee (NISC), which approves the inventory prior to its submission to the UNFCCC secretariat. The role of NISC is to assist in the review and improvement of the inventory and to facilitate better communication between inventory stakeholders, including government departments and agencies. NISC is responsible for ensuring that the inventory meets the requirements of the “Guidelines for the preparation of national communications by Parties included in Annex I to the Convention, Part I: UNFCCC reporting guidelines on annual inventories” (hereinafter referred to as the UNFCCC reporting guidelines), the “Guidelines for the preparation of the information required under Article 7 of the Kyoto Protocol”, the Revised 1996 IPCC Guidelines and the IPCC good practice guidance regarding quality, accuracy and completeness, and that the inventory is submitted on time. The ERT considers that NISC is one of the strengths of the national system and recommends that the United Kingdom make better use of this coordination mechanism to ensure that there is good communication between all of the agencies/organizations/experts involved in the inventory preparation process, either at a primary level or as key data providers, to enable better understanding of the roles of, and relationships between, all of the agencies and data providers involved in the preparation of the GHG inventory, including the inventory agency. The ERT is of the view that such an approach would further strengthen the United Kingdom’s national system and reduce the opportunities for gaps and inconsistencies in its reporting. Further, the ERT considers that improved coordination is particularly important given the contractual arrangements between the single national entity and the inventory agency (i.e. the inventory agency is not within the government).

17. As noted in paragraph 16 above, NISC is responsible for agreeing the priorities for the United Kingdom’s inventory improvement programme. The ERT noted that there is some information in the NIR on the United Kingdom’s inventory improvement programme and the Party provided additional information to the ERT during the review on the improvement process. The ERT noted that the items identified by the United Kingdom for inclusion in the inventory improvement programme are based on recommendations from inventory reviews (e.g. European Union (EU), UNFCCC and bilateral reviews), on

information and advice from key stakeholders and inventory experts, on the availability of new data (e.g. European Union emissions trading system (EU ETS) data), and when periodically updated research becomes available. DECC, the inventory agency and sector experts work together to assign a priority level to each item in the inventory improvement programme. The full inventory improvement programme is presented to NISC annually, and agreement is sought on which tasks to take forward. The improvements may be dealt with as part of the annual inventory compilation cycle, or may require the commissioning of additional work. Higher priority is given to recommendations from UNFCCC or EU reviews, and to categories that are key (either due to the significance of the category, or to the uncertainty associated with the current emission estimates). The ERT recommends that the United Kingdom provide this additional information in the NIR of its next annual submission.

18. The NIR provides a summary of the improvements completed in time for the 2012 annual submission, together with planned sectoral improvements, although the ERT notes that an overall inventory improvement plan is not reported in the NIR. The full inventory improvement plan was provided to the ERT during the review, showing how the recommendations from reviews are being incorporated into the improvement programme, and the priority and timing of their implementation. The ERT concludes that the inventory improvement plan is comprehensive and recommends that the United Kingdom include the plan in the NIR of its next annual submission. Further, the ERT encourages the United Kingdom to present the plan in a tabular format, such as that provided to the ERT during the review.

#### Inventory preparation

##### *Key categories*

19. The United Kingdom has reported a tier 2 key category analysis, both level and trend assessments, as part of its 2012 submission. The key category analysis performed by the Party and that performed by the secretariat<sup>5</sup> produced different results because the United Kingdom used a tier 2 analysis, which incorporates the estimates of its uncertainty analysis, and because the Party used a different level of disaggregation for the categories. The United Kingdom has included the LULUCF sector in its key category analysis, which was performed in accordance with 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). In addition, the United Kingdom has identified key categories for activities under Article 3, paragraphs 3 and 4, of the Kyoto Protocol, both for 1990 and for 2010.

20. In its NIR, the United Kingdom states that the results of the key category analysis are used to prioritize the development and improvement of the inventory. The approach taken by the United Kingdom with respect to the improvement process is described in the NIR and was further elaborated during the review week (see para. 17 above). In response to a recommendation in the previous review report, the United Kingdom has also introduced a qualitative approach to the key category assessment to ensure that important categories are identified. This qualitative approach is described in the NIR, and, during the review, the

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<sup>5</sup> The secretariat identified, for each Party, the categories that are key categories in terms of their absolute level of emissions, applying the tier 1 level assessment as described in the IPCC *Good Practice Guidance for Land Use, Land-Use Change and Forestry*. Key categories according to the tier 1 trend assessment were also identified for Parties that provided a full set of CRF tables for the base year or period. Where the Party performed a key category analysis, the key categories presented in this report follow the Party's analysis. However, they are presented at the level of aggregation corresponding to a tier 1 key category assessment conducted by the secretariat.

ERT learned that mitigation technologies (either in use or planned) and the expected growth in emissions are taken into account in the qualitative assessment. The ERT recommends that the United Kingdom include this further brief explanation of the items covered in the qualitative approach in the NIR of its next annual submission. The ERT further notes that the key category analysis summary tables in the annex to the NIR are incomplete (i.e. column C is not filled in), which hinders the process of reconciling the information between the tables in the annex and in the tables in chapter 1.5.1 of the NIR. The ERT therefore recommends that the United Kingdom improve the presentation of the key category assessment information in its next annual submission.

#### *Uncertainties*

21. In the NIR, the United Kingdom reported that tier 1 and tier 2 uncertainty analyses have been performed in accordance with the IPCC good practice guidance. The results of these analyses are presented at a summary level and at the individual category level, both including and excluding the LULUCF sector, and are used to prioritize the use of resources for inventory improvements. Annex 7 to the NIR contains extensive information on the uncertainty analyses, including on the uncertainty analyses of emission factors (EFs) and activity data (AD). The tier 2 analysis (including LULUCF) produces a combined uncertainty of 15 per cent for 1990 and 16 per cent for 2010. This analysis indicates that there is a 95 per cent probability that the total emissions in the latest inventory year were between 21 per cent and 26 per cent below the level in 1990 (trend uncertainty). The category with the largest contribution to the total uncertainty is N<sub>2</sub>O emissions from agricultural soils. A separate uncertainty analysis has been undertaken for the key categories for the KP-LULUCF activities. The results indicate that the land-use change data are the biggest source of uncertainty for the KP-LULUCF activities; however, this analysis has not yet produced a single uncertainty estimate for the reporting of all KP-LULUCF activities. In the interim, the United Kingdom reports an uncertainty of 25 per cent for afforestation/reforestation, an uncertainty of 50 per cent for deforestation (based on expert judgement) and an uncertainty of 25 per cent (level) for forest management (as estimated for the category forest land).

#### *Recalculations and time-series consistency*

22. Recalculations have been performed and reported by the United Kingdom in accordance with the IPCC good practice guidance for the complete time series (1990–2009). The NIR reports that there are internal procedures (through NISC) for approving the recalculations prior to their inclusion in the inventory. The ERT noted that the most significant recalculations reported by the Party have been undertaken to take into account improvements to the model for estimating emissions from solid waste disposal on land and a revision of the model for estimating emissions from refrigeration and air-conditioning equipment. For later years of the time series the United Kingdom has performed recalculations to take into account significant revisions to the national fuel-use statistics. Other recalculations have been made as a result of: a change to the method used to calculate N<sub>2</sub>O emissions from agricultural soils (following an adjustment during the 2011 annual review); revisions and updates of livestock population numbers; and new afforestation and deforestation AD. The magnitude of the impact is the following: a decrease in estimated total GHG emissions in 1990 (1.56 per cent) and an increase in 2009 (1.06 per cent). The rationale for these recalculations is provided in the NIR and in CRF table 8(b). The ERT considers that the recalculations represent a real improvement to the inventory. However, the ERT finds that the reporting of the recalculations is not always transparent and that the recalculations are not always adequately explained in the NIR (e.g. the agriculture and waste sectors, see paras. 83 and 114 below) and recommends that the United Kingdom include clearer explanations of the recalculations in the NIR of its next annual submissions.

23. The emission estimates provided by the United Kingdom are generally time-series consistent, and, where they are not, explanations are provided. However, the emission estimates for some sectors are not fully time-series consistent (e.g. in the industrial processes sector, see paras. 70 and 74 below) in instances where data availability is limited, typically in the early part of the reported time series. The ERT noted that the inventory agency used interpolation and extrapolation of available data in order to provide estimates that are neither systematically underestimated nor overestimated, applying methods in line with the Revised 1996 IPCC Guidelines. However, the ERT recommends that the United Kingdom, in its next annual submission, improve the time-series consistency of the inventory by implementing new research activities to seek improved AD, as noted in the NIR and explained during the review. Where full time-series consistency is not possible, the ERT recommends that the United Kingdom provide further explanations in the NIR of its next annual submission in order to improve the transparency of the data and methods across the time series.

*Verification and quality assurance/quality control approaches*

24. The United Kingdom has elaborated a quality assurance/quality control (QA/QC) plan in accordance with the IPCC good practice guidance and the annex to decision 19/CMP.1. The QA/QC plan is very well described in the NIR and the ERT commends the use of bilateral/trilateral reviews in the preparation of the inventory improvement plan. The QA/QC plan, as described in the NIR, is in line with the IPCC good practice guidance; however, the ERT found that there are still a number of inconsistencies and minor errors between the data reported in the NIR and in the CRF tables, indicating that the implementation of the QA/QC plan could be further improved. The ERT encourages the United Kingdom to pay more attention to the quality of the final submission (both the CRF tables and the NIR), and, building on the recommendation from the previous review report, also encourages the United Kingdom to strengthen the QC procedures during the inventory compilation process, and recommends that the United Kingdom ensure that the QC procedures are applied consistently to the whole inventory preparation and reporting process.

*Transparency*

25. Although the NIR and its annexes contain a significant amount of information on emission trends and methodologies, it is not always possible to easily understand the approaches taken by the United Kingdom and the methodologies applied (e.g. in iron and steel production and nitric acid production in the industrial processes sector, and more generally in the energy sector), as the information is not well structured (e.g. the explanations are sometimes provided in the NIR and sometimes provided in the annexes). The ERT notes that much of the information presented could be streamlined and the ERT recommends that the United Kingdom focus on this matter and continue to improve the transparency of the NIR in its next annual submission. The United Kingdom informed the ERT during the review that it is currently in the process of restructuring its NIR, in particular by ensuring that material in the annexes relates more closely to the main text of the NIR. The ERT encourages the United Kingdom to make efforts in this regard, and further encourages the United Kingdom to consider which parts of the NIR and annexes are essential and which parts might exist only in referenced or linked documents. The ERT noted that there are also a large number of instances where the incorrect notation key has been used (e.g. the notation key not applicable (“NA”) is used instead of the notation key “NO” to report some emissions in the energy sector). Reiterating and building on a recommendation in the previous review report on the use of notation keys, the ERT recommends that the United Kingdom undertake a review of its use of notation keys to ensure that the correct notation keys are being applied. In addition, the ERT recommends



that the United Kingdom ensure that use of the notation key included elsewhere (“IE”) is fully transparent by providing adequate explanations of where the corresponding emissions have been included.

#### Inventory management

26. The United Kingdom has an archiving system, which includes the archiving of disaggregated EFs and 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 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. During the review, the United Kingdom indicated that, in addition to the centralized archive, both Rothamsted Research (for the agriculture sector) and CEH (for the LULUCF sector) retain, store and archive relevant data sets and models. The ERT recommends that the United Kingdom briefly describe the role that these two agencies have with respect to archiving in the NIR of its next annual submission. The United Kingdom was able to provide archived documents requested by the ERT during the review, including confidential data according to national procedures.

### **3. Follow-up to previous reviews**

27. The ERT noted that section 1.2.2.5 of the NIR provides information on how the United Kingdom has followed up on the cross-cutting recommendations for improvement in the previous review report. This information is provided in a very useful tabular format (table 10-4 of the NIR) as it enhances the transparency of the reporting and facilitates the review process. During the review, the United Kingdom provided the ERT with further information on how it is addressing the sector-level recommendations. The ERT concluded that many of the recommendations have been addressed either in the 2012 annual submission, or by inclusion in the inventory improvement plan discussed in paragraph 17 above. The ERT recommends that, in order to continue enhancing the transparency of its reporting, the United Kingdom provide a table in the NIR of its next annual submission that contains all of the recommendations included in table 8 of this report (see para. 168 below), together with a short explanation and/or reference to the appropriate section of the NIR in which the recommendation is addressed, including in the inventory improvement plan, as appropriate. Such a table would increase the transparency of the NIR and would also further facilitate its review.

28. Major improvements made in the 2012 annual submission are described in section 10.4.2 of the NIR. The main methodological changes include: a revision of the emission estimates for solid waste disposal on land, where a number of inconsistencies and errors were corrected; a correction to the method used to estimate N<sub>2</sub>O emissions from wastewater treatment; a revision of the split between domestic and international navigation; revisions to the model used to estimate emissions from refrigeration and air-conditioning equipment; and a correction of the method used to estimate N<sub>2</sub>O emissions from agricultural soils.

29. 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 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. Although the United Kingdom mentions in the NIR that adjustments from the 2010 review cycle were subsequently replaced by recalculations in the 2011 annual submission, the Party does not explicitly mention in the 2012 annual submission that the agricultural soils category (N<sub>2</sub>O emissions from animal manure applied to soils, pasture, range and paddock manure, atmospheric deposition and nitrogen (N) leaching and run-off) was adjusted during the 2011 review cycle, although it is clear in the NIR that recalculations have been made for this previously adjusted category (see para. 83 below). The ERT strongly reiterates the recommendation in the previous review report that the United Kingdom include explicit information in the NIR whenever adjustments have been applied to the inventory, explaining how the United Kingdom has responded to the adjustments in subsequent inventories.

30. The ERT identified the following recommendations from the previous review report that are unresolved/unaddressed or not fully completed by the United Kingdom. It recognizes that while discussions on recommendations had taken place with the Party, the final 2011 annual review report was not received before the submission of the 2012 annual submission:

(a) In the energy sector: continuing to improve the use of comparable units for the AD and EFs (see para. 43(a) below);

(b) In the energy sector: investigating the reasons for the differences between the fuel consumption reported in the reference approach and the International Energy Agency (IEA) data and improving the related QC procedures (see para. 49 below);

(c) In the energy sector: providing additional information on the sectors and categories in which feedstocks are used and providing the references for the storage fractions (see para. 53 below);

(d) In the energy sector: studying the composition of municipal solid waste (MSW) to establish both a country-specific carbon content factor and a country-specific factor for the biogenic fraction and using IPCC default values until the results of the study become available (see para. 62 below);

(e) In the agriculture sector: revising the descriptions of the recalculations (see para. 83 below);

(f) In the LULUCF sector: including a full set of annual land-use transition matrices in the NIR (see para. 104 below);

(g) For the KP-LULUCF activities: including information in section 11.2.1 of the NIR on the spatial assessment unit used and, in accordance with the annex to decision 16/CMP.1, how it corresponds to the minimum land area and width requirements defined by the United Kingdom's forest definition, and hence the detection of land-use change at the scale consistent with the United Kingdom's forest definition (see para. 142 below);

(h) In the waste sector: improving the transparency of the inventory by providing information on the emission estimates for the OTs and CDs in the NIR and in the CRF tables (see para. 113 below);

(i) In the waste sector: improving the survey to update the CH<sub>4</sub> recovery rate, in order to avoid a possible overestimation of recovered CH<sub>4</sub>, and providing detailed information on the corresponding data (see para. 116 below);

(j) In the waste sector: improving the description of N<sub>2</sub>O emissions from human sewage in the NIR (see para. 117 below);

(k) Cross-cutting: applying the QC procedures consistently to the whole inventory preparation and reporting process (see para. 24 above);

(l) Cross-cutting: undertaking a review of the use of the notation keys to ensure that the correct notation keys are being applied, and ensuring that use of the notation key “IE” is fully transparent by providing adequate explanations of where the corresponding emissions have been included (see para. 25 above);

(m) Cross-cutting: including explicit information in the NIR whenever adjustments have been applied to the inventory to explain how the Party has responded to the adjustments in subsequent inventories (see para. 29 above);

(n) Article 3, paragraph 14, of the Kyoto Protocol: including information on changes to previously reported information (see para. 155 below).

#### **4. Areas for further improvement identified by the expert review team**

31. During the review, the ERT identified a number of areas for improvement. These are listed in table 8 below.

32. Recommended improvements relating to specific categories are presented in the relevant sector chapters of this report and in table 8 below.

## **B. Energy**

### **1. Sector overview**

33. The energy sector is the main sector in the GHG inventory of the United Kingdom. In 2010, emissions from the energy sector amounted to 507,746.13 Gg CO<sub>2</sub> eq, or 84.8 per cent of total GHG emissions. Since 1990, emissions have decreased by 17.0 per cent. The key drivers for the fall in emissions are:

(a) The switch from solid fuels to gaseous fuels;

(b) The reduced energy intensity of the economy (i.e. the switch from industrial production to services);

(c) The economic crisis in recent years.

34. Within the sector, 38.2 per cent of the emissions were from energy industries, followed by 23.6 per cent from transport and 21.5 per cent from other sectors. Manufacturing industries and construction accounted for 13.9 per cent and fugitive emissions from fuels accounted for 2.3 per cent. The remaining 0.6 per cent were from other (mobile military use).

35. The United Kingdom has made recalculations for the energy sector between the 2011 and 2012 annual submissions following changes in AD and EFs and in order to take account of revised AD, new research or to rectify identified errors. Recalculations have been made for the entire time series (1990–2009). The impact of these recalculations on the energy sector is an increase in emissions of 0.7 per cent for 2009 and of 0.1 per cent for 1990. The main recalculations took place in the following categories:

(a) CO<sub>2</sub>, CH<sub>4</sub> and N<sub>2</sub>O emissions from petroleum refining and other (manufacturing industries and construction), due to changes in the AD for other petroleum gases (OPGs) (see paras. 55 and 56 below);

(b) CO<sub>2</sub>, CH<sub>4</sub> and N<sub>2</sub>O emissions from diesel/gas oil in several categories (see para. 59 below), due to their reallocation from other (manufacturing industries and

construction) to the energy industries and manufacturing industries and construction subcategories based on new available data;

(c) CO<sub>2</sub>, CH<sub>4</sub> and N<sub>2</sub>O emissions from military use (other – mobile), due to the inclusion of AD for aviation gasoline and fuel classed as casual uplift;

(d) CO<sub>2</sub> emissions from solid fuels in manufacturing industries and construction, due to the use of updated calorific values for blast furnace gas and coke oven gas;

(e) CH<sub>4</sub> emissions from solid fuels, due to use of a new methodology for the estimation of emissions from closed coal mines (see para. 65 below).

36. The primary source of the AD for the energy sector is the data from the Digest of United Kingdom Energy Statistics (DUKES), compiled by DECC. These data are collected through existing and pre-defined surveys of companies importing, exporting, producing or selling primary energy or energy products. Data on final fuel use available to the inventory agency through DUKES are derived from these surveys. When new survey information becomes available, the DUKES data are revised back through the last five years of data (if necessary), but not for all years. In addition to the data from DUKES, the inventory agency uses other energy data available in the United Kingdom, such as data from the United Kingdom's Environmental and Emissions Monitoring System (EEMS) and the EU ETS, and other data sets from the petroleum refining, electricity production, cement and lime and iron and steel industries. These data are used in order to make more accurate and detailed estimates from the offshore industry and major energy users in the United Kingdom, but can cause inconsistencies with original official energy balance data sets. The ERT recommends that the United Kingdom make efforts to incorporate all available and/or updated energy information in DUKES, in order to ensure the consistency of all AD used in the energy sector. In addition, in order to improve the quality of the AD, the ERT recommends that the United Kingdom, through DECC, ensure that data on all energy consumption by all major energy-producing companies, apart from electricity and heat production and refinery activities (e.g. upstream oil and gas production and petrochemical plants), are included in the United Kingdom's energy balance in DUKES.

37. The EFs used by the United Kingdom are from various sources and are reported in the NIR or its annexes. The most important source for the CO<sub>2</sub> EFs is currently the *Review of Carbon Emission Factors in the United Kingdom Greenhouse Inventory* (Baggott et al., 2004), but the use of EFs from the EU ETS is increasing (see para. 41 below). The CH<sub>4</sub> and N<sub>2</sub>O EFs used by the United Kingdom are from CORINAIR (core inventory of air emissions), or are IPCC defaults or country-specific.

38. The United Kingdom mostly uses tier 2 and tier 3 methodologies in the energy sector. For coke production and the iron and steel industry, the Party uses a mass balance to estimate the CO<sub>2</sub> emissions. The ERT noted some differences between the information on the methods and EFs reported in CRF table Summary 3 and the detailed descriptions of the methodologies provided in the NIR. During the review, the United Kingdom informed the ERT that this CRF table would be updated in its next annual submission.

