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**Report of the individual review of the annual submission of
Denmark submitted in 2011***

* In the symbol for this document, 2011 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

A. Overview

1. This report covers the centralized review of the 2011 annual submission of Denmark, coordinated by the UNFCCC secretariat, in accordance with decision 22/CMP.1. The review took place from 12 to 17 September 2011 in Bonn, Germany, and was conducted by the following team of nominated experts from the UNFCCC roster of experts: generalists – Ms. Anna Romanovskaya (Russian Federation) and Ms. Kristina Saarinen (Finland); energy – Mr. Steven Oliver (Australia) and Mr. Pedro Torres (Portugal); industrial processes – Ms. Lisa Hanle (United States of America) and Mr. Samir Tantawi (Egypt); agriculture – Mr. Sorin Deaconu (Romania) and Mr. Dionisio Rodriguez (Spain); land use, land-use change and forestry (LULUCF) – Mr. Xiaoquan Zhang (China) and Mr. Vladimir Korotkov (Russian Federation); and waste – Mr. Baek Wonseok (Republic of Korea). Ms. Romanovskaya and Mr. Zhang were the lead reviewers. The review was coordinated by Mr. Vitor Gois Ferreira (UNFCCC secretariat).

2. In accordance with the “Guidelines for review under Article 8 of the Kyoto Protocol” (decision 22/CMP.1), a draft version of this report was communicated to the Government of Denmark, which provided comments that were considered and incorporated, as appropriate, into this final version of the report.

B. Emission profiles and trends

3. In 2009, the main greenhouse gas (GHG) in Denmark was carbon dioxide (CO₂), accounting for 79.3 per cent of total GHG emissions¹ expressed in carbon dioxide equivalent (CO₂ eq), followed by nitrous oxide (N₂O) (9.8 per cent) and methane (CH₄) (9.5 per cent). Hydrofluorocarbons (HFCs), perfluorocarbons (PFCs) and sulphur hexafluoride (SF₆) collectively accounted for 1.4 per cent of the overall GHG emissions in the country. The energy sector accounted for 79.1 per cent of total GHG emissions, followed by the agriculture sector (15.6 per cent), the industrial processes sector (2.9 per cent), the waste sector (2.2 per cent) and the solvent and other product use sector (0.2 per cent). Total GHG emissions amounted to 61,646.15 Gg CO₂ eq and decreased by 10.6 per cent between the base year² and 2009.

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, CO₂, CH₄ and N₂O emissions included in the rows under Annex A sources do not include emissions and removals from the LULUCF sector.

¹ In this report, the term “total GHG emissions” refers to the aggregated national GHG emissions expressed in terms of CO₂ eq excluding LULUCF, unless otherwise specified.

² “Base year” refers to the base year under the Kyoto Protocol, which is 1990 for CO₂, CH₄ and N₂O, and 1995 for HFCs, PFCs and SF₆. 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 to 2009^a

| | Greenhouse gas | Base year ^a | Gg CO ₂ eq | | | | | | | Change | |
|-----------------|--------------------------|------------------------|-----------------------|-----------|-----------|-----------|-----------|-----------|-----------|--------------------|--------|
| | | | 1990 | 1995 | 2000 | 2005 | 2007 | 2008 | 2009 | Base year–2009 (%) | |
| Annex A sources | CO ₂ | 53 277.56 | 53 277.56 | 61 275.73 | 54 146.82 | 51 436.78 | 54 564.99 | 51 293.63 | 48 877.45 | –8.3 | |
| | CH ₄ | 5 696.23 | 5 696.23 | 5 959.68 | 5 864.49 | 5 732.42 | 5 874.58 | 5 838.22 | 5 845.30 | 2.6 | |
| | N ₂ O | 9 667.22 | 9 667.22 | 8 683.75 | 7 877.91 | 6 324.50 | 6 307.36 | 6 374.28 | 6 067.13 | –37.2 | |
| | HFCs | 217.75 | NA, NE, NO | 217.75 | 608.61 | 807.81 | 855.96 | 859.25 | 805.41 | 269.9 | |
| | PFCs | 0.50 | NA, NE, NO | 0.50 | 17.89 | 13.90 | 15.36 | 12.79 | 14.18 | 2 722.7 | |
| | SF ₆ | 107.37 | 44.45 | 107.37 | 59.23 | 21.76 | 30.35 | 31.60 | 36.69 | –65.8 | |
| KP-LULUCF | Article 3.3 ^b | CO ₂ | | | | | | –11.94 | –111.11 | | |
| | | CH ₄ | | | | | | NO | NO | | |
| | | N ₂ O | | | | | | 0.53 | 0.54 | | |
| | Article 3.4 ^c | CO ₂ | 3 501.82 | | | | | | –2 114.69 | –1 037.69 | –129.6 |
| | | CH ₄ | NO | | | | | | NO | NO | NA |
| | | N ₂ O | IE, NA, NO | | | | | | 12.22 | 12.04 | NA |

Abbreviations: IE = included elsewhere, 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, NE = not estimated, NO = not occurring.