39. The GHG inventory for the energy sector is complete in terms of gases, years and categories, and almost complete in terms of geographical coverage. However, the ERT noted that some emission estimates were still missing or underestimated:

(a) CO<sub>2</sub>, CH<sub>4</sub> and N<sub>2</sub>O emissions from fishing outside United Kingdom waters are not estimated (see para. 60 below);

(b) CO<sub>2</sub>, CH<sub>4</sub> and N<sub>2</sub>O emissions from domestic navigation to and from the OTs are not estimated (see para. 64 below);

- (c) CO<sub>2</sub>, CH<sub>4</sub> and N<sub>2</sub>O emissions from the combustion of other petroleum gases in the petrochemical industry are underestimated (see paras. 55–57 below);
- (d) CH<sub>4</sub> and N<sub>2</sub>O emissions from the combustion of waste oils in electricity and heat production are not estimated;
- (e) CH<sub>4</sub> emissions from leakage of natural gas from cooking in the residential category are not estimated;
- (f) CH<sub>4</sub> and N<sub>2</sub>O emissions from road transportation are underestimated in some years of the time series (see para. 63 below);
- (g) CO<sub>2</sub> emissions from other fuels (MSW) in public electricity and heat production are underestimated (see paras. 61 and 62 below).

Therefore, during the review, the ERT recommended that the United Kingdom provide these emission estimates. 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 for these categories, with the exception of CH<sub>4</sub> and N<sub>2</sub>O emissions from road transportation (see para. 63 below) and categories indicated in points (d) and (e) above, since no EFs are available in the Revised 1996 IPCC Guidelines or in the IPCC good practice guidance. The impact of these revised estimates is an increase in emissions of 3,349.46 Gg CO<sub>2</sub> eq, or 0.7 per cent of total sectoral GHG emissions, for 2010. The ERT agreed with the revised emission estimates.

40. The NIR and its annexes contain a significant amount of information on emission trends, methodologies, AD and EFs. However, the ERT is of the opinion that a large quantity of information does not always improve, or allow for, transparency. Further, the amount of information provided in the NIR varies significantly for the different categories. During the review, the United Kingdom informed the ERT that the NIR is being restructured for the next annual submission. The ERT encourages the United Kingdom to use this opportunity to reassess the quantity of information provided in the NIR and carefully define what information could be provided in the NIR, in the annexes or through references to external sources.

41. The United Kingdom makes extensive use of EU ETS data in the energy sector. Access to both the data and the monitoring protocols is very well arranged to make this possible. The data are used for:

- (a) Identifying country-specific EFs, as only the highest-quality EFs available in the EU ETS data set are used for the emission estimates, and the previously used IPCC default EFs are disregarded;
- (b) Verifying the quality of the energy statistics;
- (c) Finding gaps in the energy statistics.

Therefore, the ERT encourages the United Kingdom to use these country-specific EFs, if they are properly verified in accordance with the IPCC good practice guidance. However, the ERT also highlights the fact that IPCC default EFs might be applicable to some companies or categories and should therefore not by design be excluded from the calculations. The ERT further noted that the energy statistics do not contain data on energy use at a company level; as such, this makes further use of the EU ETS data more difficult, since comparisons are only possible at the company level or for activities for which the coverage of installations reported within the EU ETS is complete and provides a direct comparison against the sectoral breakdown of the energy statistics. The ERT recommends that the United Kingdom, in its next annual submission, improve its use of EU ETS data within the GHG inventory estimates by ensuring that aggregated AD by fuel and category for EU ETS installations are included in the United Kingdom's energy balance in DUKES

and can be reconciled with the United Kingdom's energy statistics, in order to provide more complete and accurate energy use allocation for use in the GHG inventory across the time series.

42. In response to recommendations in previous review reports, the United Kingdom has provided a further breakdown of the energy use in manufacturing industries and construction for the most important fuels in its 2012 annual submission. The ERT commends the United Kingdom for its efforts in this regard, which have increased both the transparency and the comparability of its GHG inventory.

43. The major improvement resulting from the breakdown of the emissions from manufacturing industries and construction to the different subcategories has been the increased comparability of the United Kingdom's inventory for the energy sector with those of other reporting Parties. However, the ERT still noted a number of areas for further improvement in relation to comparability, including:

(a) The units used by the United Kingdom for the AD and EFs are different from those used by most other reporting Parties. The ERT acknowledges the improvements made in the 2012 annual submission, including the provision of EFs on an energy basis provided in the Excel file that was submitted alongside the NIR and is referenced below the tables of EFs in annex 3 to the NIR. However, the ERT recommends that the United Kingdom complete the improvement regarding the use of comparable units (e.g. t CO<sub>2</sub>/TJ for the carbon EFs and PJ for consumption of gaseous fuels);

(b) Emissions from the iron and steel category are calculated using a mass balance for different stages of the process and are allocated on that basis. However, for reasons of comparability, the ERT encourages the United Kingdom to highlight and report in the NIR which emission estimates are stable and which emission estimates are balancing items. This would further enable the ERT to assess which IEFs are reliable and which fluctuate due to uncertainties in the mass balance;

(c) N<sub>2</sub>O emissions from flaring of coke oven gas are not reported in CRF table 1.B.1 together with the accompanying CO<sub>2</sub> and CH<sub>4</sub> emissions, since it is technically not possible to report N<sub>2</sub>O emissions in CRF table 1.B.1. The emissions are, however, included in the national totals. The ERT encourages the United Kingdom to provide, in its next annual submission, a reference to these estimates in the documentation box of CRF table 1.B.1 (and in the NIR), including an explanation of the precise items reported under the solid fuel transformation subcategory.

44. The ERT noted that the QA/QC procedures applied during the compilation of the inventory seem to be limited to the process of estimating emissions. In response to questions raised by the ERT during the review on the energy sector, the national experts were able to provide the ERT with further clarification on the emission trends or on the specific allocation of emissions which appeared (among other things) to be available as a result of the documentation on the QA/QC procedures. Conversely, the QA/QC procedures performed by the United Kingdom in the context of completing the CRF tables appear to be limited to checks of reported emissions, with fewer checks on AD and notation keys, since the ERT noted several inconsistencies in different CRF tables. In addition, the ERT identified a number of places in the CRF tables where the notation keys used were incorrect. During the review, the United Kingdom recognized the need to improve the QA/QC procedures performed during the last step of compilation of the inventory. The ERT recommends that the United Kingdom implement its planned efforts in this regard in its next annual submission.

45. The ERT considers that the time-series consistency of the United Kingdom's inventory for the energy sector is good. Where possible, the AD, EFs and methodologies are consistent over the time series. Where it is not possible to maintain time-series

consistency, the United Kingdom has provided an explanation, and has applied extrapolations or interpolations in accordance with the IPCC good practice guidance.

46. The energy sector has several cross-sectoral links with both the industrial processes sector and the waste sector. The ERT noted that these links were not always sufficiently explicit in the inventory estimates. The ERT identified the following three specific issues:

(a) The CH<sub>4</sub> recovery from landfills reported in the waste sector did not correspond with the produced and combusted quantity of landfill gas reported in the energy sector;

(b) The CH<sub>4</sub> recovery from wastewater treatment installations reported in the waste sector did not correspond with the produced and combusted quantity of sewage sludge gas in the energy sector;

(c) The amount of natural gas used as feedstock reported in CRF table 1.A(d) did not correspond with the amount of natural gas reported under ammonia production in the industrial processes sector.

Therefore, the ERT recommends that the United Kingdom improve the consistency of the information reported in the different sectors in its next annual submission, in particular in relation to the cases indicated above.

47. During the review, the ERT identified the following issues for improvement:

(a) The incorporation of any relevant additional and/or updated energy information into DUKES, in order to ensure the consistency of all AD in the energy sector, noting the need to derive a consistent time series of AD;

(b) The improvement of the quality of the AD in the energy balance compiled by DECC by ensuring that all energy consumption by all major energy-producing companies, outside electricity and heat production and refinery activities (e.g. upstream oil and gas production and petrochemical plants) are included in the United Kingdom energy balance in DUKES;

(c) The continuation of improving the use of comparable units (e.g. t CO<sub>2</sub>/TJ for the carbon EFs and PJ for consumption of gaseous fuels) (this recommendation was also made in the previous review report);

(d) The improvement of the consistency of the information reported in the different sectors of the inventory (e.g. the waste and industrial processes sectors), in particular in relation to the cases indicated in paragraph 46(a)–(c) above;

(e) The investigation of the reasons for the differences between the reference approach and the sectoral approach and the improvement of the QC procedures conducted prior to the submission of the CRF tables (this recommendation was also made in the previous review report);

(f) The revision of the use of the notation key “NA” in the reference approach and closely following the definitions of the notation keys provided in the UNFCCC reporting guidelines;

(g) The provision of additional information on the categories where feedstocks are used (this recommendation was also made in the previous review report) and the inclusion of the references for the storage fractions;

(h) Reporting the CH<sub>4</sub> emissions from closed coal mines in the category other (fugitive emissions from solid fuels), in order to improve the transparency and comparability of the information on this category.

## 2. Reference and sectoral approaches

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

48. CO<sub>2</sub> emissions from fuel combustion were calculated using the reference approach and the sectoral approach. For 2010, there is a difference of 0.67 per cent in the CO<sub>2</sub> emission estimates between the reference approach and the sectoral approach. Explanations are provided in the documentation box of CRF table 1.A(c). In addition, the United Kingdom has provided in the NIR explanations for the fluctuations in the differences between the two approaches over the time series. Although the explanations have been significantly expanded since the 2011 annual submission, the ERT encourages the United Kingdom to include quantitative information on the known factors responsible for the differences (e.g. the difference in the definitions between the reference approach and the sectoral approach), as well as information on the country-specific EFs used. This information should preferably be presented in a tabular format, with separate explanations of the reasons for all differences observed. The ERT considers that this would provide better insights into the actual reasons for the differences between the two approaches and into ways of further reducing those differences, if possible.

49. The apparent consumption in the United Kingdom's reference approach corresponds closely to the IEA data. For 2010, there is a difference of 0.4 per cent in the total apparent consumption between the reference approach and the IEA data (the apparent consumption in the CRF tables is lower than that of the IEA data). For specific fuels, however, there are significant differences, especially for natural gas liquids (NGL). Both data sets are based on DUKES, and although there are some small definition issues regarding the inclusion of the OTs, this specific difference seems to be due to an editorial error in the CRF tables. The ERT reiterates the recommendation in the previous review report that the United Kingdom investigate the reasons for the differences and improve the QC procedures to be performed prior to the submission of the CRF tables.

50. The ERT noted that the United Kingdom uses the notation key "NA" in CRF table 1.A(b) for the reference approach for a large number of cells. During the review, the United Kingdom explained the ERT that it uses the notation key "NA" when activities have never occurred in the country. The ERT recommends that the United Kingdom reconsider this use of the notation key "NA" and closely follow the definitions of the notation keys provided in the UNFCCC reporting guidelines.

### *International bunker fuels*

51. The United Kingdom uses detailed flight information to separate the fuel used for domestic aviation and the fuel used for international flights. Since the 2011 annual submission, the estimates for domestic aviation also include fuel and emissions from flights to and from the OTs. However, the ERT noted that the energy data on aviation as reported to IEA are different from those reported in the CRF tables. This may be due to the different definitions used by DECC for reporting to IEA and the definitions used for the inventory estimates, but the United Kingdom has not provided an explanation in its NIR. The ERT encourages the United Kingdom to investigate the reason for these differences and ensure that the data submitted to IEA and the UNFCCC are the same, or that a sufficient explanation for the differences is provided.

52. To distinguish between emissions from national and international navigation, the United Kingdom uses a study prepared by Entec UK Ltd.<sup>6</sup> on the calculation of fuel consumption and emissions from shipping activities around the United Kingdom waters using a bottom-up procedure based on detailed shipping movement data for different vessel

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<sup>6</sup> DEFRA UK ships emissions inventory. 2010.



types, fuels and journeys. The shipping inventory developed by Entec UK Ltd. provides shipping estimates for journeys that can be classified as domestic, for journeys departing from or arriving at United Kingdom ports on international journeys and for journeys passing through United Kingdom shipping waters, but not stopping at United Kingdom ports or using United Kingdom fuels. Domestic journeys and fishing were subtracted from the total estimates for marine bunkers as reported by DUKES and the resulting AD were allocated as international navigation. Although this bottom-up approach is very thorough, the ERT noted that, since the scope of the Entec UK Ltd. study was limited to United Kingdom waters only, the AD and resulting emissions from fishing outside United Kingdom waters and from shipping movements to and from the OTs are not included in the relevant subcategories or in the national total. During the review, the ERT recommended that the United Kingdom estimate the emissions both for fishing outside United Kingdom waters and for shipping movements to and from the OTs, and include these emissions in the estimated total GHG emissions (see paras. 60 and 64 below).

#### *Feedstocks and non-energy use of fuels*

53. In response to a recommendation in the previous review report, the United Kingdom has ensured consistency between CRF tables 1.A(b) (reference approach) and 1.A(d) (feedstocks and non-energy use of fuels). Data on feedstock use are taken from the non-energy use as reported in DUKES. The references for the storage fractions reported in CRF table 1.A(d) are not available in the NIR. Further, the ERT noted the United Kingdom has not yet provided additional information in CRF table 1.A(d) on the categories where feedstocks are used. Therefore, the ERT reiterates the recommendation in the previous review report that the United Kingdom provide additional information on the categories where feedstocks are used and recommends that the United Kingdom provide the references for the storage fractions in its next annual submission.

#### Country-specific issues

54. As part of its geographical coverage, the United Kingdom includes OTs and CDs in its Kyoto Protocol reporting obligations. Emission estimates have to be provided for the OTs and CDs for all sectors, but for the energy sector, matters are more complicated. First, the ERT noted that the scope of the definitions used in DUKES and the definitions used for the submission of energy data to IEA are different; therefore, the comparison of the national and international data is not always possible. Secondly, transport, both by air and by sea, from and to the OTs and CDs forms part of the United Kingdom's estimated total GHG emissions, but the relevant AD are not easily available. The ERT encourages the United Kingdom to make efforts to further improve the collection of these AD.

### **3. Key categories**

#### Stationary combustion: liquid fuels – CO<sub>2</sub>, CH<sub>4</sub> and N<sub>2</sub>O<sup>7</sup>

55. In the United Kingdom, a number of petrochemical companies are active in the production of ethylene and propylene. In the production process, feedstock is fed into a steam cracker and the resulting products are mostly ethylene, propylene and residual gases. Ethylene and propylene are chemical products, so the carbon in these products is considered to be stored. The residual gases are, however, used for combustion processes in heating a furnace; producing heat; or as input for a combined heat and power plant. These residual gases (other petroleum gases (OPG)) are not included as an energy source in

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<sup>7</sup> Not all emissions related to all gases and fuels under this category are key categories. However, since the calculation procedures for issues related to this category are discussed as a whole, the individual gases and fuels are not assessed in separate sections.

DUKES and, therefore, were not previously included in the emission estimates. The ERT recommends that the United Kingdom, through DECC, in its next annual submission review the allocation of fuels to non-energy uses within DUKES, in order to identify any other misallocations of fuels to non-energy use that may lead to underestimates of emissions in the United Kingdom's GHG inventory.

56. In the 2012 annual submission, based on information from the EU ETS, the United Kingdom has reported the combustion of OPGs and the resulting CO<sub>2</sub>, CH<sub>4</sub> and N<sub>2</sub>O emissions from one of the petrochemical plants under the category other (manufacturing industries and construction), instead of under the chemicals category (for confidentiality reasons). In addition to this emissions estimate, a separate estimate of CO<sub>2</sub> emissions is reported under the category other (chemical industry (all)) in the industrial processes sector, which according to the NIR covers, among others, emissions from waste fuels in chemical plants. Based on the underlying documentation provided to the ERT during the review,<sup>8</sup> the ERT noted that only part of this estimate is related to energy recovery and that this is not related to the emissions from the combustion of OPGs. Based on the feedstock use in the chemical industry of approximately 200 PJ (based on the capacity of the ethylene plants) and an assumed conversion to OPGs of 20 per cent (calculated by the ERT), the ERT considers that the emissions from the combustion of these OPGs are expected to be in the order of 2,500 Gg CO<sub>2</sub> eq. The ERT noted that the Party's estimate, as provided to the ERT during the review under the category other (manufacturing industries and construction), is around 600 Gg CO<sub>2</sub> eq. Therefore, the ERT considered that this may represent an underestimation of emissions of approximately 1,900 Gg CO<sub>2</sub> eq. During the review, the ERT recommended that the United Kingdom further analyse the method used to report emissions from the petrochemical industry and report all emissions resulting from the combustion of OPGs.

57. 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 CO<sub>2</sub>, CH<sub>4</sub> and N<sub>2</sub>O emissions for the category other (manufacturing industries and construction) for the complete time series. The impact of these estimates is an increase in emissions of 2,752.69 Gg CO<sub>2</sub> eq, or 0.5 per cent of total sectoral emissions, for 2010. The ERT agreed with the revised emission estimates. In addition, the ERT encourages the United Kingdom to report the emissions under the correct category in its next annual submission to the extent possible allowing for the protection of commercially confidential data.

58. The ERT also noted that a detailed analysis from AEA comparing the CO<sub>2</sub> emissions from refineries according to the EU ETS data and the emissions reported in the CRF tables based on the DUKES data resulted in the conclusion that the DUKES data did not include all OPGs used for combustion and reported under the petroleum refining category. To correct this underestimation, the United Kingdom added the missing AD and included the resulting CO<sub>2</sub>, CH<sub>4</sub> and N<sub>2</sub>O emissions in the CRF tables of its 2012 annual submission. The ERT commends the United Kingdom for this improvement and the good use of the EU ETS data for verification.

59. Gas oil use in oil and gas extraction activities has recently been included in DUKES and in the inventory for the first time in the 2012 annual submission. These data are only available for 2005 onwards. However, they have been extrapolated backwards for the earlier years of the time series in order to maintain time-series consistency. The United Kingdom has also reallocated the use of diesel/gas oil to different categories (e.g. off-road machinery and domestic navigation). The ERT commends the United Kingdom for these improvements.

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<sup>8</sup> Passant, NP; Watterson, J and Jackson, J. 2007. *Review of the Treatment of Stored Carbon and the Non-Energy Uses of Fuel in the UK Greenhouse Gas Inventory.*

60. As stated in paragraph 52 above, the United Kingdom has reported emissions from fishing partly under international marine bunkers, due to the use of the study conducted by Entec UK Ltd. 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 CO<sub>2</sub>, CH<sub>4</sub> and N<sub>2</sub>O emissions from agriculture/forestry/fisheries for the complete time series. The impact of these estimates is an increase in emissions of 191.24 Gg CO<sub>2</sub> eq, or 0.04 per cent of total sectoral emissions, for 2010. The ERT agreed with the revised emission estimates.

#### Stationary combustion: other fuels – CO<sub>2</sub>

61. The United Kingdom reported the combustion of MSW for heat purposes under the public electricity and heat production category for the first time in the 2012 annual submission in response to a recommendation in the previous review report that the Party reallocate these emissions from other sectors. The ERT commends the United Kingdom for this improvement.

62. The fossil carbon EF for MSW used by the United Kingdom in its emission calculations is 75 kt C/Mt MSW. This EF is based on two assumptions. First, the United Kingdom uses a carbon content for MSW of 300 kt C/Mt MSW based on a report from the Royal Commission on Environmental Pollution.<sup>9</sup> After examining this report more closely, the ERT noted there was no scientific reference for this carbon content. The ERT also noted that the range of the carbon content provided in the IPCC good practice guidance is 300–500 kt C/Mt MSW and the default value is 400 kt C/Mt MSW. Secondly, the United Kingdom assumes that the fraction of the non-biogenic part of MSW is 25 per cent. The ERT found no reference for this percentage in the report and notes that the range provided in the IPCC good practice guidance is 30–50 per cent and the default value is 40 per cent. At the end of the review week, the United Kingdom made additional documentation available, both for the carbon content and for the biogenic fraction of MSW, but the ERT was not able to assess this information due to time constraints. The ERT reiterated the recommendation in the previous review report that the United Kingdom study the composition of MSW in the country to establish both a country-specific carbon content factor and a country-specific value for the non-biogenic fraction of MSW and recommended that the United Kingdom use the IPCC default values until the results of the study become available. 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 CO<sub>2</sub> emissions for this category for the complete time series. The impact of these estimates is an increase in emissions of 338.28 Gg CO<sub>2</sub> eq, or 0.1 per cent of total sectoral emissions, for 2010. The ERT agreed with the revised emission estimates.

#### **4. Non-key categories**

##### Road transportation: liquid fuels – CH<sub>4</sub> and N<sub>2</sub>O

63. Emissions from road transportation are calculated using either a combination of total fuel consumption data and fuel properties, or a combination of vehicle drive-related EFs and road traffic data. The United Kingdom uses the COPERT IV model to calculate these estimates. To calculate the CO<sub>2</sub> 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. However, to calculate the CH<sub>4</sub> and N<sub>2</sub>O emissions, the Party does not scale the AD for fuel consumption. Therefore, the AD reported for road transportation in the CRF tables (i.e. fuel sold) has no direct relation to the emission estimates for CH<sub>4</sub> and N<sub>2</sub>O. This leads to adverse effects, since the trends in the implied emission factors (IEFs) for these gases are dependent not only on the underlying characteristics of the car fleet, but

<sup>9</sup> Incineration of Waste, 17th report, Cmnd 2181, HMSO London. 1993.

also on the difference between the model-based approach for fuel consumption compared to the actual fuel sales. Further, the rationale for scaling the fuel consumption for CO<sub>2</sub> emissions also applies to CH<sub>4</sub> and N<sub>2</sub>O 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. Therefore, during the review, the ERT recommended that the United Kingdom expand the scaling of the AD and resulting emissions to cover the emission estimates of CH<sub>4</sub> and N<sub>2</sub>O. In response to the list of potential problems and further questions raised by the ERT during the review, the United Kingdom did not submit revised estimates of CH<sub>4</sub> and N<sub>2</sub>O emissions for this category and provided additional information explaining why it did not submit revised estimates. The ERT disagreed with this additional information. Therefore, in accordance with the Article 8 review guidelines, the ERT decided to calculate, recommend and apply an adjustment for this category (see paras. 123–140 below).

#### Navigation: liquid fuels – CO<sub>2</sub>, CH<sub>4</sub> and N<sub>2</sub>O

64. As stated in paragraph 52 above, the United Kingdom has reported emissions from domestic navigation partly under international marine bunkers, due to the use of the study conducted by Entec UK Ltd. 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 CO<sub>2</sub>, CH<sub>4</sub> and N<sub>2</sub>O emissions for this category for the complete time series. The impact of these estimates is an increase in emissions of 67.26 Gg CO<sub>2</sub> eq, or 0.01 per cent of total sectoral emissions, for 2010. The ERT agreed with the revised emission estimates.

#### Fugitive emissions from solid fuels: solid fuels – CH<sub>4</sub>

65. In the 2012 annual submission, the United Kingdom has accounted for CH<sub>4</sub> emissions from closed coal mines within the coal mining and handling category, and the emission estimates are based on a recent study funded by DECC. The ERT commends the United Kingdom for the improvement made to the estimation of these emissions. However, the ERT recommends that, in its next annual submission, the United Kingdom report these emissions under the category other (fugitive emissions from solid fuels), in order to improve the transparency and comparability of the inventory for this category.

## **C. Industrial processes and solvent and other product use**

### **1. Sector overview**

66. In 2010, emissions from the industrial processes sector amounted to 26,821.89 Gg CO<sub>2</sub> eq, or 4.5 per cent of total GHG emissions, and emissions from the solvent and other product use sector have been reported as “NO” or “NE” for the complete time series. Since the base year, emissions have decreased by 53.2 per cent in the industrial processes sector. The key driver for the fall in emissions in the industrial processes sector is the significant decrease in N<sub>2</sub>O emissions from adipic acid production due to the installation of an N<sub>2</sub>O abatement system in the plant in 1998 and the subsequent closure of the adipic acid plant in 2009. Furthermore, the closure of six nitric acid production units over the time series has led to a further decrease in N<sub>2</sub>O emissions. As a result, N<sub>2</sub>O emissions from adipic acid production were reported as “NO” for 2010. In 2010, within the industrial processes sector, 55.4 per cent of the emissions were from consumption of halocarbons and SF<sub>6</sub>, followed by 20.4 per cent from mineral products. Chemical industry accounted for 16.2 per cent and metal production accounted for 7.5 per cent. The remaining 0.4 per cent were from production of halocarbons and SF<sub>6</sub>, while other production was reported as “NO”.

67. The United Kingdom has made recalculations for the industrial processes sector between the 2011 and 2012 annual submissions in order to account for updated information and to respond to recommendations from an EU review for the calculation of the emission estimates for lime production; due to the use of updated AD for limestone and dolomite use, other mineral products, ammonia production, other chemical industries, and iron and steel production; as a result of the reallocation of emissions from glass manufacturing from limestone and dolomite use and soda ash use to other (mineral products); and in order to improve the estimates of HFC emissions from refrigeration and air-conditioning equipment by updating the model used from a top-down to a bottom-up modelling approach based on equipment stocks and average charge sizes. The impact of these recalculations on the industrial processes sector is an increase in emissions of 12.2 per cent for 2009 and an increase of 0.2 per cent for 1990. The main recalculations took place in the following categories:

- (a) CO<sub>2</sub> emissions from lime production, due to revision of the EF for accounting dolomite and following the update of the AD for 2009;
- (b) CO<sub>2</sub> emissions from limestone and dolomite use, due to an update of the AD for limestone used in flue-gas desulphurization (FDG) systems, and following the reallocation of emissions from glass manufacturing to other mineral products;
- (c) CO<sub>2</sub> emissions from soda ash use, following the reallocation of emissions from glass manufacturing from soda ash use to other (mineral products);
- (d) CO<sub>2</sub> emissions from other (mineral products), due to the correction of errors in the calculation of emissions from fletton brick manufacture, the reallocation of emissions from glass manufacturing from limestone and dolomite use and soda ash use (see also points (b) and (c) above) and due to an update of the consumption data on carbonate feedstocks for glass production;
- (e) CO<sub>2</sub> emissions from ammonia production, due to the removal of CO<sub>2</sub> recovery;
- (f) CO<sub>2</sub> emissions from other (chemical industry (all)), due to an update of the AD;
- (g) CO<sub>2</sub> emissions from iron and steel production, due to an update of the data on the carbon balance;
- (h) HFC emissions from production of halocarbons and SF<sub>6</sub>, in order to update the HFC emission estimates for 2009;
- (i) HFC emissions from consumption of halocarbons and SF<sub>6</sub>, following a revision of the model used to calculate the emission estimates for refrigeration and air-conditioning equipment, changing from a top-down to a bottom-up approach.

68. The ERT noted that the recalculations have been consistently applied across the time series, where necessary, and have been justified and explained in the CRF tables and in the NIR.

69. Although the Party had made improvements to the transparency of its reporting in the NIR of its previous annual submission, specifically in relation to the trend analysis and the explanations of the methods used across the time series, the NIR of the 2012 annual submission still lacks transparency with regard to complex categories, such as iron and steel production and nitric acid production, where a number of plants were closed or opened during the time period covered in the GHG inventory and different methodologies were used by several manufacturing plants to estimate emissions. The ERT therefore recommends that the United Kingdom improve the transparency of the NIR in its next annual submission by using tables and figures and providing summarized information on

the number of facilities, the changes in production capacities and the abatement measures introduced over the whole time series. The ERT encourages the United Kingdom to collect all underlying data/information on the AD and the country- or plant-specific EFs and clarify the assumptions and methods used in the calculation spreadsheets or tools, in order to support the review of its next annual submission.

70. The United Kingdom frequently uses plant-specific methods and/or data for the industrial processes sector. The ERT noted that the AD and methodologies used in some categories vary across the time series. For example, the United Kingdom reported that the methodology used to estimate N<sub>2</sub>O emissions from nitric acid production varies throughout the time series depending on the availability of data (see para. 74 below). Also, the United Kingdom reported that less detailed information has been available from the British Geological Survey for the last ten years to estimate emissions from lime production and, since 2003, the Party has estimated limestone use by chemical industry. For this reason, the United Kingdom plans to conduct further research to verify alternative AD for lime production, which will assist the Party in deciding whether to replace the current AD with new values. In addition, for other (mineral production), the United Kingdom reported that further investigation might be beneficial so as to identify other options for obtaining the AD for limestone and dolomite used for reporting under this category. Therefore the ERT recommends that the United Kingdom implement the planned category-specific improvements, in order to ensure the consistency of the AD and methodologies used.

71. The inventory for the industrial processes sector is complete in terms of years, categories, gases and geographical coverage. However, the ERT noted that the United Kingdom had provided apparently incomplete estimates for the following categories:

- (a) CO<sub>2</sub> emissions from ammonia production (see paras. 72 and 77 below);
- (b) CH<sub>4</sub> emissions from other (chemical industry (all)) (see para. 79 below).

72. During the review, the ERT recommended that the United Kingdom provide revised estimates for these categories. In response to the list of potential problems and further questions raised by the ERT during the review, the United Kingdom submitted revised CH<sub>4</sub> estimates for other (chemical industry (all)) for the complete time series. The impact of the revised estimates is an increase in emissions of 10.40 Gg CO<sub>2</sub> eq, or 0.04 per cent of total sectoral emissions, for 2010. The ERT agreed with the revised emission estimates. Regarding CO<sub>2</sub> emissions from ammonia production, the United Kingdom did not provide revised estimates for this category, but provided detailed clarifications confirming that the reported emissions were complete and estimated in accordance with the Revised 1996 IPCC Guidelines (see para. 78 below).

## **2. Key categories**

### Cement production – CO<sub>2</sub>

73. Following a recommendation in the previous review report, the United Kingdom has identified cement production as a key category by qualitative assessment. For its calculations, the United Kingdom used plant-specific data, including the calcium oxide (CaO) and magnesium oxide (MgO) content and the cement kiln dust correction factor from 2005 to 2010, and country-specific EFs for 2005 were applied to the years 1990–2004 in order to achieve consistency across the time series. The method described by the United Kingdom is appropriate and in line with the IPCC good practice guidance. The NIR of the 2012 annual submission discussed the trends in CO<sub>2</sub> emissions and clinker production, as requested in the previous review report. The ERT commends the United Kingdom for its efforts to improve the transparency of the NIR.

#### Nitric acid production – N<sub>2</sub>O

74. N<sub>2</sub>O emissions from nitric acid plants decreased by 66.2 per cent between 1990 and 2010. In 1990, the United Kingdom operated 10 production units in six nitric acid plants. The decreasing emissions trend resulted from the closure of four plants and the cessation of a part of production in the two other plants. In 2010, there were only four production units operating in two plants. Based on additional information provided by the Party, the ERT determined that the N<sub>2</sub>O emissions were estimated from: N<sub>2</sub>O emissions data directly provided by the plant operators from 1998 onwards for four plants and from 1990 onwards for one plant; plant-specific EFs and production data from 1994 to 1997 for three plants, from 1990 to 1997 for one plant and from 1990 onwards for one plant, and for the plants with no data, the emissions were estimated based on the level of N<sub>2</sub>O emissions in 1994 or on a default EF from the Revised 1996 IPCC Guidelines of 6 kg N<sub>2</sub>O/t nitric acid for medium-pressure plants. The method used to estimate the N<sub>2</sub>O emissions varies throughout the time series based on the availability of emissions data and plant-specific EFs. The methods used by the plant operators to estimate the N<sub>2</sub>O emissions were not described in the NIR. The ERT noted that the NIR lacks transparency in relation to the descriptions of the trends in AD and the emission estimates. The ERT recommends that the United Kingdom improve the transparency of the NIR in its next annual submission by, for example, reporting the years when the plants closed and providing a table containing the AD and EFs to clearly show the impacts on the N<sub>2</sub>O emission estimates. The ERT also recommends that the United Kingdom collect information on the methods used by the plant operators to estimate the N<sub>2</sub>O emissions and ensure the consistency of the data reported across the entire time series.

#### Consumption of halocarbons and SE<sub>6</sub> – HFCs

75. In the 2012 annual submission, the model used by the United Kingdom to estimate emissions from HFC use in refrigeration and air-conditioning equipment was updated from a top-down to a bottom-up approach. The resulting recalculations led to an increase in total HFC emissions from the category of 28.2 per cent and to an increase in HFC emissions from the refrigeration and air-conditioning equipment sub-category of 41.3 per cent for 2009. The updated model includes the addition of new end-uses, bringing the total to 13. The methodological approach of the model used is appropriate and in line with the IPCC good practice guidance. The ERT commends the United Kingdom for updating the model and for the methodological improvement made in moving from a tier 1 to a tier 2 approach.

76. The ERT noted that the reported ratio of potential to actual emissions from the unspecified mix of HFCs in 2010 is high (1,138:1) suggesting the possibility of an underestimation of actual emissions or an overestimation of potential emissions. In response to questions raised by the ERT during the review, the United Kingdom indicated that the ratio reported for the unspecified mix of HFCs has little meaning and cannot be compared to the ratios reported by other reporting Parties because the actual emissions reported are only those of the OTs, while the potential emissions are from the entire United Kingdom and are not disaggregated by species. The ERT noted that the move to disaggregate actual emissions by species has only taken place in recent years, while potential emissions are not currently available in this format. The United Kingdom confirmed that it will review and improve the transparency of its reporting in the next annual submission and, as a minimum, will add a note to the NIR to explain the current reporting limitations. The ERT welcomes this planned improvement and recommends that the United Kingdom, in its next annual submission, report a correct and realistic estimate of the potential to actual emissions ratio for the unspecified mix of HFCs for the United Kingdom as a whole.

### 3. Non-key categories

#### Ammonia production – CO<sub>2</sub>

77. The United Kingdom reported total CO<sub>2</sub> emissions from ammonia production of 978.43 Gg for 2010 based on natural gas consumption. The NIR indicates that there are three ammonia production sites in the United Kingdom contributing to CO<sub>2</sub> emissions. The ammonia plants use natural gas as feedstock, amounting to 26.48 PJ in 2010 (net natural gas input to the process). In response to questions raised by the ERT during the review, the United Kingdom informed the ERT that the total ammonia production from the three plants amounts to 1,080 kt. The ammonia plants were identified as Ince, Hull and Billingham. The United Kingdom also provided more detailed information from two of the ammonia plant operators on the split of CO<sub>2</sub> emissions from the natural gas used as fuel and from the natural gas used in the process. The total process emissions reported from the Ince and Billingham ammonia plants amount to 978.43 Gg CO<sub>2</sub>. The ERT noted that the reported CO<sub>2</sub> emissions from industrial processes were probably based on the emissions from two of the plants and not from the three operating plants. In addition, the emissions estimate calculated by the ERT based on the default EF from the Revised 1996 IPCC Guidelines and the total ammonia production showed that the total CO<sub>2</sub> emissions reported by the United Kingdom might be underestimated.

78. During the review, the ERT recommended that the United Kingdom check the number of ammonia plants operating from 1990 to 2010, determine the natural gas consumption of each ammonia plant for energy and feedstock use and report the emissions from energy use in the energy sector under the chemicals category. Further, the ERT recommended that, using these data on each plant, the United Kingdom calculate the CO<sub>2</sub> emissions from natural gas used as feedstock in accordance with the Revised 1996 IPCC Guidelines and report the sum of the CO<sub>2</sub> emissions from all ammonia plants operating in the United Kingdom for the whole time series (1990–2010). In response to the list of potential problems and further questions raised by the ERT during the review, the United Kingdom did not submit revised estimates of CO<sub>2</sub> emissions for this category. The United Kingdom did, however, provide additional information explaining how the CO<sub>2</sub> emissions of 978.43 Gg for 2010 were estimated and the calculation spreadsheet showing the assumptions used and the steps taken in the calculation. The United Kingdom also suggested improving the transparency and comparability of its estimates by reporting the ammonia production as AD. The ERT agreed with this additional information and recommends that the United Kingdom report only the amount of natural gas used for ammonia production and provide clear explanations of the distribution of natural gas consumption for non-energy use by ammonia production plants in its next annual submission.

#### Other (chemical industry (all)) – CH<sub>4</sub>

79. The United Kingdom reported CH<sub>4</sub> emissions of 2.82 Gg from other (chemical industry (all)) based on an analysis of pollution inventory data reported to the Environment Agency for the years 1998–2002 and contained in the Pollution Inventory data supplied in 2005. The value reported by the United Kingdom includes CH<sub>4</sub> emissions from chemical processes and industrial wastewater treatment plants. The method used to calculate these emissions is not transparent due to the lack of AD and EFs reported in the NIR, and lack of clear description of the methodological approach used. Based on the additional information provided by the United Kingdom during the review, the ERT noted that the total CH<sub>4</sub> emissions from the industries listed under other (chemical industry (all)) were greater than the 2.82 Gg reported and that, therefore, the reported CH<sub>4</sub> emissions were underestimated.



80. During the review, the ERT recommended that the United Kingdom disaggregate the CH<sub>4</sub> emissions from chemical industries from the CH<sub>4</sub> emissions from industrial wastewater treatment plants reported under this category, and report the CH<sub>4</sub> emissions from industrial wastewater treatment plants in the waste sector under industrial wastewater. 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 this category for the complete time series and provided additional information explaining that additional plants/sites were included in the estimates and that the data reported in the pollution inventories of the environmental regulatory agencies are the best available data for this category in the United Kingdom. Also, the Party indicated that a separate estimate for industrial wastewater had been developed for the reporting in the waste sector. The revised estimates amounted to 3.32 Gg CH<sub>4</sub>, increasing the total GHG emissions from this category by 17.6 per cent for 2010. The ERT agreed with the revised emission estimates and recommends that the United Kingdom include the additional information provided to the ERT during the review in the NIR of its next annual submission.

#### Solvent and other product use – CO<sub>2</sub> and N<sub>2</sub>O

81. The ERT noted that CO<sub>2</sub> and N<sub>2</sub>O emissions from solvent and other product use were reported as “NE” in CRF table 3 for the complete time series. The ERT encourages the United Kingdom to report CO<sub>2</sub> and N<sub>2</sub>O emissions from solvent and other product use in its next annual submission.

## **D. Agriculture**

### **1. Sector overview**

82. In 2010, emissions from the agriculture sector amounted to 46.647.04 Gg CO<sub>2</sub> eq, or 7.8 per cent of total GHG emissions. Since 1990, emissions have decreased by 19.5 per cent. The key drivers for the fall in emissions are the decline in emissions from enteric fermentation and manure management, related to the decreasing livestock population, and the reduction in emissions from agricultural soils due to changes in agricultural practices, including a decline in manure applied to soil, and a decline in the use of synthetic fertilizer. Within the sector, 57.5 per cent of the emissions were from agricultural soils, followed by 33.0 per cent from enteric fermentation and 9.3 per cent from manure management. The remaining 0.2 per cent were from other (emissions from manure management in the OTs and CDs).

83. The United Kingdom has made recalculations for the agriculture sector between the 2011 and 2012 annual submissions in response to the conclusions of the previous review report. These were performed in order to lift the applied adjustments in the previous review report, following changes in AD and EFs (for enteric fermentation, manure management and agricultural soils), and in order to rectify identified errors (in manure management and agricultural soils for all years of the time series). The impact of these recalculations on the agriculture sector is an increase in emissions of 1.7 per cent for 2009 and of 0.3 per cent for 1990. Aside from some changes to the descriptions of the recalculations in the NIR since the previous annual submission, in general the descriptions of the recalculations in the NIR and in the CRF tables continue to be limited and could be improved to increase transparency. The ERT reiterates the recommendation in the previous review report that the United Kingdom revise and improve the descriptions of the recalculations in its next annual submission by including more detailed explanations for each recalculation. The main recalculations in the agriculture sector took place in the following categories:

(a) CH<sub>4</sub> and N<sub>2</sub>O emissions from other (OT and CD emissions from manure management (all)), due to new AD for Montserrat, Jersey and Guernsey;

(b) CH<sub>4</sub> and N<sub>2</sub>O emissions from manure management, due to changes in animal numbers, the application of a tier 2 method for the calculation of CH<sub>4</sub> emissions, and due to the revision of the animal waste management systems (AWMS) breakdown according to recent survey data;

(c) N<sub>2</sub>O emissions from agricultural soils, due to changes in the time spent grazing for dairy and beef cattle, updated N excretion (Nex) factors for cattle and an update of the crop areas, production and residues.

84. Rothamsted Research, under contract to the Department for Environment, Food and Rural Affairs (DEFRA), is responsible for the preparation and development of the inventory for the agriculture sector for the devolved administrations (DAs): England, Wales, Scotland and Northern Ireland. Rothamsted Research conducts specific research on the agriculture sector and provides finalized GHG emissions data to the inventory agency for inclusion in the GHG inventory of the United Kingdom. For the OTs and CDs, AEA has responsibility for the inventory for the agriculture sector; it has adopted different methodological approaches and QA/QC procedures from Rothamsted Research for the estimation of emissions for some categories (see paras. 89, 92, 96 and 98 below). During the review, the United Kingdom informed the ERT that there are plans to discuss a possible revision of the division of responsibilities among Rothamsted Research and AEA. The ERT welcomes this approach, in particular as it aims to ensure that the emission estimates across the United Kingdom, including the OTs and CDs, are more consistent. The ERT recommends that the United Kingdom provide, in its next annual submission, information on any changes in the division of responsibilities between Rothamsted Research and AEA.

85. The ERT noted that the use of the notation keys is not consistent between the NIR and CRF tables, and in some cases the correct notation key has not been used (e.g. the Party has reported rice cultivation and prescribed burning of savannas using the notation key "NA", when the correct notation key is "NO"). The ERT recommends that the United Kingdom revise the use of the notation keys, applying the correct notation keys consistently across the NIR and the CRF tables in its next annual submissions.

86. The United Kingdom is currently implementing a large research programme (the *UK Agricultural GHG Research and Development Platform*) over a period of five years (with expected delivery in June 2015) aimed at significantly improving the methodologies used by the United Kingdom for the agriculture sector (see paras. 93 and 94 below). During the review, the United Kingdom provided the ERT with further information on this programme, in particular the milestones already achieved and to be achieved. The ERT welcomes this programme and encourages the United Kingdom to report updates on the programme in its next annual submission.

87. The inventory for the agriculture sector is complete in terms of years, categories, gases and geographical coverage. However, some emission estimates for the agricultural soils category are still incomplete or underestimated (see para. 95 below). During the review, the ERT recommended that the United Kingdom provide revised emission estimates for this category. 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 for agricultural soils for the complete time series. The impact of the revised estimates is an increase in emissions of 445.66 Gg CO<sub>2</sub> eq, or 1.0 per cent of total sectoral emissions, for 2010. The ERT agreed with the revised emission estimates.

## 2. Key categories

### Enteric fermentation – CH<sub>4</sub>

88. Emissions from enteric fermentation for dairy and non-dairy cattle are 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 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 feed digestibility value. Also, during the review week, the United Kingdom provided the ERT with background information on the calculations for such parameters and suggested a method for the correction of anomalies in the time series of live weights for dairy cattle. The ERT welcomes such information and corrections and recommends that the United Kingdom incorporate these in its next annual submission.

89. Owing to the lack of data for the application of a tier 2 method, the United Kingdom has applied a tier 1 method for the estimation of CH<sub>4</sub> emissions from enteric fermentation in the OTs and CDs. During the review, the United Kingdom indicated that it is planning to revise the methods used to estimate the emissions for the OTs and CDs in order to apply, where possible, a tier 2 method. The ERT welcomes such revisions and encourages the United Kingdom to report thereon in its next annual submission.

90. With regard to the EF for sheep, the United Kingdom is currently undertaking a programme of work to improve the methodology used to calculate the emissions from this animal category, which will include a derivation of the monthly sheep and lamb population models and country-specific EFs. In the current approach, the United Kingdom uses the IPCC tier 1 default EF for enteric fermentation (8 kg CH<sub>4</sub>/head/year) for all mature sheep (>1 year old). Lambs have a lower average live weight than mature sheep and the majority have a lifespan of less than 12 months, and should therefore be associated with a lower EF than mature sheep. The United Kingdom therefore uses a country-specific EF (3.2 kg CH<sub>4</sub>/head/year) for enteric fermentation for lambs, derived as 40 per cent of the value for mature sheep,<sup>10</sup> multiplied by the average lifespan of lambs in the United Kingdom of six months, thereby resulting in an EF of 1.6 kg CH<sub>4</sub>/head/year. During the review, the preliminary results from this programme were presented to the ERT, in particular the finding that the average lifespan of lambs has been determined as 8.12 months. The ERT welcomes the upcoming results of this programme and strongly recommends that, based on results of the programme, the United Kingdom revise the emission estimates for enteric fermentation for sheep in its next annual submission.

### Manure management – N<sub>2</sub>O

91. Emissions of N<sub>2</sub>O from manure management are calculated using country-specific data for AWMS breakdown and Nex and IPCC default EFs for the specific AWMS. In addition, following a recommendation in the previous review report, the N<sub>2</sub>O emissions occurring during the storage of poultry litter that will later be used for energy generation are now estimated following the IPCC good practice guidance and reported under other AWMS.

92. The ERT noted that the N<sub>2</sub>O EFs for each AWMS type for the DAs are used to estimate the emissions for the OTs and CDs without proper justification in the NIR. During the review, the United Kingdom indicated that it is planning to revise the methods used to estimate emissions for the OTs and CDs, in order to apply, where possible, a more specific

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<sup>10</sup> Sneath, R., Phillips, V.R., Demmers, T.G.M., et al., 1997. Longterm measurement of greenhouse gas emission from UK livestock building.

method. The ERT welcomes such revisions and encourages the United Kingdom to report thereon in its next annual submission, or as soon as possible.

93. The United Kingdom continues to use a constant Nex rate for non-dairy cattle across the time series. During the review, the United Kingdom indicated that it is seeking robust data on the live weight of non-dairy cattle for use in an improved methodology. This work is included in the *UK Agricultural GHG Research and Development Platform* and the results are expected to be available in the near future. The ERT welcomes such research and encourages the United Kingdom to revise the Nex rate in its next annual submission, or as soon as possible.

#### Agricultural soils – N<sub>2</sub>O

94. In response to a recommendation in the previous review report, the United Kingdom no longer subtracts the N<sub>2</sub>O emissions during manure management and the volatilized N (ammonia (NH<sub>3</sub>)/nitrogen oxide (NO<sub>x</sub>)) from the deposition of excreta during grazing before soil application. This recalculation has resulted in an increase in emissions from agricultural soils of 1,181.57 Gg CO<sub>2</sub> eq for 2009. The ERT welcomes these recalculations and encourages the United Kingdom to continue its research undertaken under the *UK Agricultural GHG Research and Development Platform* in this regard.

95. The ERT noted that there is a potential discrepancy in the area of cultivated histosols as reported in CRF tables 4.D and 5.B. CRF table 4.D reports the area of cultivated histosols as 39,200 ha for 2010, while CRF table 5.B. reports the area of lowland drainage as 150,000 ha. In response to questions raised by the ERT during the review, the United Kingdom explained that “the underlying evidence for the LULUCF tables suggests that the agriculture sector may be able to improve on the currently used guideline methodology and provide a better country-specific estimate of the area of cultivated histosols for estimation of nitrous oxide emissions”. In addition, the United Kingdom suggested that “the LULUCF and agriculture inventory compilation teams work together to agree the best methodology for deriving a country-specific estimate of the area of cultivated histosols and that a revision to the methodology and clear explanation in the NIR is included, ensuring consistency of approach between sectors”. The ERT welcomed this approach and recommended that the United Kingdom revise the reported estimate of N<sub>2</sub>O emissions from the cultivation of histosols sub-category by using the total area of organic soils (150,000 ha) and applying the default EF of 8 kg N<sub>2</sub>O-N/ha-year from the IPCC good practice guidance. 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 this category for the complete time series, resulting in an increase in emissions of 1.39 Gg N<sub>2</sub>O, or 0.9 per cent of total sectoral emissions, for 2010. The ERT agreed with the revised emission estimates and recommends that the United Kingdom develop a country-specific estimate of the area of cultivated histosols as soon as possible and report it in its future annual submissions.

96. The ERT noted that N<sub>2</sub>O emissions from agricultural soils are not estimated for the OTs and CDs for the complete time series. In response to questions raised by the ERT during the review, the United Kingdom provided an emissions estimate for the OTs and CDs based on the IPCC tier 1a method. The ERT recommended that the United Kingdom estimate the N<sub>2</sub>O emissions (direct and indirect) from agricultural soils for the OTs and CDs as indicated by the Party using country-specific data and, wherever necessary, default parameters and default EFs. In response to the list of potential problems and further questions raised by the ERT during the review, the United Kingdom submitted estimates of N<sub>2</sub>O emissions from agricultural soils for the OTs and CDs for the complete time series. These estimates resulted in an increase in emissions of 0.04 Gg N<sub>2</sub>O, or 0.03 per cent of total sectoral emissions, for 2010.

### 3. Non-key categories

#### Manure management – CH<sub>4</sub>

97. In response to a recommendation in the previous review report, CH<sub>4</sub> emissions from manure management for all animal categories are now estimated using the IPCC tier 2 method based on country-specific data (e.g. the distribution of the manure in the different management systems) and IPCC default parameters (e.g. the methane conversion factors (MCFs) and methane-producing potential (B<sub>0</sub>) of the manure). The ERT welcomes this improvement in the inventory.

98. Owing to the lack of data for the application of a tier 2 method, the United Kingdom has applied a tier 1 method for the estimation of CH<sub>4</sub> emissions from manure management for the OTs and CDs. During the review, the United Kingdom indicated that it is planning to revise the method used to estimate the emissions for the OTs and CDs in order to apply, where possible, a more specific method. The ERT welcomes such revision and encourages the United Kingdom to report thereon in its next annual submission, or as soon as possible.

## E. Land use, land-use change and forestry

### 1. Sector overview

99. In 2010, net removals from the LULUCF sector amounted to 3,842.40 Gg CO<sub>2</sub> eq. Since 1990, net emissions (3,893.01 Gg CO<sub>2</sub> eq) have decreased by 198.7 per cent, changing from net emissions to net removals. The key driver for the fall in emissions is the increase in the annual increment of forest, which depends on the age structure of forests, and the decrease in emissions from soil organic matter (SOM). According to the model used by the United Kingdom for its estimates, soils are approaching equilibrium between annual losses and gains of carbon. Within the sector, net removals of 10,599.92 Gg CO<sub>2</sub> eq were from forest land, followed by net emissions of 12,769.94 Gg CO<sub>2</sub> eq from cropland and net removals of 8,640.97 Gg CO<sub>2</sub> eq from grassland. Settlements accounted for net emissions of 6,259.55 Gg CO<sub>2</sub> eq and other (harvested wood products) accounted for net removals of 3,894.51 Gg CO<sub>2</sub> eq. The remaining net emissions of 263.51 Gg CO<sub>2</sub> eq were from wetlands.

100. The United Kingdom has made recalculations for the LULUCF sector between the 2011 and 2012 annual submissions in response to the recommendations in the previous review report. The impact of these recalculations on the LULUCF sector is an increase in net removals of 3.2 per cent for 2009 and a decrease in net emissions of 0.7 per cent for 1990. The main recalculations took place in the following categories:

- (a) CO<sub>2</sub>, CH<sub>4</sub> and N<sub>2</sub>O from land converted to forest land, due to the use of new AD on deforestation;
- (b) CO<sub>2</sub>, CH<sub>4</sub> and N<sub>2</sub>O from forest land, cropland and grassland, owing to the use of a revised methodology and additional data for the OTs and CDs;
- (c) N<sub>2</sub>O emissions from disturbance associated with land-use conversion to cropland were reported for first time.

101. The United Kingdom has presented an extensive improvement plan for the LULUCF sector for expected completion by 2015 in its NIR and further explained this plan to the ERT during the review. These ongoing activities address almost all of the recommendations made in the previous review report; however, they were not fully implemented in the 2012 annual submission. In addition, according to the United Kingdom, the findings in this review report will also be reflected in this improvement plan, in particular:

(a) For inclusion in the inventories for the years 1990–2011: new estimates of the geographical extent of forest on organic soils; new estimates of N<sub>2</sub>O emissions associated with forest drainage on organic and mineral soils; and a revision of data on forest wildfires;

(b) For inclusion in the inventories for the years 1990–2012: a revision of the total reported area of forest land and of the areas under forest management (see para. 142 below) and, consequently, a revision of the areas under deforestation, when the national forest inventory data are finalized (currently awaiting statistics on woodland loss); an assessment of the carbon stock changes in pre-1920 woodland; and a replacement of the C-Flow carbon accounting model with the FC CARBINE model;

(c) Additional work ongoing in the LULUCF improvement plan for 2012–2015: addressing the issue of the over-reporting of areas in the cropland and grassland categories due to crop rotation management; the use of new AD for non-forest wildfires; the assimilation of data to improve the land-use change matrices/vectors; and the inclusion of cropland and grassland management impacts on soil carbon.

102. To build its land representation time series, the United Kingdom combines different sources of data for forest land and for other land-use categories. Although the information provided is complete, it is nevertheless difficult to understand, in particular with regard to which source of data has been used for each land use and land-use change category and how consistency has been ensured when combining and harmonizing the data from different sources. The ERT noted that the resulting time series of land use and land-use change area data shows the following inconsistencies:

(a) The total area of the country is not constant and changes from one year to the following year;

(b) Changes in the area of the other land category, in each year in which the area of the category increases, are inconsistent, since the area increase reported for other land remaining other land is larger than the area reported under land converted to other land for the previous year. However, the United Kingdom did not report any emissions and removals from this category;

(c) The conversions of wetlands to any other land use have been aggregated under other land as “wetlands converted to other land” and no carbon stock changes have been estimated.

103. The United Kingdom is currently implementing a data assimilation process to build the time series of land-use changes and other activities, as listed in its improvement plan for the LULUCF sector, in order to address the inconsistencies in land representation. The ERT recommends that the United Kingdom prioritize these activities in order to ensure that a consistent time series (for 1990–2012) for land representation is reported in the inventory of the 2014 annual submission. While conducting this work, the ERT encourages the United Kingdom to consider:

(a) Revising the boundaries of the land-use categories with the aim of making them homogeneous, as far as possible. For instance: allocating land without relevant carbon stocks to the other land category; avoiding the use of other land as a buffer category, since the conversion to and from other land determines large carbon losses/gains and consequently has a relevant impact on the uncertainty of the estimates; given that the losses from the conversion of lands to other land are reported as “NO”, the use of other land as a buffer category results in an overall overestimation of the stock gains associated with the conversion of other land to other land uses; using cropland and/or grassland (pasture land subdivision) as a buffer to reconcile data from different surveys – agricultural land is the predominant land-use; creating a subcategory “pasture land” for grasslands that are in

rotation with crops; creating one or more subdivisions in settlements to distinguish land without relevant carbon stocks, wooded land, and land with grass and crops;

(b) 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 (i.e. vectors). National and international databases on land use/land cover, such as LUCAS,<sup>11</sup> can be used.

Therefore, the ERT recommends that the United Kingdom improve the transparency of the information reported in the NIR of its next annual submission by providing, for example, decision trees that show how the different data sources have been combined and harmonized to produce a consistent time series of land use and land-use change areas.

104. According to the NIR, additional information on the inventory, including the complete set of land-use transition matrices, is provided on a separate website.<sup>12</sup> The ERT noted that this website appeared to be out of date at the time of the review. The ERT reiterates the recommendation in the previous review report that the United Kingdom include a full set of annual land-use transition matrices in the NIR of its next annual submission. Further, the ERT encourages the United Kingdom to place all relevant information on the indicated website as soon as it becomes available.

## 2. Key categories

### Forest land – CO<sub>2</sub>

105. For forest established since 1920, the United Kingdom uses the C-Flow model to estimate the carbon stock changes in each pool in the forest land category. The carbon stocks in older forests are assumed to be in equilibrium and the associated emissions/removals are not reported. The ERT identified the following weaknesses in the model:

(a) It uses a parameter (5 per cent) to calculate the losses from harvested biomass which seems to be too small compared to other reporting Parties and to the IPCC default values (which are for above-ground biomass only: 30 per cent losses and 7–10 per cent left to decay in the forest);

(b) It does not assign a portion of the estimated harvested wood to fuel wood use, which is consequently estimated to equal zero;

(c) It models the annual emissions from soils according to an exponential negative function (first order decay), which reaches its maximum one year after planting, plus a constant rate of 0.3 t C ha<sup>-1</sup> year<sup>-1</sup>. The equation has the same parameters for organic and mineral soils and the rate of emissions from mineral soils is assumed (without evidence) to be half that of organic soils. Therefore, the emissions associated with soil disturbance in the following cycle of replanting are not estimated, and, hence, this leads to an underestimation of emissions. In addition, a long-term loss of carbon in mineral soils, equivalent to approximately 0.15 t C ha<sup>-1</sup> year<sup>-1</sup>, is reported, leading to a probable overestimation.

Further, the ERT noted that the model outputs are not verified or reconciled with annual statistics on harvesting and timber production; it is therefore not possible to assess the accuracy of the estimated carbon stock changes. The ERT acknowledges the action taken by the United Kingdom to address the current weaknesses in the carbon stock change estimates by implementing an alternative model – the FC CARBINE model. According to

<sup>11</sup> <<http://epp.eurostat.ec.europa.eu/portal/page/portal/lucas/introduction>>.

<sup>12</sup> <<http://ecosystemghg.ceh.ac.uk>>.

the improvement plan for the LULUCF sector, this is due to be completed in time for the 2014 annual submission. The ERT recommends that the United Kingdom meet its planned deadline for reporting the carbon stock change estimates using the FC CARBINE model for inclusion in its next annual submission, or as soon as possible.

106. With respect to pre-1920 forests, as reported in the NIR, the United Kingdom assumes that no net carbon stock changes occur in these forests. The United Kingdom indicated in its improvement plan for the LULUCF sector that it is planning to report estimates of the carbon stock changes for this subdivision in its 2014 annual submission. The ERT recommends that the United Kingdom meet its planned deadline for reporting the carbon stock change estimates for pre-1920 forest land.

#### Cropland and grassland – CO<sub>2</sub>

107. The United Kingdom does not report SOM 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.

108. The ERT noted that, with the exception of land conversions to forest land, 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 does not account for long-term losses due to the drainage of organic soils that are associated with some conversions (e.g. from grassland to cropland). The ERT recommends that the United Kingdom differentiate between mineral and organic soils in the cropland and grassland categories, including the land-use conversion categories to and from cropland and grassland, and that the Party report, in its next annual submission, the carbon stock changes in mineral and organic soils separately, including emissions from the drainage of organic soils. If the lack of data is an impediment, the United Kingdom may consider assigning the mineral and organic soil areas to various subcategories in proportion to their relative contribution to the category or in the overall area of each DA.

### **3. Non-key categories**

#### Land converted to cropland – CO<sub>2</sub>

109. The United Kingdom reports CO<sub>2</sub> emissions from organic soils associated with conversions of grassland to cropland for the OTs and CDs. However, the time series of estimates covers the period 2006–2010 only. The ERT recommends that the United Kingdom build a consistent time series of emissions for the OTs and CDs from 1990 onwards by applying one of the methods provided in the IPCC good practice guidance for LULUCF, for example the use of a proxy for crop production, and report these emissions in its next annual submission.

## **F. Waste**

### **1. Sector overview**

110. In 2010, emissions from the waste sector amounted to 17,890.42 Gg CO<sub>2</sub> eq, or 3.0 per cent of total GHG emissions. Since 1990, emissions have decreased by 62.3 per cent. The key driver for the fall in emissions is the United Kingdom's policy on waste, which focused on the reduction of waste sent to landfill and landfill gas recovery. Within



the sector, 82.5 per cent of the emissions were from solid waste disposal on land, followed by 15.5 per cent from wastewater handling. The remaining 2.0 per cent were from waste incineration.

111. The United Kingdom has made recalculations for the waste sector between the 2011 and 2012 annual submissions in response to the 2011 annual review report, in order to rectify identified errors, and to reflect changes in AD. The impact of these recalculations on the waste sector is a decrease in emissions of 5.1 per cent for 2009 and a decrease of 22.2 per cent for 1990. The main recalculations took place in the following categories:

(a) CH<sub>4</sub> emissions from solid waste disposal on land, due to a review of the model used to calculate the emission estimates, in order to address the identified errors and changes in AD;

(b) CH<sub>4</sub> and N<sub>2</sub>O emissions from wastewater handling, due to the removal of emissions from sewage sludge in the waste sector that are also included in the agriculture sector, in order to avoid double counting;

(c) CO<sub>2</sub>, CH<sub>4</sub> and N<sub>2</sub>O emissions from waste incineration, due to the use of updated AD.

112. The waste sector is complete in terms of gases, years and mandatory IPCC categories. However, the United Kingdom did not include estimates of CH<sub>4</sub> emissions from solid waste disposal on land for the complete time series for one of the OTs (Montserrat) due to a lack of AD (see para. 115 below). In addition, the ERT identified that the estimates for the following categories lack transparency, or are still incomplete or underestimated: CH<sub>4</sub> emissions from industrial wastewater (see para. 120 below); N<sub>2</sub>O emissions from waste incineration (see para. 121 below); and CO<sub>2</sub> emissions from waste incineration (see para. 122 below). During the review, the ERT recommended that the United Kingdom provide revised or complete estimates for these categories. 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 these categories for the complete time series. The impact of the revised estimates is an increase in emissions of 1,278.45 Gg CO<sub>2</sub> eq, or 7.1 per cent of total sectoral emissions, for 2010. The ERT agreed with the revised emission estimates.

113. The ERT noted a lack of transparency in the inventory regarding the methodological approach described in the NIR and the presentation of data on the OTs and CDs in the NIR and in the CRF tables. The ERT reiterates the recommendation in the previous review report that the United Kingdom improve the transparency of the inventory by providing information related to the emission estimates for the OTs and CDs in the NIR and in the CRF tables. The ERT also recommends that the United Kingdom improve the description of the relevant data in the NIR with respect to the methodology and parameters used in the calculation of these emissions. The ERT also noted that the United Kingdom has used some incorrect notation keys in the CRF tables (e.g. the notation key "NO" has been used instead of the notation key "NE" or "IE", with no explanation, if applicable, of where the emissions have been included (e.g. in the energy and industrial processes sectors). The ERT recommends that the United Kingdom improve its QA/QC procedures in order to ensure consistency throughout the CRF tables and the NIR in its next annual submission, and to ensure the accuracy of the information in sectors with cross-sectoral links.

## 2. Key categories

### Solid waste disposal on land – CH<sub>4</sub>

114. CH<sub>4</sub> emissions from solid waste disposal on land were calculated using the IPCC first order decay model and some country-specific parameters (e.g. national data on waste

quantities, composition, properties and disposal practices). For the 2012 annual submission, the AD on the amount of waste landfilled and the country-specific degradable organic carbon values were updated, in line with an official research study published in 2011. The model adopted in the previous annual submission was revised in order to address the errors identified in the previous review report (e.g. the overestimation of landfilled dissimilable degradable organic carbon compounds (DDOC) from commercial and industrial waste and inconsistencies in the method used to calculate the DDOC values). Recalculations were therefore applied to the entire time series. However, the ERT noted a lack of transparency in the explanations of the recalculations provided in the NIR, particularly in relation to the revised errors in the model and the update of the waste composition data considered for solid waste disposal on land. The ERT recommends that the United Kingdom improve the transparency of its explanations of the recalculations performed in its next annual submission.

115. The ERT noted that CH<sub>4</sub> emissions from solid waste disposal on land were not estimated for one of the OTs (Montserrat) for all years of the time series. The ERT considered this to be a potential underestimation of emissions. In response to questions raised by the ERT during the review, the United Kingdom provided the ERT with additional information and informed the ERT of its intention to estimate and report these emissions. 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 this category for the complete time series. These estimates resulted in an increase in emissions of 1.13 Gg CO<sub>2</sub> eq, or 0.01 per cent of total sectoral emissions, for 2010. The ERT agreed with the revised emission estimates.

116. The United Kingdom estimated the CH<sub>4</sub> captured using the figures of gas utilized for energy purposes and the total available flaring capacity of the landfills. The previous review report highlighted as an issue the fact that the CH<sub>4</sub> collection efficiency rate increased from 1990 to 2004 and was considered constant and equal to 75 per cent from 2005 onwards. In the current annual submission, the CH<sub>4</sub> collection efficiency rate has remained the same as in the previous annual submission. In the NIR, the Party does not justify its use of the assumed values, but makes reference only to the permit conditions for landfill operators in the United Kingdom (to collect 85 per cent of the CH<sub>4</sub> formed in landfills) and states that a pilot study is being implemented in a selection of landfills of different ages in order to improve the accuracy of the calculations of the CH<sub>4</sub> collection rate. In response to questions raised by the ERT during the review, the United Kingdom provided additional information on this issue to the ERT: the preliminary results of the study show a wide range of values for the CH<sub>4</sub> collection rate for different landfills and, thus, the data could not be used as a basis for extrapolation for all landfills from 2005 onwards. During the review, the United Kingdom informed the ERT that it is planning to improve the study and that the results will be provided in the next annual submission. The ERT strongly reiterates the recommendation in the previous review report that the United Kingdom improve the estimates of the CH<sub>4</sub> collection rate in order to provide better evidence to support its estimates of landfilled waste emissions in the United Kingdom. Moreover, the ERT also noted that the CH<sub>4</sub> collection values presented in table A 3.8.2 of the NIR are not consistent with the values presented in the text in the NIR. The ERT recommends that the United Kingdom ensure that these values are consistent across the NIR in its next annual submission.

#### Wastewater handling – N<sub>2</sub>O

117. N<sub>2</sub>O emissions from human sewage were calculated using the IPCC default methodology. In the 2012 annual submission, the United Kingdom has revised the protein consumption based on data from the Expenditure and Food Survey Report (conducted by DEFRA in 2010). However, the ERT noted that the reported values for the time series of

protein consumption are still below the values published by the United Nations Food and Agriculture Organization (FAO) for the United Kingdom. During the review, the United Kingdom explained that data from FAO are an aggregate calculation based on aggregate commodity supply data that use common conversion factors to derive the food, protein and fat per capita consumption estimates. These methodological limitations of the FAO estimates are more significant for developed countries such as the United Kingdom where a greater proportion of consumption is in the form of processed products. The ERT reiterates the recommendation in the previous review report that the United Kingdom improve the description of the data used to estimate the emissions from this category in the NIR of its next annual submission, including the explanations provided to the ERT during the review.

118. The ERT noted that N<sub>2</sub>O emissions from industrial wastewater were reported in the CRF tables as “IE” (under the industrial processes sector); however, it was not possible for the ERT to identify where these emissions were reported in the industrial processes sector. The United Kingdom has not provided any further information in the NIR on these emissions. The ERT recommends that the United Kingdom provide, in the waste chapter of the NIR of its next annual submission, information on the exact location where these emissions are included and on the methodology used for their calculation.

### 3. Non-key categories

#### Wastewater handling – CH<sub>4</sub>

119. In the United Kingdom, the CH<sub>4</sub> emissions from domestic and commercial wastewater handling are estimated together with sludge. This is consistent with the Revised 1996 IPCC Guidelines. As in the previous annual submission, the country-specific EF used for the calculation of the emission estimates was based on data reported by five out of 12 wastewater handling companies in the United Kingdom in 2009 and applied for the entire time series. As this EF is derived from data from less than half of the wastewater handling companies, it raises questions regarding the accuracy of the estimates. The ERT therefore strongly recommends that the United Kingdom, in its next annual submission, ensure the accuracy of the data used for the emission estimates, including the descriptions of and references for the data used, and ensure that the applied EFs are fully representative of the activity and emissions for the entire United Kingdom.

120. CH<sub>4</sub> emissions from industrial wastewater were not transparently reported in the 2012 annual submission. The United Kingdom did not provide information in the NIR on which industries and EFs were considered in the calculation of the estimates of CH<sub>4</sub> emissions from this category (reported as “IE”), nor did it explain where the emissions were allocated under the industrial processes sector. In response to questions raised by the ERT during the review, the United Kingdom explained that emissions from industrial wastewater were allocated under chemical industry in the industrial processes sector; however, the ERT noted that the figure reported is not supported by the provision of the list of industries considered in the estimates and the method used to calculate the emissions. The value reported under chemical industry seems to be small considering the potential of CH<sub>4</sub> emissions from industrial wastewater in a country such as the United Kingdom. The ERT considered that this could represent a potential underestimation of emissions and recommended that the United Kingdom report complete revised estimates under this subcategory. 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 this category for the complete time series, resulting in an increase in emissions of 1,268.61 Gg CO<sub>2</sub> eq, or 7.1 per cent of total sectoral emissions, for 2010. The ERT agreed with the revised emission estimates. The ERT strongly recommends that the United Kingdom provide, in the NIR of its next annual submission, a list of the industries included in the estimate for

this category and ensure that the calculation of the CH<sub>4</sub> emission estimates is fully transparent.

#### Waste incineration – CO<sub>2</sub>, CH<sub>4</sub> and N<sub>2</sub>O

121. N<sub>2</sub>O emissions from chemical waste incineration were reported as “NE” for the complete time series in the 2012 annual submission. The United Kingdom stated in a comment in CRF table 6.C that it did not estimate the emissions, since under a high temperature process the N<sub>2</sub>O emissions would be negligible. However, the ERT considered that under high temperatures more N<sub>2</sub>O is emitted in the incinerators. The ERT noted that a default EF value is available in the IPCC good practice guidance to calculate these emissions. Therefore, the ERT recommended that the United Kingdom calculate the N<sub>2</sub>O emissions from this category using the available IPCC default value. In response to the list of potential problems and further questions raised by the ERT during the review, the United Kingdom submitted estimates for this category for the complete time series, resulting in an increase in emissions of 4.34 Gg CO<sub>2</sub> eq, or 0.02 per cent of total sectoral emissions, for 2010. The ERT agreed with the revised emission estimates.

122. The CO<sub>2</sub> EF (275 kg CO<sub>2</sub>/t MSW) for non-biogenic solid waste incinerated without energy recovery was calculated based on a carbon content (75 kt C/Mt MSW) that has no scientific reference and is significantly below the value calculated using the IPCC default assumptions (see para. 62 above). The ERT considered this to be a potential underestimation of emissions. The ERT recommended that the United Kingdom provide verifiable references for the assumed value or use the available IPCC default assumptions. 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 this category for the complete time series, resulting in an increase in emissions of 4.37 Gg CO<sub>2</sub> eq, or 0.02 per cent of total sectoral emissions, for 2010. The ERT agreed with the revised emission estimates.

### **G. Adjustments**

123. The ERT identified underestimations in the emission estimates and recommended four adjustments in the energy sector for 2008, 2009 and 2010. In accordance with the “Technical guidance on methodologies for adjustments under Article 5, paragraph 2, of the Kyoto Protocol” (hereinafter referred to as the guidance for adjustments under Article 5, paragraph 2, of the Kyoto Protocol) (annex to decision 20/CMP.1), the adjustments to the energy sector were prepared by the ERT in consultation with the United Kingdom. In addition, in accordance with the Article 8 review guidelines, the ERT officially notified the United Kingdom of the calculated adjustments.

124. The underestimations leading to adjustments in the energy sector for 2008, 2009 and 2010 relate to CH<sub>4</sub> and N<sub>2</sub>O emissions for gasoline and diesel oil used in road transportation.

125. The adjusted estimates for GHG emissions from the energy sector for 2008, 2009 and 2010 amount, respectively, to 538,236.56 Gg CO<sub>2</sub> eq, compared with 537,918.33 Gg CO<sub>2</sub> eq (an increase of 0.1 per cent), 491,090.90 Gg CO<sub>2</sub> eq, compared with 490,808.78 Gg CO<sub>2</sub> eq (an increase of 0.1 per cent) and 508,055.25 Gg CO<sub>2</sub> eq, compared with 507,746.13 Gg CO<sub>2</sub> eq (an increase of 0.1 per cent) as originally reported by the United Kingdom in its revised 2012 annual submission. The calculation and application of the adjustments leads to an increase in estimated total GHG emissions from Annex A sources of 0.1 per cent (318.22 Gg CO<sub>2</sub> eq) for 2008, from 634,890.97 Gg CO<sub>2</sub> eq as reported by the United Kingdom to 635,209.19 Gg CO<sub>2</sub> eq as calculated by the ERT; an increase of 0.05 per cent (282.12 Gg CO<sub>2</sub> eq) for 2009, from 581,041.58 Gg CO<sub>2</sub> eq as reported by the

United Kingdom to 581,323.70 Gg CO<sub>2</sub> eq as calculated by the ERT; and an increase of 0.1 per cent (309.12 Gg CO<sub>2</sub> eq) for 2010, from 599,105.48 Gg CO<sub>2</sub> eq as reported by the United Kingdom to 599,414.60 Gg CO<sub>2</sub> eq as calculated by the ERT.

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

127. The ERT notes that the United Kingdom may submit revised estimates for the parts of its inventory to which an adjustment was applied, in conjunction with its next inventory, or at the latest with the inventory for the year 2012. The revised estimates will be part of the review under Article 8 and if accepted by the ERT the revised estimates will replace the adjustments.

### **CH<sub>4</sub> and N<sub>2</sub>O emissions from road transportation**

#### The original estimate

128. In its 2012 annual submission, the United Kingdom reported estimates of CH<sub>4</sub> emissions from gasoline used in road transportation of 48.11 Gg CO<sub>2</sub> eq for 2010, of 58.87 Gg CO<sub>2</sub> eq for 2009 and of 85.51 Gg CO<sub>2</sub> eq for 2008. The estimates of CH<sub>4</sub> emissions from diesel oil used in road transportation were 22.59 Gg CO<sub>2</sub> eq for 2010, 25.38 Gg CO<sub>2</sub> eq for 2009 and 31.20 Gg CO<sub>2</sub> eq for 2008. The estimates of N<sub>2</sub>O emissions from gasoline used in road transportation were 232.65 Gg CO<sub>2</sub> eq for 2010, 272.92 Gg CO<sub>2</sub> eq for 2009 and 347.82 Gg CO<sub>2</sub> eq for 2008. The estimates of N<sub>2</sub>O emissions from diesel oil used in road transportation were 612.72 Gg CO<sub>2</sub> eq for 2010, 562.71 Gg CO<sub>2</sub> eq for 2009 and 532.31 Gg CO<sub>2</sub> eq for 2008.

#### The underlying problem

129. In its 2012 submission, the United Kingdom estimated its CH<sub>4</sub> and N<sub>2</sub>O emissions from road transportation using the COPERT IV model without scaling the resulting fuel data (and derived emissions) to the amount of fuel sold as reported in the national energy balance (DUKES), a procedure that the United Kingdom has performed for the CO<sub>2</sub> emission estimates for this category. The fuel consumption reported in the CRF tables is not used as the AD, and the emission estimates are directly calculated using a bottom-up approach (COPERT IV model). Since CH<sub>4</sub> and N<sub>2</sub>O emissions from road transportation are linearly related to the use of fuel, the accuracy of the top-down fuel estimate is higher than that of the bottom-up fuel estimate; therefore, the uncertainty of the top-down fuel estimate (fuel sold) is lower than the uncertainty of the bottom-up estimate (COPERT IV model). The ERT noted that the difference between the calculated fuel consumption and fuel sales varies from year to year, and also varies for gasoline and diesel oil. The method used does not systematically overestimate or underestimate CH<sub>4</sub> and N<sub>2</sub>O emissions across the time series; the approach used by the United Kingdom in some years gives higher emissions compared with the emissions based on fuel sales data, and in some years gives lower estimates than those based on fuel sales data. However, the ERT considered that the approach used by the United Kingdom is not only less accurate but also represents an underestimation of emissions for the 2010, 2009 and 2008 inventory years and for some of the previous years of the time series. This issue was included in the list of potential problems and further questions raised by the ERT during the review.

#### The recommendation to the Party

130. In the list of potential problems and further questions raised by the ERT during the review, the ERT recommended that the United Kingdom apply the scaling of the fuel consumption calculated using the COPERT IV model to the fuel sold according to the

national energy balance, and report the emissions of CH<sub>4</sub> and N<sub>2</sub>O accordingly for the entire time series.

#### The rationale for adjustment

131. In response to the list of potential problems and further questions raised by the ERT during the review, the United Kingdom informed the ERT that it considers that its current approach is justified, and, in particular, that it complies with the IPCC good practice guidance. This is based on the following reasoning: the United Kingdom produces estimates of CO<sub>2</sub> emissions calculated using traffic data and using fuel sales, and the two approaches agree closely. The CO<sub>2</sub> emissions calculated using fuel sales data are those reported in the GHG inventory to the UNFCCC. The CO<sub>2</sub> emissions calculated using traffic data are used to estimate the split between vehicle classes. For the purposes of estimating emissions of CH<sub>4</sub> and N<sub>2</sub>O, the United Kingdom uses a tier 3 bottom-up method based on traffic data (vehicle-km) and fleet composition data. The United Kingdom considers that an approach based on traffic and fleet composition data is more aligned to the factors affecting these emissions than an approach based on fuel consumption. The United Kingdom also considers this to be consistent with the IPCC methodological guidance, for the following reasons: while the Revised 1996 IPCC Guidelines and the IPCC good practice guidance are explicit in stating that CO<sub>2</sub> emissions must be based on fuel sold, this is not the case for CH<sub>4</sub> and N<sub>2</sub>O emissions. The IPCC good practice guidance encourages the use of a national method for the calculation of non-CO<sub>2</sub> emissions from road transportation (figure 2.5 – “Decision tree for CH<sub>4</sub> and N<sub>2</sub>O emissions from road vehicles”). The United Kingdom noted that under section 2.3.1.1 – “Choice of method – CH<sub>4</sub> and N<sub>2</sub>O emissions”, the IPCC good practice guidance states: “CH<sub>4</sub> and N<sub>2</sub>O emissions depend primarily on the distribution of emission controls in the fleet. Good practice is to use a bottom-up approach taking into account the various emission factors for different pollution control technologies.” Further, the United Kingdom noted that under section 2.3.1.3 – “Choice of activity data”, the IPCC good practice guidance states: “Some inventory agencies have or will have greater confidence in vehicle fuel consumption data by vehicle type and technology while others prefer vehicle kilometres. Either approach is acceptable so long as the basis for the estimates is clearly documented. If the distribution of fuel use by vehicle and fuel type is unknown, it should be estimated based on the number of vehicles by type. If the number of vehicles by vehicle and fuel type is not known, it must be estimated from national statistics. If local data on annual kilometres travelled per vehicle and average fuel economies by vehicle and fuel type are available, they should be used.” Lastly, the United Kingdom noted that the IPCC good practice guidance does not explicitly state that the results from the modelling approach, accounting for the parameters set out above, must be normalized to the total fuel sales data.

132. The ERT noted, however, that CH<sub>4</sub> and N<sub>2</sub>O emissions from road transportation are linearly related to fuel use. The ERT recognizes that there is a dependency of these emissions according to the vehicle type and pollution control technologies, but for this particular potential problem the ERT considers that this is not relevant. In addition, the ERT, recognizing that well-documented national methods should be used in the calculation of the emission estimates, noted that the COPERT IV model is a tier 3 method, for which the fuel consumption should be allocated by fuel for the different vehicle types and control technologies prior to calculating the estimates, as indicated in the decision tree mentioned in paragraph 131 above. Further, the ERT noted that section 2.3.1.3 of the IPCC good practice guidance states that any difference between the bottom-up calculation of fuel used by each road vehicle type and the total fuel used in the category (the top-down estimate) should be ascribed to the off-road sector, or, if special studies are conducted to determine off-road fuel use thereby supplementing the bottom-up calculation, as is the case for the United Kingdom, the total fuel used in the category (the top-down estimate) should be

disaggregated according to each vehicle type and the off-road fuel use in proportion to the bottom-up estimate, highlighting the importance of ensuring that the emission estimates fully correspond to the total fuel sales as reported in the national energy balance. In this respect, the approach followed by the United Kingdom results in three specific problems:

(a) Accuracy and completeness: the estimates of fuel consumption resulting from the United Kingdom's bottom-up approach (using the COPERT IV model), in particular for gasoline and diesel oil use, are considered by the ERT to be less accurate than estimates derived from a top-down approach (fuel sales). The ERT understands that the uncertainty in the fuel sales data is much smaller than the difference between the estimates of fuel consumption obtained from these two approaches. In addition, the ERT understands that the uncertainty in the fuel sales data is lower than the uncertainty of the model. For gasoline, the ERT also considers that there is no reason for any difference between these two approaches. As the CH<sub>4</sub> and N<sub>2</sub>O emissions are related to the fuel use, the ERT further considers that the CH<sub>4</sub> and N<sub>2</sub>O emissions as reported by the United Kingdom are less accurate than those estimated derived from a bottom-up approach using scaling. Since the approach using scaling results in higher CH<sub>4</sub> and N<sub>2</sub>O emission estimates, the ERT considers that the approach used by the United Kingdom is not only less accurate, but also leads to an underestimation of emissions for the 2010, 2009 and 2008 inventory years and for some of the previous years of the time series;

(b) Consistency: the ERT understands that the AD used and reported for road transportation are supposed to be the same for all reported gases under this category, but that this is not the case for the United Kingdom's reporting. Further, the ERT noted, for example, that the United Kingdom scales the fuel consumption to derive the estimates of CH<sub>4</sub> and N<sub>2</sub>O emissions from civil aviation calculated using a detailed tier 3 method. The ERT noted that this is inconsistent with the approach used to calculate the emission estimates for road transportation and shows an internal inconsistency within the inventory;

(c) Comparability: to the ERT's knowledge, the United Kingdom is the only reporting Party that does not scale the AD used for the estimation of CH<sub>4</sub> and N<sub>2</sub>O emissions from road transportation.

133. The ERT noted that, in accordance with paragraph 4 of the annex to decision 20/CMP.1, an adjustment procedure shall be applied when inventory data submitted by the Party are found to be incomplete and/or prepared in a way that is not consistent with the Revised 1996 IPCC Guidelines as elaborated by the IPCC good practice guidance. The ERT therefore considered this as the rationale for the calculation of adjustments of the CH<sub>4</sub> and N<sub>2</sub>O emission estimates for road transportation and decided to recommend and apply adjustments for this category.

#### The assumptions, data and methodology used to calculate the adjustment

134. In accordance with the guidance for adjustments under Article 5, paragraph 2, of the Kyoto Protocol (annex to decision 20/CMP.1), the ERT should calculate the adjustment at the level at which the problem was identified. In the case of the United Kingdom, the problem was identified in relation to the AD used to estimate CH<sub>4</sub> and N<sub>2</sub>O emissions from consumption of gasoline and diesel oil used in road transportation.

135. In accordance with table 1 of the guidance for adjustments under Article 5, paragraph 2, of the Kyoto Protocol (annex to decision 20/CMP.1), the ERT decided to calculate the adjustments using adjustment method 1: default IPCC tier 1. The calculation of the emission estimates for the adjustments was performed using the IEFs based on the COPERT IV emission estimates of CH<sub>4</sub> and N<sub>2</sub>O reported in CRF table 1.A(a) and the bottom-up AD (fuel consumption not scaled to fuel sales) resulting from the use of the COPERT IV model provided by the United Kingdom. These IEFs were applied to the AD (gasoline and diesel oil consumption corresponding to fuel sales) reported in CRF table

1.A(a) (656,868.77 TJ gasoline and 894,032.02 TJ diesel oil for 2010; 692,428.58 TJ gasoline and 860,831.88 TJ diesel oil for 2009; and 732,617.57 TJ gasoline and 882,063.19 TJ diesel oil for 2008) to calculate the adjusted CH<sub>4</sub> and N<sub>2</sub>O emission estimates.

136. The adjustments for each year (2008, 2009 and 2010) for gasoline and diesel oil were calculated using data available in the CRF tables and data provided by the United Kingdom, using the following steps:

(a) The AD (not scaled) for gasoline and diesel oil provided by the United Kingdom in mass units were converted to energy units using the net calorific values (NCVs) provided by the United Kingdom (see tables 6 and 7 below);

(b) The CH<sub>4</sub> and N<sub>2</sub>O IEFs were calculated by dividing the CH<sub>4</sub> and N<sub>2</sub>O emissions for gasoline and diesel oil reported in the CRF tables by the calculated AD in energy units under point (a) above. The fact that the emissions reported in the CRF tables include emissions from the OTs/CDs is not taken into account since the ERT did not have adequate data on the OTs/CDs. This leads to an unavoidable marginal increase in the IEFs;

(c) The CH<sub>4</sub> and N<sub>2</sub>O adjusted emissions for gasoline and diesel oil were estimated using the AD (corresponding to fuel sales) reported in the CRF tables and the IEFs calculated under point (b) above;

(d) Conservativeness factors were applied to the CH<sub>4</sub> and N<sub>2</sub>O adjusted estimates.

#### The adjusted estimates

137. Tables 6 and 7 show the steps for the calculation of the adjustments for the category road transportation for 2008, 2009 and 2010, in line with paragraph 7 of decision 20/CMP.1, as described in paragraph 136 above. These tables present the results of the ERT's adjustment calculations, including the estimates of CH<sub>4</sub> and N<sub>2</sub>O emissions from gasoline and CH<sub>4</sub> and N<sub>2</sub>O emissions from diesel oil as reported by the United Kingdom, the adjusted estimates as calculated by the ERT, and the impact of the adjustments on total estimated GHG emissions for 2008, 2009 and 2010.

138. As table 6 shows, the adjusted estimate for the subcategory gasoline (CH<sub>4</sub> and N<sub>2</sub>O emissions) for 2008 amounts to 601.79 Gg CO<sub>2</sub> eq compared with 433.33 Gg CO<sub>2</sub> eq as reported by the United Kingdom, for 2009 the adjusted estimate amounts to 451.62 Gg CO<sub>2</sub> eq compared with 331.79 Gg CO<sub>2</sub> eq as reported by the United Kingdom, and for 2010 the adjusted estimate amounts to 388.17 Gg CO<sub>2</sub> eq compared with 280.76 Gg CO<sub>2</sub> eq as reported by the United Kingdom. The application of the adjustments leads to an increase in total estimated GHG emissions of 168.46 Gg CO<sub>2</sub> eq, or 0.03 per cent, for 2008; 119.83 Gg CO<sub>2</sub> eq, or 0.02 per cent, for 2009; and 107.40 Gg CO<sub>2</sub> eq, or 0.02 per cent, for 2010.

139. As table 7 shows, the adjusted estimate for the subcategory diesel oil (CH<sub>4</sub> and N<sub>2</sub>O emissions) for 2008 amounts to 713.28 Gg CO<sub>2</sub> eq compared with 563.51 Gg CO<sub>2</sub> eq as reported by the United Kingdom, for 2009 the adjusted estimate amounts to 750.39 Gg CO<sub>2</sub> eq compared with 588.09 Gg CO<sub>2</sub> eq as reported by the United Kingdom, and for 2010 the adjusted estimate amounts to 837.03 Gg CO<sub>2</sub> eq compared with 635.31 Gg CO<sub>2</sub> eq as reported by the United Kingdom. The application of the adjustment leads to an increase in total estimated GHG emissions of 149.76 Gg CO<sub>2</sub> eq, or 0.02 per cent, for 2008; 162.29 Gg CO<sub>2</sub> eq, or 0.03 per cent, for 2009; and 201.72 Gg CO<sub>2</sub> eq, or 0.03 per cent, for 2010.



Table 6  
**Description of the calculation of the adjustments for CH<sub>4</sub> and N<sub>2</sub>O emissions from gasoline under road transportation for 2008, 2009 and 2010**

<i>Parameter/estimate</i>	<i>Value</i>	<i>Unit</i>	<i>Source</i>
Category: road transportation – gasoline – CH <sub>4</sub> and N <sub>2</sub> O			
United Kingdom's estimate of gasoline use in road transportation for 2008	15.57	Mt	Calculation sheet provided by the United Kingdom
United Kingdom's estimate of gasoline use in road transportation for 2009	15.07	Mt	Calculation sheet provided by the United Kingdom
United Kingdom's estimate of gasoline use in road transportation for 2010	14.09	Mt	Calculation sheet provided by the United Kingdom
United Kingdom's estimate of CH <sub>4</sub> emissions from gasoline use in road transportation for 2008	4.072	Gg	CRF table 1.A(a)
United Kingdom's estimate of CH <sub>4</sub> emissions from gasoline use in road transportation for 2009	2.803	Gg	CRF table 1.A(a)
United Kingdom's estimate of CH <sub>4</sub> emissions from gasoline use in road transportation for 2010	2.291	Gg	CRF table 1.A(a)
United Kingdom's estimate of N <sub>2</sub> O emissions from gasoline use in road transportation for 2008	1.122	Gg	CRF table 1.A(a)
United Kingdom's estimate of N <sub>2</sub> O emissions from gasoline use in road transportation for 2009	0.880	Gg	CRF table 1.A(a)
United Kingdom's estimate of N <sub>2</sub> O emissions from gasoline use in road transportation for 2010	0.750	Gg	CRF table 1.A(a)
United Kingdom's NCV for gasoline for 2008	44.74	TJ/t	Data provided by the United Kingdom
United Kingdom's NCV for gasoline for 2009	44.74	TJ/t	Data provided by the United Kingdom
United Kingdom's NCV for gasoline for 2010	44.74	TJ/t	Data provided by the United Kingdom
Calculated CH <sub>4</sub> IEF for gasoline for 2008	5.84	kg/TJ	ERT's calculation
Calculated CH <sub>4</sub> IEF for gasoline for 2009	4.16	kg/TJ	ERT's calculation
Calculated CH <sub>4</sub> IEF for gasoline for 2010	3.63	kg/TJ	ERT's calculation
Calculated N <sub>2</sub> O IEF for gasoline for 2008	1.61	kg/TJ	ERT's calculation
Calculated N <sub>2</sub> O IEF for gasoline for 2009	1.31	kg/TJ	ERT's calculation

<i>Parameter/estimate</i>	<i>Value</i>	<i>Unit</i>	<i>Source</i>
Calculated N <sub>2</sub> O IEF for gasoline for 2010	1.19	kg/TJ	ERT's calculation
Gasoline AD for road transportation for 2008	732 617.57	TJ	CRF table 1.A(a)
Gasoline AD for road transportation for 2009	692 428.58	TJ	CRF table 1.A(a)
Gasoline AD for road transportation for 2010	656 868.77	TJ	CRF table 1.A(a)
Calculated estimate of CH <sub>4</sub> emissions from gasoline use in road transportation for 2008	4.282	Gg	ERT's calculation
Calculated estimate of CH <sub>4</sub> emissions from gasoline use in road transportation for 2009	2.878	Gg	ERT's calculation
Calculated estimate of CH <sub>4</sub> emissions from gasoline use in road transportation for 2010	2.387	Gg	ERT's calculation
Calculated estimate of N <sub>2</sub> O emissions from gasoline use in road transportation for 2008	1.180	Gg	ERT's calculation
Calculated estimate of N <sub>2</sub> O emissions from gasoline use in road transportation for 2009	0.904	Gg	ERT's calculation
Calculated estimate of N <sub>2</sub> O emissions from gasoline use in road transportation for 2010	0.782	Gg	ERT's calculation
Conservativeness factor: CH <sub>4</sub>	1.12		Table 2 of appendix III to the guidance for adjustments under Article 5, paragraph 2, of the Kyoto Protocol
Conservativeness factor: N <sub>2</sub> O	1.37		Table 2 of appendix III to the guidance for adjustments under Article 5, paragraph 2, of the Kyoto Protocol
Adjusted conservative estimate of CH <sub>4</sub> emissions from gasoline use in road transportation for 2008	4.795	Gg	ERT's calculation
Adjusted conservative estimate of CH <sub>4</sub> emissions from gasoline use in road transportation for 2009	3.224	Gg	ERT's calculation
Adjusted conservative estimate of CH <sub>4</sub> emissions from gasoline use in road transportation for 2010	2.673	Gg	ERT's calculation
Adjusted conservative estimate of N <sub>2</sub> O emissions from gasoline use in road transportation for	1.616	Gg	ERT's calculation

<i>Parameter/estimate</i>	<i>Value</i>	<i>Unit</i>	<i>Source</i>
2008			
Adjusted conservative estimate of N <sub>2</sub> O emissions from gasoline use in road transportation for 2009	1.238	Gg	ERT's calculation
Adjusted conservative estimate of N <sub>2</sub> O emissions from gasoline use in road transportation for 2010	1.071	Gg	ERT's calculation
United Kingdom's estimate of CH <sub>4</sub> emissions from gasoline use in road transportation for 2008	85.506	Gg CO <sub>2</sub> eq	ERT's calculation
United Kingdom's estimate of CH <sub>4</sub> emissions from gasoline use in road transportation for 2009	58.867	Gg CO <sub>2</sub> eq	ERT's calculation
United Kingdom's estimate of CH <sub>4</sub> emissions from gasoline use in road transportation for 2010	48.110	Gg CO <sub>2</sub> eq	ERT's calculation
United Kingdom's estimate of N <sub>2</sub> O emissions from gasoline use in road transportation for 2008	347.823	Gg CO <sub>2</sub> eq	ERT's calculation
United Kingdom's estimate of N <sub>2</sub> O emissions from gasoline use in road transportation for 2009	272.925	Gg CO <sub>2</sub> eq	ERT's calculation
United Kingdom's estimate of N <sub>2</sub> O emissions from gasoline use in road transportation for 2010	232.654	Gg CO <sub>2</sub> eq	ERT's calculation
Adjusted conservative estimate of CH <sub>4</sub> emissions from gasoline use in road transportation for 2008	100.704	Gg CO <sub>2</sub> eq	ERT's calculation
Adjusted conservative estimate of CH <sub>4</sub> emissions from gasoline use in road transportation for 2009	67.697	Gg CO <sub>2</sub> eq	ERT's calculation
Adjusted conservative estimate of CH <sub>4</sub> emissions from gasoline use in road transportation for 2010	56.131	Gg CO <sub>2</sub> eq	ERT's calculation
Adjusted conservative estimate of N <sub>2</sub> O emissions from gasoline use in road transportation for 2008	501.087	Gg CO <sub>2</sub> eq	ERT's calculation
Adjusted conservative estimate of N <sub>2</sub> O emissions from gasoline use in road transportation for 2009	383.921	Gg CO <sub>2</sub> eq	ERT's calculation
Adjusted conservative estimate of N <sub>2</sub> O emissions from gasoline use in road transportation for 2010	332.035	Gg CO <sub>2</sub> eq	ERT's calculation

<i>Parameter/estimate</i>	<i>Value</i>	<i>Unit</i>	<i>Source</i>
Adjusted conservative estimate of CH <sub>4</sub> and N <sub>2</sub> O emissions from gasoline use in road transportation for 2008	601.791	Gg CO <sub>2</sub> eq	ERT's calculation
Adjusted conservative estimate of CH <sub>4</sub> and N <sub>2</sub> O emissions from gasoline use in road transportation for 2009	451.617	Gg CO <sub>2</sub> eq	ERT's calculation
Adjusted conservative estimate of CH <sub>4</sub> and N <sub>2</sub> O emissions from gasoline use in road transportation for 2010	388.166	Gg CO <sub>2</sub> eq	ERT's calculation
Total aggregated GHG emissions (excluding LULUCF) as reported by the United Kingdom for 2008	634 890.968	Gg CO <sub>2</sub> eq	2012 annual submission of the United Kingdom, v1.3, CRF table Summary 2
Total aggregated GHG emissions (excluding LULUCF) as reported by the United Kingdom for 2009	581 041.584	Gg CO <sub>2</sub> eq	2012 annual submission of the United Kingdom, v1.3, CRF table Summary 2
Total aggregated GHG emissions (excluding LULUCF) as reported by the United Kingdom for 2010	599 105.476	Gg CO <sub>2</sub> eq	2012 annual submission of the United Kingdom, v1.3, CRF table Summary 2
Total aggregated GHG emissions (excluding LULUCF) after application of adjustment: CH <sub>4</sub> and N <sub>2</sub> O emissions from gasoline use in road transportation for 2008	635 059.430	Gg CO <sub>2</sub> eq	ERT's calculation
Total aggregated GHG emissions (excluding LULUCF) after application of adjustment: CH <sub>4</sub> and N <sub>2</sub> O emissions from gasoline use in road transportation for 2009	581 161.410	Gg CO <sub>2</sub> eq	ERT's calculation
Total aggregated GHG emissions (excluding LULUCF) after application of adjustment: CH <sub>4</sub> and N <sub>2</sub> O emissions from gasoline use in road transportation for 2010	599 212.879	Gg CO <sub>2</sub> eq	ERT's calculation
Difference between original and adjusted total aggregated GHG emissions: CH <sub>4</sub> and N <sub>2</sub> O emissions from gasoline use in road transportation for 2008	168.462	Gg CO <sub>2</sub> eq	ERT's calculation
	0.03	%	ERT's calculation
Difference between original and adjusted total aggregated GHG emissions: CH <sub>4</sub> and N <sub>2</sub> O emissions from gasoline use in road transportation for 2009	119.826	Gg CO <sub>2</sub> eq	ERT's calculation
	0.02	%	ERT's calculation

<i>Parameter/estimate</i>	<i>Value</i>	<i>Unit</i>	<i>Source</i>
Difference between original and adjusted total aggregated GHG emissions: CH <sub>4</sub> and N <sub>2</sub> O	107.403	Gg CO <sub>2</sub> eq	ERT's calculation
emissions from gasoline use in road transportation for 2010	0.02	%	ERT's calculation

*Abbreviations:* AD = activity data, CRF = common reporting format, ERT = expert review team, GHG = greenhouse gas, IEF= implied emission factor, LULUCF = land use, land-use change and forestry, NCV = net calorific value.

Table 7

**Description of the calculation of the adjustments for CH<sub>4</sub> and N<sub>2</sub>O emissions from diesel oil under road transportation for 2008, 2009 and 2010**

<i>Parameter/estimate</i>	<i>Value</i>	<i>Unit</i>	<i>Source</i>
Category: road transportation – diesel oil – CH <sub>4</sub> and N <sub>2</sub> O			
United Kingdom's estimate of diesel oil use in road transportation for 2008	21.80	Mt	Calculation sheet provided by the United Kingdom
United Kingdom's estimate of diesel oil use in road transportation for 2009	21.13	Mt	Calculation sheet provided by the United Kingdom
United Kingdom's estimate of diesel oil use in road transportation for 2010	21.30	Mt	Calculation sheet provided by the United Kingdom
United Kingdom's estimate of CH <sub>4</sub> emissions from diesel oil use in road transportation for 2008	1.486	Gg	CRF table 1.A(a)
United Kingdom's estimate of CH <sub>4</sub> emissions from diesel oil use in road transportation for 2009	1.209	Gg	CRF table 1.A(a)
United Kingdom's estimate of CH <sub>4</sub> emissions from diesel oil use in road transportation for 2010	1.076	Gg	CRF table 1.A(a)
United Kingdom's estimate of N <sub>2</sub> O emissions from diesel oil use in road transportation for 2008	1.717	Gg	CRF table 1.A(a)
United Kingdom's estimate of N <sub>2</sub> O emissions from diesel oil use in road transportation for 2009	1.815	Gg	CRF table 1.A(a)
United Kingdom's estimate of N <sub>2</sub> O emissions from diesel oil use in road transportation for 2010	1.977	Gg	CRF table 1.A(a)
United Kingdom's NCV for	43.35	TJ/t	Data provided by the

<i>Parameter/estimate</i>	<i>Value</i>	<i>Unit</i>	<i>Source</i>
diesel oil for 2008			United Kingdom
United Kingdom's NCV for diesel oil for 2009	43.40	TJ/t	Data provided by the United Kingdom
United Kingdom's NCV for diesel oil for 2010	43.36	TJ/t	Data provided by the United Kingdom
Calculated CH <sub>4</sub> IEF for diesel oil for 2008	1.57	kg/TJ	ERT's calculation
Calculated CH <sub>4</sub> IEF for diesel oil for 2009	1.32	kg/TJ	ERT's calculation
Calculated CH <sub>4</sub> IEF for diesel oil for 2010	1.16	kg/TJ	ERT's calculation
Calculated N <sub>2</sub> O IEF for diesel oil for 2008	1.82	kg/TJ	ERT's calculation
Calculated N <sub>2</sub> O IEF for diesel oil for 2009	1.98	kg/TJ	ERT's calculation
Calculated N <sub>2</sub> O IEF for diesel oil for 2010	2.14	kg/TJ	ERT's calculation
Diesel oil AD for road transportation for 2008	882 063.19	TJ	CRF table 1.A(a)
Diesel oil AD for road transportation for 2009	860 831.88	TJ	CRF table 1.A(a)
Diesel oil AD for road transportation for 2010	894 032.02	TJ	CRF table 1.A(a)
Calculated estimate of CH <sub>4</sub> emissions from diesel oil use in road transportation for 2008	1.387	Gg	ERT's calculation
Calculated estimate of CH <sub>4</sub> emissions from diesel oil use in road transportation for 2009	1.135	Gg	ERT's calculation
Calculated estimate of CH <sub>4</sub> emissions from diesel oil use in road transportation for 2010	1.041	Gg	ERT's calculation
Calculated estimate of N <sub>2</sub> O emissions from diesel oil use in road transportation for 2008	1.603	Gg	ERT's calculation
Calculated estimate of N <sub>2</sub> O emissions from diesel oil use in road transportation for 2009	1.704	Gg	ERT's calculation
Calculated estimate of N <sub>2</sub> O emissions from diesel oil use in road transportation for 2010	1.913	Gg	ERT's calculation
Conservativeness factor: CH <sub>4</sub>	1.12		Table 2 of appendix III to the guidance for adjustments under Article 5, paragraph 2, of the Kyoto Protocol
Conservativeness factor: N <sub>2</sub> O	1.37		Table 2 of appendix III to the guidance for adjustments under

<i>Parameter/estimate</i>	<i>Value</i>	<i>Unit</i>	<i>Source</i>
			Article 5, paragraph 2, of the Kyoto Protocol
Adjusted conservative estimate of CH <sub>4</sub> emissions from diesel oil use in road transportation for 2008	1.553	Gg	ERT's calculation
Adjusted conservative estimate of CH <sub>4</sub> emissions from diesel oil use in road transportation for 2009	1.271	Gg	ERT's calculation
Adjusted conservative estimate of CH <sub>4</sub> emissions from diesel oil use in road transportation for 2010	1.166	Gg	ERT's calculation
Adjusted conservative estimate of N <sub>2</sub> O emissions from diesel oil use in road transportation for 2008	2.196	Gg	ERT's calculation
Adjusted conservative estimate of N <sub>2</sub> O emissions from diesel oil use in road transportation for 2009	2.335	Gg	ERT's calculation
Adjusted conservative estimate of N <sub>2</sub> O emissions from diesel oil use in road transportation for 2010	2.621	Gg	ERT's calculation
United Kingdom's estimate of CH <sub>4</sub> emissions from diesel oil use in road transportation for 2008	31.203	Gg CO <sub>2</sub> eq	ERT's calculation
United Kingdom's estimate of CH <sub>4</sub> emissions from diesel oil use in road transportation for 2009	25.382	Gg CO <sub>2</sub> eq	ERT's calculation
United Kingdom's estimate of CH <sub>4</sub> emissions from diesel oil use in road transportation for 2010	22.589	Gg CO <sub>2</sub> eq	ERT's calculation
United Kingdom's estimate of N <sub>2</sub> O emissions from diesel oil use in road transportation for 2008	532.311	Gg CO <sub>2</sub> eq	ERT's calculation
United Kingdom's estimate of N <sub>2</sub> O emissions from diesel oil use in road transportation for 2009	562.712	Gg CO <sub>2</sub> eq	ERT's calculation
United Kingdom's estimate of N <sub>2</sub> O emissions from diesel oil use in road transportation for 2010	612.724	Gg CO <sub>2</sub> eq	ERT's calculation
Adjusted conservative estimate	32.618	Gg CO <sub>2</sub> eq	ERT's calculation

<i>Parameter/estimate</i>	<i>Value</i>	<i>Unit</i>	<i>Source</i>
of CH <sub>4</sub> emissions from diesel oil use in road transportation for 2008			
Adjusted conservative estimate of CH <sub>4</sub> emissions from diesel oil use in road transportation for 2009	26.687	Gg CO <sub>2</sub> eq	ERT's calculation
Adjusted conservative estimate of CH <sub>4</sub> emissions from diesel oil use in road transportation for 2010	24.489	Gg CO <sub>2</sub> eq	ERT's calculation
Adjusted conservative estimate of N <sub>2</sub> O emissions from diesel oil use in road transportation for 2008	680.658	Gg CO <sub>2</sub> eq	ERT's calculation
Adjusted conservative estimate of N <sub>2</sub> O emissions from diesel oil use in road transportation for 2009	723.700	Gg CO <sub>2</sub> eq	ERT's calculation
Adjusted conservative estimate of N <sub>2</sub> O emissions from diesel oil use in road transportation for 2010	812.543	Gg CO <sub>2</sub> eq	ERT's calculation
Adjusted conservative estimate of CH <sub>4</sub> and N <sub>2</sub> O emissions from diesel oil use in road transportation for 2008	713.276	Gg CO <sub>2</sub> eq	ERT's calculation
Adjusted conservative estimate of CH <sub>4</sub> and N <sub>2</sub> O emissions from diesel oil use in road transportation for 2009	750.387	Gg CO <sub>2</sub> eq	ERT's calculation
Adjusted conservative estimate of CH <sub>4</sub> and N <sub>2</sub> O emissions from diesel oil use in road transportation for 2010	837.032	Gg CO <sub>2</sub> eq	ERT's calculation
Total aggregated GHG emissions (excluding LULUCF) as reported by the United Kingdom for 2008	634 890.968	Gg CO <sub>2</sub> eq	2012 annual submission of the United Kingdom, v1.3, CRF table Summary 2
Total aggregated GHG emissions (excluding LULUCF) as reported by the United Kingdom for 2009	581 041.584	Gg CO <sub>2</sub> eq	2012 annual submission of the United Kingdom, v1.3, CRF table Summary 2
Total aggregated GHG emissions (excluding LULUCF) as reported by the United Kingdom for 2010	599 105.476	Gg CO <sub>2</sub> eq	2012 annual submission of the United Kingdom, v1.3, CRF table Summary 2
Total aggregated GHG emissions (excluding LULUCF) after application of adjustment: CH <sub>4</sub> and N <sub>2</sub> O emissions from diesel	635 040.730	Gg CO <sub>2</sub> eq	ERT's calculation



<i>Parameter/estimate</i>	<i>Value</i>	<i>Unit</i>	<i>Source</i>
oil use in road transportation for 2008			
Total aggregated GHG emissions (excluding LULUCF) after application of adjustment: CH <sub>4</sub> and N <sub>2</sub> O emissions from diesel oil use in road transportation for 2008	581 203.876	Gg CO <sub>2</sub> eq	ERT's calculation
Total aggregated GHG emissions (excluding LULUCF) after application of adjustment: CH <sub>4</sub> and N <sub>2</sub> O emissions from diesel oil use in road transportation for 2009	599 307.195	Gg CO <sub>2</sub> eq	ERT's calculation
Total aggregated GHG emissions (excluding LULUCF) after application of adjustment: CH <sub>4</sub> and N <sub>2</sub> O emissions from diesel oil use in road transportation for 2010			
Difference between original and adjusted total aggregated GHG emissions: CH <sub>4</sub> and N <sub>2</sub> O emissions from diesel oil use in road transportation for 2008	149.762	Gg CO <sub>2</sub> eq	ERT's calculation
	0.02	%	
Difference between original and adjusted total aggregated GHG emissions: CH <sub>4</sub> and N <sub>2</sub> O emissions from diesel oil use in road transportation for 2009	162.293	Gg CO <sub>2</sub> eq	ERT's calculation
	0.03	%	
Difference between original and adjusted total aggregated GHG emissions: CH <sub>4</sub> and N <sub>2</sub> O emissions from diesel oil use in road transportation for 2010	201.719	Gg CO <sub>2</sub> eq	ERT's calculation
	0.03	%	

*Abbreviations:* AD = activity data, CRF = common reporting format, ERT = expert review team, GHG = greenhouse gas, IEF= implied emission factor, LULUCF = land use, land-use change and forestry, NCV = net calorific value.

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

140. In line with paragraph 5 of decision 20/CMP.1, conservativeness was ensured by applying a conservativeness factor of 1.12 (for the CH<sub>4</sub> emission estimates under transport (road and other)) and of 1.37 (for the N<sub>2</sub>O emission estimates under transport (road and other)) from table 2 of appendix III to the guidance for adjustments under Article 5, paragraph 2, of the Kyoto Protocol (annex to decision 20/CMP.1). The ERT therefore considers that the resulting adjusted values are conservative. The ERT did not apply conservativeness factors to the AD as it considers that the fuel consumption data (fuel sales) are very accurate and correspond to the data used to calculate the CO<sub>2</sub> emissions estimates under this category which were obtained from the national energy balance.

## **H. 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

141. The United Kingdom has provided a complete set of information in accordance with the requirements outlined in paragraphs 5–9 of the annex to decision 15/CMP.1. The United Kingdom's national system is able to provide reliable data on units of land subject to activities under Article 3, paragraph 3, of the Kyoto Protocol and on lands subject to forest management, the Party's elected activity under Article 3, paragraph 4, of the Kyoto Protocol, and to track those lands and units of land over time. Further, the United Kingdom's ongoing improvement activities are expected to increase the accuracy of the land representation data that will be reported at the end of the commitment period when the United Kingdom accounts for its KP-LULUCF activities. The ERT noted that the United Kingdom did not report in CRF table 5(KP-I)A.1.3 information on "Units of land subject to activities under Article 3, paragraph 3, which would otherwise be included in land subject to elected activities under Article 3, paragraph 4". However, the whole area reported under afforestation and reforestation, which includes planted areas or areas where forest expansion is under a grant scheme, would otherwise be included under forest management. The ERT recommends that the United Kingdom report the required information in CRF table 5(KP-I)A.1.3 in its next annual submission.

142. As indicated in the previous review report, the United Kingdom reports that the geographical unit used to determine the area of the units of land is the four countries of the United Kingdom (England, Wales, Scotland and Northern Ireland). However, the United Kingdom does not provide information on the spatial assessment unit. The ERT therefore reiterates the recommendation in the previous review report that the United Kingdom also include information in section 11.2.1 of its NIR describing the spatial assessment unit used and, in accordance with the annex to decision 16/CMP.1, on how it corresponds to the minimum land area and width requirements defined by the United Kingdom's forest definition, and hence the detection of land-use change at the scale consistent with the Party's forest definition.

143. The United Kingdom has made recalculations for the KP-LULUCF activities between the 2011 and 2012 annual submissions in response to the 2011 annual review report by revising the AD, in particular for deforestation activities. The impact of these recalculations on each KP-LULUCF activity for 2009 is as follows:

- (a) Afforestation/reforestation: a decrease in net removals of 0.7 per cent;
- (b) Deforestation: a decrease in net emissions of 13.1 per cent;
- (c) Forest management: a decrease in net removals of 0.2 per cent.

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

##### *Afforestation and reforestation – CO<sub>2</sub>*

144. To estimate the carbon stock changes in unit of lands subject to afforestation and reforestation activities, the Party used the C-Flow model (see para. 105 above). As stated by the United Kingdom during the review, a new model (FC CARBINE) will be used for the estimation of the carbon stock changes for these activities by the 2014 annual submission. The ERT recommends that the United Kingdom meet its planned deadline in

order to report carbon stock change estimates with the FC CARBINE model when accounting for afforestation and reforestation at the end of the commitment period.

#### *Deforestation – CO<sub>2</sub>*

145. The ERT noted that the United Kingdom does not differentiate between mineral and organic soils in the estimation of emissions and removals from deforestation. Further, the model (exponential negative function) applied by the Party for the estimation of the carbon stock changes in SOM does not estimate the emissions associated with the drainage of organic soils. The ERT recommends that the United Kingdom, in its next annual submission, differentiate the SOM carbon stock changes for mineral and organic soils and estimate the emissions associated with the drainage of organic soils, if this practice occurs. If the lack of data is an impediment, the United Kingdom may consider assigning the mineral and organic soil areas subject to deforestation in proportion to their relative contribution to the forest land category.

146. With respect to the carbon stock changes in the above-ground and below-ground biomass, litter and dead wood pools, the United Kingdom reports an available biomass of 240 t ha<sup>-1</sup> and applies an expansion factor to account for litter and dead wood. In view of the availability of country-specific data for each carbon pool for each country of the United Kingdom averaged according to the forest area of the whole country and estimated using the current model (C-Flow) and the new model (FC CARBINE) (see para. 105 above), the ERT recommends that the United Kingdom, in its next annual submission, use country-specific values to estimate the carbon stocks contained in each pool prior to deforestation or, as recommended in the previous review report, to provide justification for using a unique available biomass factor (i.e. 240 t ha<sup>-1</sup>).

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

##### *Forest management – CO<sub>2</sub>*

147. The C-Flow model applied by the United Kingdom for the estimation of emissions and removals from forest management does not verify or reconcile the model outputs with annual statistics on harvesting and timber production; thus, it is not possible to assess the accuracy of the estimated carbon stock changes. The ERT acknowledges that, in order to address this and other current weaknesses in the carbon stock change estimates, the United Kingdom is implementing an alternative model, FC CARBINE, which, according to the improvement plan provided to the ERT during the review, is due to be completed for the 2014 annual submission. The ERT recommends that the United Kingdom meet its planned deadline in order to report carbon stock change estimates with the FC CARBINE model when accounting for forest management at the end of the commitment period.

## **2. Information on Kyoto Protocol units**

#### Standard electronic format and reports from the national registry

148. 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 included in the SIAR on the SEF tables and the SEF comparison report.<sup>13</sup> The SIAR was forwarded to the ERT prior to the review, pursuant to decision 16/CP.10. The ERT reiterated the main findings contained in the SIAR.

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<sup>13</sup> 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.

149. 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. This information is consistent with that contained in the national registry and with the records of the international transaction log (ITL) and the clean development mechanism registry and meets the requirements referred to in decision 22/CMP.1, annex, paragraph 88(a–j). The transactions of Kyoto Protocol units initiated by the national registry are in accordance with the requirements of the annex to decision 5/CMP.1 and the annex to decision 13/CMP.1. No discrepancy has been identified by the ITL other than that relating to an error outside of the control of the United Kingdom’s national registry, for which the United Kingdom’s national registry terminated the external transaction. The discrepancy did not affect the capacity of the United Kingdom’s national registry to ensure accurate accounting, and no non-replacement has occurred. The national registry has adequate procedures in place to minimize discrepancies.

150. Information reported by the Party on records of any discrepancies and on any records of non-replacement was found to be consistent with the information provided to the secretariat by the ITL.

#### National registry

151. The ERT took note of the SIAR and its finding that the reported information on the national registry is complete and has been submitted in accordance with the annex to decision 15/CMP.1. The ERT further noted from the SIAR and its finding that 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 decisions 16/CP.10 and 12/CMP.1. The national registry also has adequate security, data safeguard and disaster recovery measures in place and its operational performance is adequate.

#### Calculation of the commitment period reserve

152. The United Kingdom has reported its commitment period reserve in its 2012 annual submission. The United Kingdom reported that its commitment period reserve has not changed since the initial report review (3,070,872,567 t CO<sub>2</sub> eq). This calculation is based on 90 per cent of the assigned amount, which is lower than the calculation based on the total estimated GHG emissions in the 2008 GHG inventory of the 2010 annual submission used by the United Kingdom as the most recently reviewed inventory. According to the United Kingdom “the 1990–2008 inventory has been taken as the most recently reviewed inventory, because the report of the 1990–2009 inventory review is not yet finalised”. The ERT disagreed with this figure, because it considers that this calculation should be based on the comparison of 90 per cent of the assigned amount with the total estimated GHG emissions in the 2010 GHG inventory of the 2012 annual submission, which are lower. In response to questions raised by the ERT during the review, the United Kingdom reported its commitment period reserve to be 2,995,527,381 t CO<sub>2</sub> eq based on the national emissions in its most recently reviewed inventory (599,105.476 Gg CO<sub>2</sub> eq). The ERT noted that, although this value is correctly calculated, taking into account the applied adjustment for 2010 (309.12 Gg CO<sub>2</sub> eq) (see paras. 138 and 139 above), the new commitment period reserve calculated by the ERT equals 2,997,072,992 t CO<sub>2</sub> eq. The ERT recommends that the United Kingdom correctly calculate its commitment period reserve in the next annual submission, in accordance with paragraph 6 of the annex to decision 11/CMP.1.

### **3. Changes to the national system**

153. The United Kingdom reported that there have been changes to its national system since the previous annual submission. The Party described the changes in its NIR, indicating that in 2011 a new contract for the compilation of the national GHG inventory was awarded to a consortium led by AEA, and that North Wyke Research, the organization responsible for the compilation of the GHG inventory for the agriculture sector is now a part of Rothamsted Research. 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**

154. The United Kingdom reported that there have been changes to its national registry since the previous annual submission and these are described in its NIR. The changes were related to the software and included increased capacity, a number of security enhancements, the implementation of the improved ITL message flow, data migration enhancements and maintenance fixes. The ERT concluded that, taking into account the confirmed changes to the national registry, 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).

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

155. The United Kingdom reported information on the minimization of adverse impacts in accordance with Article 3, paragraph 14, of the Kyoto Protocol in its 2012 annual submission, but did not explicitly identify the changes in its reporting compared with the previous annual submission in accordance with the annex to decision 15/CMP.1. However, the ERT noted changes in the United Kingdom's reporting under Article 3, paragraph 14, of the Kyoto Protocol and these are described in paragraph 156 below. The ERT reiterates the recommendation in the previous review report that the United Kingdom include information on any changes made to its reporting under Article 3, paragraph 14, of the Kyoto Protocol in its next annual submission. The ERT concluded that, taking into account the identified changes in the reporting, the information provided is complete. The ERT also concluded that the reporting is generally transparent given that the United Kingdom does not clearly identify the changes in its reporting compared with the previous annual submission. The ERT recommends that the United Kingdom continue to update such information with the aim of increasing transparency.

156. In chapter 15 of the NIR of its 2012 annual submission, the United Kingdom continues to outline the key directions of its actions on the minimization of adverse impacts in accordance with Article 3, paragraph 14, of the Kyoto Protocol. The ERT noted the following changes in the United Kingdom's reporting:

(a) Information on the International Climate Fund (ICF): the United Kingdom is investing 130 million pounds sterling (GBP) in the Climate Public Private Partnership to support projects delivering renewable and efficient energy, and new technology, and to protect natural resources in emerging and developing countries, including in Africa and Asia. Through ICF, the United Kingdom is also providing GBP 6 million to help kick start solar energy projects in India; and GBP 7 million as well as technical support to the World Bank Partnership for Market Readiness to help developing countries set up their own carbon trading systems to cut emissions;

(b) Information on the Avoiding Dangerous Climate Change (AVOID) programme: the programme has investigated China's technology options for reducing CO<sub>2</sub> emissions from the energy sector in order to meet a national 2050 emissions target;

(c) A memorandum of understanding (MoU) on energy research with the Government of Bangladesh: under the MoU, collaborative research projects on renewable energy as well as research related to energy technologies, systems, services and policies will be developed;

(d) Information on the United Kingdom's participation in the International Renewable Energy Agency (IRENA): the Party has been playing an active part in IRENA by chairing its Policy and Strategy Committee to help develop the Agency's work programme for 2012 (which includes activities on policy advisory services and capacity-building) and its mid-term strategy;

(e) Information on new financial support to the Department for International Development (DFID): the United Kingdom announced at the United Nations Climate Change Conference in Durban, South Africa, in 2011 a further GBP 85 million in support from DFID for the Pilot Programme for Climate Resilience (PPCR). This support is designed "to deliver transformational outcomes in a small number of pilot countries through supporting the integration of climate resilience into development planning and budgeting";

(f) Information on new financial support to the Adaptation Fund: the United Kingdom also announced GBP 10 million in support from DFID for the Adaptation Fund "to support concrete adaptation activities that reduce vulnerability and increase adaptive capacity to respond to the impacts of climate change, including variability at local and national levels";

(g) Information on Energy Market Reform (EMR): in July 2011 the United Kingdom Government published the EMR White Paper ("Planning our electric future: a White Paper for secure, affordable and low-carbon electricity") which set out a package of electricity market reforms (e.g. low-carbon contracts (Feed-in-Tariff with Contracts for Difference (FiT CfD)) to bring forward all forms of low-carbon electricity generation; the transition from the current Renewables Obligation to FiT CfD; a Carbon Price Floor to put a fair price on carbon; and an Emissions Performance Standard to provide a regulatory backstop on the amount of emissions new fossil fuel plants can emit). The White Paper marked the first stage of the market reform process and was followed by the publication of the Technical Update to the White Paper in December 2011 which completed the strategic framework outlined in the White Paper.

### **III. Conclusions and recommendations**

#### **A. Conclusions**

157. The United Kingdom made its annual submission on 13 April 2012. The annual submission contains the GHG inventory (comprising CRF tables and an NIR) and supplementary information under Article 7, paragraph 1, of the Kyoto Protocol (information on: activities under Article 3, paragraphs 3 and 4, of the Kyoto Protocol, Kyoto Protocol units, changes to the national system and the national registry, and the minimization of adverse impacts in accordance with Article 3, paragraph 14, of the Kyoto Protocol). This is in line with decision 15/CMP.1.

158. The ERT concludes that the inventory submission of the United Kingdom has been prepared and reported in accordance with the UNFCCC reporting guidelines. The inventory

submission is complete and the United Kingdom has submitted a complete set of CRF tables for the years 1990–2010 and an NIR; these are generally complete in terms of geographical coverage, as well as complete in terms of years, sectors, categories and gases. The ERT identified that for some categories in the energy, agriculture and waste sectors there are still some small gaps in the reporting of emissions from the OTs and CDs, leading to very small underestimations of emissions. 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 these categories (see paras. 39 and 96 above).

159. 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.

160. The United Kingdom's inventory is generally in line with the Revised 1996 IPCC Guidelines, the IPCC good practice guidance and the IPCC good practice guidance for LULUCF. During the review, the ERT identified some potential underestimations in several categories in most sectors (e.g. in the energy, industrial processes, agriculture and waste sectors). 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 these categories (see paras. 39, 72, 96 and 120 above), with the exception of CH<sub>4</sub> and N<sub>2</sub>O emissions from road transportation in the energy sector (see para. 63 above). Although the United Kingdom provided its rationale for its approach, the ERT considered that it is not consistent with the Revised 1996 IPCC Guidelines as elaborated by the IPCC good practice guidance and decided to recommend and apply an adjustment for CH<sub>4</sub> and N<sub>2</sub>O emissions from road transportation in the energy sector in accordance with the Article 8 review guidelines (see para. 63 above). The ERT considers that the overall transparency of the NIR still requires further improvement; although the NIR and its annexes contain a lot of information, it is not always possible to easily understand the approaches taken and the methodologies applied as the information is not well structured.

161. The United Kingdom has made recalculations for the complete time series for the inventory between the 2011 and 2012 annual submissions in response to the 2011 annual review report, in order to lift applied adjustments, following changes in AD and EFs, and in order to rectify identified errors. The impact of these recalculations on the national totals is an increase in emissions of 1.06 per cent for 2009 and a decrease in emissions of 1.56 per cent for 1990. The main recalculations took place in the following sectors/categories:

- (a) In the energy sector: revisions of national fuel use statistics;
- (b) In the industrial processes sector: a revision of the model used to estimate emissions from refrigeration and air-conditioning equipment;
- (c) In the waste sector: improvements to the model used to estimate emissions from solid waste disposal on land.

162. The United Kingdom provided a complete set of information in accordance with the requirements outlined in paragraphs 5–9 of the annex to decision 15/CMP.1. The United Kingdom's national system is able to provide reliable data on units of land subject to activities under Article 3, paragraphs 3 and 4, of the Kyoto Protocol and to track those lands and units of land over time. The ERT acknowledges the ongoing improvements in the LULUCF sector, in particular the development of a new model for estimating the carbon stock changes. These improvements are expected to increase the accuracy of the information that will be reported when the Party accounts for its KP-LULUCF activities at the end of the commitment period.

163. The Party has made recalculations for the KP-LULUCF activities between the 2011 and 2012 annual submissions in response to the 2011 annual review report by revising the

AD, in particular for deforestation activity. The impact of these recalculations on each KP-LULUCF activity for 2009 is as follows:

- (a) Afforestation/reforestation: a decrease in net removals of 0.7 per cent;
- (b) Deforestation: a decrease in net emissions of 13.1 per cent;
- (c) Forest management: a decrease in net removals of 0.2 per cent.

164. 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.

165. The national system continues to perform its required functions as set out in the annex to decision 19/CMP.1.

166. 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.

167. The United Kingdom has reported information under decision 15/CMP.1, annex, chapter I.H, “Minimization of adverse impacts in accordance with Article 3, paragraph 14” and the information was provided on 13 April 2012 as part of its 2012 annual submission. The information provided is complete and, given that the United Kingdom does not clearly identify the changes in its reporting compared with the previous annual submission, is generally transparent.

## B. Recommendations

168. The ERT identifies issues for improvement as listed in table 8 below. Unless indicated otherwise, the recommendations are to be implemented in the next annual submission.

Table 8  
**Recommendations identified by the expert review team**

<i>Sector</i>	<i>Category</i>	<i>Recommendation</i>	<i>Paragraph reference</i>
General	Inventory planning	Make better use of the coordination mechanism provided by the National Inventory Steering Committee to ensure that there is good communication between all of the agencies/organizations/experts involved in the inventory preparation process, either at a primary level or as key data providers, to enable better understanding of the roles of, and relationships between, all of the agencies and data providers involved in the preparation of the GHG inventory, including the inventory agency	16
		Provide additional information on the inventory improvement programme (e.g. regarding priority-setting) in the NIR	17



<i>Sector</i>	<i>Category</i>	<i>Recommendation</i>	<i>Paragraph reference</i>
		Provide a comprehensive improvement plan in the NIR	18
	Key category analysis	Include in the NIR a further brief explanation of what is covered in the qualitative approach	20
		Improve the presentation of the key category assessment information	20
	Recalculations	Include clearer explanations of the recalculations in the NIR	22
	Time-series consistency	Improve time-series consistency of the inventory by implementing new research activities to seek improved AD, or where full time-series consistency is not possible, provide further explanations in the NIR to improve the transparency of the data and methods across the time series	23
	QA/QC	Apply the QC procedures consistently to the whole inventory preparation and reporting process	24
	Transparency	Focus on the presentation and streamlining of the information provided in the NIR and continue to improve the transparency of the NIR	25
		Undertake a review of the use of the notation keys to ensure that the correct notation keys are being applied	25
		Ensure that use of the notation key “IE” is fully transparent by providing adequate explanations of where the corresponding emissions have been included	25
	Inventory management	Briefly describe in the NIR the roles of Rothamsted Research and the United Kingdom Centre for Ecology and Hydrology with respect to archiving	26
	Previous review reports	Provide a table in the NIR that contains all of the recommendations contained in table 8 of the 2012 annual review report, together with a short explanation and/or reference to the appropriate section of the NIR in which the recommendation is addressed, including in the inventory improvement plan, as appropriate	27
		Include explicit information in the NIR whenever adjustments have been applied to the inventory, explaining how the United Kingdom has responded to the adjustments in subsequent inventories (reiteration of recommendation	29

<i>Sector</i>	<i>Category</i>	<i>Recommendation</i>	<i>Paragraph reference</i>
		from previous review report)	
Energy	AD	Make efforts to incorporate all available and/or updated energy information in DUKES, in order to ensure the consistency of all AD used in the energy sector	36
		Improve the quality of the AD through DECC and ensure that data on all energy consumption by all major energy-producing companies, apart from the electricity and heat production and refinery activities (e.g. upstream oil and gas production and petrochemical plants), are included the United Kingdom's energy balance in DUKES	36
		Improve the use of EU ETS data within the GHG inventory estimates by ensuring that aggregated AD by fuel and category for EU ETS installations are included in the energy balance in DUKES and can be reconciled with the energy statistics, in order to provide more complete and accurate energy use allocation for use in the GHG inventory across the time series	41
	AD and EFs	Complete the improvement regarding the use of comparable units (e.g. t CO <sub>2</sub> /TJ for the carbon EFs and PJ for consumption of gaseous fuels) (partial reiteration of a recommendation from a previous review report)	43(a)
	QA/QC	Implement its planned efforts on QA/QC procedures during the last step of compilation of the inventory	44
	AD	Improve the consistency of the information reported in the different sectors (e.g. in the waste and industrial processes sectors), in particular in relation to the cases indicated in paragraph 46(a–c)	46
	Reference approach	Investigate the reasons for the differences and improve the QC procedures performed prior to the submission of the CRF tables (reiteration of recommendation from previous review report)	49
		Reconsider the use of the notation key “NA” and closely follow the definitions of the notation keys provided 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”	50

<i>Sector</i>	<i>Category</i>	<i>Recommendation</i>	<i>Paragraph reference</i>
	Feedstocks and non-energy use of fuels	Provide additional information on the categories where feedstocks are used, (reiteration of recommendation from previous review report) and provide the references for the storage fractions	53
	Stationary combustion: liquid fuels – CO <sub>2</sub> , CH <sub>4</sub> and N <sub>2</sub> O	Review, through DECC, the allocation of fuels to non-energy uses within DUKES, in order to identify any other misallocations of fuels to non-energy use that may lead to underestimates of emissions in the GHG inventory	55
	Fugitive emissions from solid fuels – CH <sub>4</sub>	Report CH <sub>4</sub> emissions from closed coal mines under the category other (fugitive emissions from solid fuels), in order to improve the transparency and comparability of the inventory for this category	65
Industrial processes and solvent and other product use	Transparency	Improve the transparency of the NIR by using tables and figures and providing summarized information on the number of facilities, the changes in production capacities and the abatement measures introduced over the entire time series in relation to complex categories such as iron and steel production and nitric acid production	69
	AD	Implement the planned category-specific improvements, in order to ensure the consistency of the AD and methodologies used	70
	Nitric acid production – N <sub>2</sub> O	Improve the transparency of the NIR by, for example, reporting the years when the plants closed and providing a table containing the AD and EFs to clearly show the impacts on the N <sub>2</sub> O emission estimates	74
		Collect information on the methods used by the plant operators to estimate N <sub>2</sub> O emissions and ensure the consistency of the data reported across the entire time series	74
	Consumption of halocarbons and SF <sub>6</sub> – HFCs	Report a correct and realistic estimate of the potential to actual emissions ratio for the unspecified mix of HFCs for the United Kingdom as a whole	76
	Ammonia production – CO <sub>2</sub>	Report only the amount of natural gas used for ammonia production and provide clear explanations of the distribution of natural gas consumption for non-energy use by ammonia production plants	78
	Other (chemical industry)	Include additional information in the NIR explaining that additional plants/sites were	80

<i>Sector</i>	<i>Category</i>	<i>Recommendation</i>	<i>Paragraph reference</i>	
	(all) – CH <sub>4</sub>	included in the estimates and that the data reported in the regulator’s inventories are the best available data for this category for the United Kingdom		
Agriculture	Recalculations	Revise and improve the descriptions of the recalculations by including more detailed explanations for each recalculation (reiteration of recommendation from previous review report)	83	
	Institutional arrangements	Provide information on any changes in the division of responsibilities regarding the preparation and development of the inventory for the agriculture sector between Rothamsted Research and AEA	84	
	Transparency	Revise the use of the notation keys, applying the correct notation keys consistently across the NIR and the CRF tables	85	
	Enteric fermentation – CH <sub>4</sub>		Incorporate background information on the calculations for the country-specific parameters and a proposal for the correction of anomalies in the time series of live weights for dairy cattle	88
			Revise the emission estimates for enteric fermentation for sheep based on the results of the programme of work to improve the methodology for calculating the emissions from this animal category	90
	Agricultural soils – N <sub>2</sub> O	Develop a country-specific estimate of the area of cultivated histosols as soon as possible and report it in future annual submissions	95	
LULUCF	Time-series consistency	Prioritize the implementation of the data assimilation process to build the time series of land-use changes and other activities, as listed in the improvement plan for the LULUCF sector, to address the inconsistencies in land representation, in order to ensure that a consistent time series (for 1990–2012) for land representation is reported in the inventory of the 2014 annual submission	103	
	Transparency	Improve the transparency of the information reported in the NIR by providing, for example, decision trees that show how different data sources have been combined and harmonized to produce a consistent time series of land use and land-use change areas	103	
			Include a full set of annual land-use transition matrices (reiteration of recommendation in the	104

<i>Sector</i>	<i>Category</i>	<i>Recommendation</i>	<i>Paragraph reference</i>
		previous review report)	
	Forest land – CO <sub>2</sub>	Meet the planned deadline for reporting the carbon stock change estimates using the FC CARBINE model for inclusion in the 2014 annual submission, or as soon as possible	105
		Meet the planned deadline for reporting the carbon stock change estimates for pre-1920 forest land in the 2014 annual submission	106
	Cropland and grassland – CO <sub>2</sub>	Differentiate between mineral and organic soils in the cropland and grassland categories, including the land-use conversion categories to and from cropland and grassland, and report the carbon stock changes in mineral and organic soils separately, including emissions from the drainage of organic soils	108
	Land converted to cropland – CO <sub>2</sub>	Build a consistent time series of emissions for the OTs and CDs from 1990 onwards by applying one of the methods provided in the <i>IPCC Good Practice Guidance for Land Use, Land-Use Change and Forestry</i> , for example the use of a proxy for crop production, and report these emissions	109
Waste	Transparency	Provide information related to the emission estimates for the OTs and CDs in the NIR and in the CRF tables (reiteration of recommendation in the previous review report) and improve the description of the relevant data in the NIR with respect to the methodology and parameters used in the calculation of these emissions	113
	QA/QC	Improve QA/QC procedures in order to ensure consistency throughout the CRF tables and the NIR and ensure the accuracy of the information in sectors with cross-sectoral links	113
	Solid waste disposal on land – CH <sub>4</sub>	Improve the transparency of the explanations of the recalculations performed	114
		Improve the estimates of the CH <sub>4</sub> collection rate in order to provide better evidence to support the estimates of landfilled waste emissions in the United Kingdom (reiteration of recommendation in the previous review report)	116
	Wastewater handling – N <sub>2</sub> O	Improve the description of the data used to estimate the emissions from this category in the NIR (reiteration of recommendation in the previous review report), and include the	117

<i>Sector</i>	<i>Category</i>	<i>Recommendation</i>	<i>Paragraph reference</i>
		explanations provided to the ERT during the review	
		Provide, in the waste chapter of the NIR, information on the exact location where the N <sub>2</sub> O emissions from industrial wastewater reported as “IE” are included in the CRF tables and on the methodology used for their calculation	118
	Wastewater handling – CH <sub>4</sub>	Ensure the accuracy of the data used for the estimates, including the descriptions of and references for the data used and ensure that the applied EFs are fully representative of the activity and emissions for the whole United Kingdom	119
		Provide in the NIR a list of the industries included in the estimate for this category and ensure that the calculation of the CH <sub>4</sub> emission estimates is more transparent	120
KP-LULUCF	Transparency	Report the required information on units of land subject to activities under Article 3, paragraph 3, of the Kyoto Protocol, which would otherwise be included in land subject to elected activities under Article 3, paragraph 4, of the Kyoto Protocol in CRF table 5(KP-D)A.1.3	141
		Include information in section 11.2.1 of the NIR describing the spatial assessment unit used and, in accordance with the annex to decision 16/CMP.1, on how it corresponds to the minimum land area and width requirements defined by the United Kingdom’s forest definition, and hence the detection of land-use change at the scale consistent with the United Kingdom’s forest definition (reiteration of recommendation in the previous review report)	142
	Afforestation and reforestation – CO <sub>2</sub>	Meet the planned deadline in order to report the carbon stock change estimates using the FC CARBINE model in the 2014 annual submission, when accounting for afforestation and reforestation at the end of the commitment period	144
	Deforestation – CO <sub>2</sub>	Differentiate the soil organic matter carbon stock changes for mineral and organic soils and estimate the emissions associated with the drainage of organic soils if this practice occurs	145
		Use country-specific values to estimate the	146

<i>Sector</i>	<i>Category</i>	<i>Recommendation</i>	<i>Paragraph reference</i>
		carbon stocks contained in each pool prior to deforestation or, as recommended in the previous review report, provide justification for using a unique available biomass factor (i.e. 240 t ha <sup>-1</sup> )	
	Forest management – CO <sub>2</sub>	Meet the planned deadline in order to report the carbon stock change estimates using the FC CARBINE model in the 2014 annual submission, when accounting for forest management at the end of the commitment period	147
	Calculation of the commitment period reserve	Correctly calculate the commitment period reserve in accordance with paragraph 6 of the annex to decision 11/CMP.1	152
	Article 3, paragraph 14, of the Kyoto Protocol	Include information on changes in the reporting compared with the previous annual submission in accordance with the annex to decision 15/CMP.1 (reiteration of recommendation in the previous review report), and continue to update such information with the aim of increasing transparency	155

*Abbreviations:* AD = activity data, CDs = crown dependencies, CRF = common reporting format, DECC = Department of Energy and Climate Change, DUKES = Digest of United Kingdom Energy Statistics, EF = emission factor, ERT = expert review team, GHG = greenhouse gas, IE = included elsewhere, IPCC = Intergovernmental Panel on Climate Change, 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, LULUCF = land use, land-use change and forestry, NA = not applicable, OTs = overseas territories, QA/QC = quality assurance/quality control, UNFCCC = United Nations Framework Convention on Climate Change.

#### IV. Adjustments

169. The ERT concludes, based on the review of the inventories for 2008, 2009 and 2010, that for CH<sub>4</sub> and N<sub>2</sub>O emissions from gasoline and diesel oil used in road transportation, the method used to calculate the emission estimates is not fully in line with the Revised 1996 IPCC Guidelines and the IPCC good practice guidance as required by Article 5, paragraph 2, of the Kyoto Protocol, leading to incomplete emission estimates. The ERT recommended that the United Kingdom submit revised estimates or provide further justifications for its calculations for the identified category as a way of resolving the identified potential problem. The ERT, following the review of the additional information provided by the United Kingdom during and after the review week, concluded that it did not satisfactorily correct the problem through the submission of acceptable revised estimates and decided to calculate and recommend four adjustments in accordance with the guidance for adjustments under Article 5, paragraph 2, of the Kyoto Protocol (annex to decision 20/CMP.1).

170. The United Kingdom, in its communication of 7 June 2013, accepted the calculated adjustments. In accordance with the Article 8 review guidelines, the ERT applied the calculated adjustments.

171. The application of adjustments by the ERT resulted in a change in the estimate of: the CH<sub>4</sub> and N<sub>2</sub>O emissions from road transportation for 2008 – from 1,001.460 Gg CO<sub>2</sub> eq, as originally reported by the United Kingdom, to 1,319.684 Gg CO<sub>2</sub> eq, or 31.8 per cent of the total national emissions; the CH<sub>4</sub> and N<sub>2</sub>O emissions from road transportation for 2009 – from 923.468 Gg CO<sub>2</sub> eq, as originally reported by the United Kingdom, to 1,205.586 Gg CO<sub>2</sub> eq, or 30.5 per cent of the total national emissions; and the CH<sub>4</sub> and N<sub>2</sub>O emissions from road transportation for 2010 – from 919.364 Gg CO<sub>2</sub> eq, as originally reported by the United Kingdom, to 1,228.486 Gg CO<sub>2</sub> eq, or 33.6 per cent of the total national emissions. This in turn resulted in a change in the estimated total emissions of the United Kingdom for: 2008 – from 634,890.968 Gg CO<sub>2</sub> eq, as originally reported by the United Kingdom, to 635,209.192 Gg CO<sub>2</sub> eq, or 0.05 per cent; 2009 – from 581,041.584 Gg CO<sub>2</sub> eq, as originally reported by the United Kingdom, to 581,323.702 Gg CO<sub>2</sub> eq, or 0.05 per cent; and 2010 – from 599,105.476 Gg CO<sub>2</sub> eq, as originally reported by the United Kingdom, to 599,414.598 Gg CO<sub>2</sub> eq, or 0.05 per cent.

172. In accordance with paragraph 70(b) of the annex to decision 22/CMP.1, the ERT calculated the sum of the numerical values of the percentages by which the aggregate adjusted total GHG emissions for the United Kingdom exceed the aggregate submitted total GHG emissions from the sources listed in Annex A to the Kyoto Protocol. For the 2010, 2011 and 2012 annual submissions this value is 0.74 per cent.

173. In accordance with paragraph 71 of the annex to decision 22/CMP.1, the ERT identified the following key categories, as defined in chapter 7 of the IPCC good practice guidance, that were adjusted in previous review reports and the percentage that these key categories contribute to the aggregate submitted total GHG emissions from the sources listed in Annex A to the Kyoto Protocol in the latest reported year (2010) of the 2012 annual submission:

- (a) CH<sub>4</sub> emissions from oil and natural gas: 0.9 per cent – adjusted in the 2010 annual review;
- (b) HFC emissions from substitutes for ozone-depleting substances: 2.4 per cent – adjusted in the 2010 annual review;
- (c) N<sub>2</sub>O direct soil emissions: 1.9 per cent – adjusted in the 2010 and 2011 annual reviews;
- (d) N<sub>2</sub>O emissions from pasture, range and paddock manure: 0.9 per cent – adjusted in the 2011 annual review;
- (e) N<sub>2</sub>O indirect emissions: 1.6 per cent – adjusted in the 2010 and 2011 annual reviews.

## V. Questions of implementation

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



## Annex I

### 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 2012. Available at <http://unfccc.int/resource/docs/2012/asr/gbr.pdf>.

Synthesis and assessment report on the greenhouse gas inventories submitted in 2012. Available at <http://unfccc.int/resource/webdocs/sai/2012.pdf>.

FCCC/ARR/2011/GBR. Report of the individual review of the annual submission of the United Kingdom of Great Britain and Northern Ireland submitted in 2011. Available at <http://unfccc.int/resource/docs/2012/arr/gbr.pdf>.

UNFCCC. *Standard Independent Assessment Report*, parts I and II. Available at [http://unfccc.int/kyoto\\_protocol/registry\\_systems/independent\\_assessment\\_reports/items/4061.php](http://unfccc.int/kyoto_protocol/registry_systems/independent_assessment_reports/items/4061.php).

**B. Additional information provided by the Party**

Responses to questions during the review were received from Mr. John Mackintosh, Ms. Helen Champion and Ms. Emma Salisbury (Department of Energy and Climate Change), including additional material on the methodologies and assumptions used. The following documents<sup>1</sup> were also provided by the United Kingdom:

Bradley, R.I. 2005. *A soil carbon and land use database for the United Kingdom*. Soil Use and Management (2005).

DEFRA. 2012. *2012 Agricultural Statistics and Climate Change 3rd Edition July 2012*. London: DEFRA.

DEFRA. 2000. *Waste water collection and treatment, and disposal of sewage sludge*. Available at <<http://www.defra.gov.uk/publications/files/pb6655-uk-sewage-treatment-020424.pdf>>.

DEFRA /DECC. 2011. *Inventory Improvement Project - UK Landfill Methane Emissions Model*. Available at <<http://randd.defra.gov.uk/Default.aspx?Menu=Menu&Module=More&Location=None&Completed=0&ProjectID=17448>>.

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<sup>1</sup> Reproduced as received from the Party.

## Annex II

### Acronyms and abbreviations

AD	activity data
AWMS	animal waste management systems
B <sub>0</sub>	methane-producing potential
CaO	calcium oxide
CDs	crown dependencies
CEH	Centre for Ecology and Hydrology
CH <sub>4</sub>	methane
C	carbon
CMP	Conference of the Parties serving as the meeting of the Parties to the Kyoto Protocol
CO <sub>2</sub>	carbon dioxide
CO <sub>2</sub> eq	carbon dioxide equivalent
CRF	common reporting format
DAs	devolved administrations
DDOC	dissimilable degradable organic carbon compounds
DECC	Department of Energy and Climate Change
DFID	Department for International Development
DUKES	Digest of United Kingdom Energy Statistics
EF	emission factor
EMR	Energy Market Reform
ERT	expert review team
EU	European Union
EU ETS	European Union emissions trading system
FAO	Food and Agriculture Organization of the United Nations
FiT CfD	Feed-in-Tariff with Contracts for Difference
GBP	pounds sterling
Gg	Gigagram
GHG	greenhouse gas; unless indicated otherwise, GHG emissions are the sum of CO <sub>2</sub> , CH <sub>4</sub> , N <sub>2</sub> O, HFCs, PFCs and SF <sub>6</sub> without GHG emissions and removals from LULUCF
HFCs	hydrofluorocarbons
ICF	International Climate Fund
IE	included elsewhere
IEA	International Energy Agency
IEF	implied emission factor
IPCC	Intergovernmental Panel on Climate Change
IRENA	International Renewable Energy Agency
ITL	international transaction log
kg	kilogram (1 kg = 1,000 grams)
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
kt	kilotonnes
LULUCF	land use, land-use change and forestry
MCF	methane conversion factors
MgO	magnesium oxide
MoU	memorandum of understanding
MSW	municipal solid waste
Mt	million tonnes
N	nitrogen

N <sub>2</sub> O	nitrous oxide
NA	not applicable
NCV	net calorific values
NE	not estimated
Nex	N excretion
NH <sub>3</sub>	ammonia
NISC	National Inventory Steering Committee
NIR	national inventory report
NO	not occurring
NO <sub>x</sub>	nitrogen oxide
OPG	petroleum gases
OTs	overseas territories
PFCs	perfluorocarbons
PJ	petajoule (1 PJ = 10 <sup>15</sup> joule)
QA/QC	quality assurance/quality control
SEF	standard electronic format
SF <sub>6</sub>	sulphur hexafluoride
SIAR	standard independent assessment report
SOM	soil organic matter
TJ	terajoule (1 TJ = 10 <sup>12</sup> joule)
UNFCCC	United Nations Framework Convention on Climate Change

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