^a “Base year” for Annex A sources refers to the base year under the Kyoto Protocol, which is 1990 for CO₂, CH₄ and N₂O, and 1995 for HFCs, PFCs and SF₆. The “base year” for activities under Article 3, paragraphs 3 and 4, of the Kyoto Protocol is 1990.

^b 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.

^c 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 to 2009^a

| | | <i>Gg CO₂ eq</i> | | | | | | | | <i>Change</i> |
|-------------------------------|-------------------------------|---------------------------------|------------------|------------------|------------------|------------------|------------------|------------------|------------------|--------------------------------|
| <i>Sector</i> | | <i>Base year^a</i> | <i>1990</i> | <i>1995</i> | <i>2000</i> | <i>2005</i> | <i>2007</i> | <i>2008</i> | <i>2009</i> | <i>Base year– 2009 (%)</i> |
| Annex A sources | Energy | 52 523.11 | 52 523.11 | 60 550.91 | 53 341.79 | 50 744.95 | 53 819.02 | 50 811.07 | 48 761.98 | –7.2 |
| | Industrial processes | 2 520.69 | 2 239.52 | 2 726.81 | 3 390.28 | 2 447.82 | 2 549.01 | 2 263.18 | 1 772.46 | –29.7 |
| | Solvent and other product use | 136.19 | 136.19 | 109.27 | 102.22 | 91.16 | 103.24 | 94.96 | 101.94 | –25.1 |
| | Agriculture | 12 412.51 | 12 412.51 | 11 466.13 | 10 345.49 | 9 718.67 | 9 776.26 | 9 834.58 | 9 643.35 | –22.3 |
| | Waste | 1 374.14 | 1 374.14 | 1 391.68 | 1 395.16 | 1 334.57 | 1 401.08 | 1 405.98 | 1 366.42 | –0.6 |
| | LULUCF | NA | 3 154.68 | 1 676.36 | 2 915.20 | 3 590.44 | –86.31 | –2 113.99 | –1 117.66 | NA |
| Total (with LULUCF) | | NA | 71 840.14 | 77 921.15 | 71 490.14 | 67 927.61 | 67 562.31 | 62 295.77 | 60 528.49 | NA |
| Total (without LULUCF) | | 68 966.63 | 68 685.46 | 76 244.79 | 68 574.94 | 64 337.18 | 67 648.61 | 64 409.76 | 61 646.15 | –10.6 |
| Other ^b | | NA | NA | NA | NA | NA | NA | NA | NA | NA |
| KP-LULUCF | Article 3.3 ^c | Afforestation and reforestation | | | | | | –45.07 | –145.31 | |
| | | Deforestation | | | | | | 33.66 | 34.74 | |
| | | Total (3.3) | | | | | | –11.41 | –110.57 | |
| | Article 3.4 ^d | Forest management | | | | | | –4 816.98 | –2 579.13 | |
| | | Cropland management | 3 188.62 | | | | | 2 530.16 | 1 369.30 | –57.1 |
| | | Grazing land management | 313.20 | | | | | 184.35 | 184.17 | –41.2 |
| | | Revegetation | NA | | | | | NA | NA | NA |
| | | Total (3.4) | 3 501.82 | | | | | | –2 102.47 | –1 025.66 |

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, LULUCF = land use, land-use change and forestry, NA = not applicable.

^a “Base year” for Annex A sources refers to the base year under the Kyoto Protocol, which is 1990 for CO₂, CH₄ and N₂O, and 1995 for HFCs, PFCs and SF₆. The “base year” for activities under Article 3, paragraphs 3 and 4, of the Kyoto Protocol is 1990.

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

^c 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.

^d 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.

5. Table 3 provides information on the most important emissions and removals and accounting parameters that will be included in the compilation and accounting database.

Table 3

Information to be included in the compilation and accounting database in t CO₂ eq

| | <i>As reported</i> | <i>Revised estimates</i> | <i>Adjustment^a</i> | <i>Final^b</i> | <i>Accounting quantity^c</i> |
|---|--------------------|--------------------------|-------------------------------|--------------------------|--|
| Commitment period reserve | 249 155 060 | | | 249 155 060 | |
| Annex A emissions for current inventory year | | | | | |
| CO ₂ | 48 877 446 | | | 48 877 446 | |
| CH ₄ | 5 817 694 | 5 845 299 | | 5 845 299 | |
| N ₂ O | 6 067 128 | | | 6 067 128 | |
| HFCs | 805 408 | | | 805 408 | |
| PFCs | 14 177 | | | 14 177 | |
| SF ₆ | 36 689 | | | 36 689 | |
| Total Annex A sources | 61 618 541 | 61 646 147 | | 61 646 147 | |
| Activities under Article 3, paragraph 3, for current inventory year | | | | | |
| 3.3 Afforestation and reforestation on non-harvested land for current year of commitment period as reported | -145 309 | | | -145 309 | -145 309 |
| 3.3 Afforestation and reforestation on harvested land for current year of commitment period as reported | IE, NA, NO | | | IE, NA, NO | 0 |
| 3.3 Deforestation for current year of commitment period as reported | 33 481 | 34 737 | | 34 737 | 34 737 |
| Activities under Article 3, paragraph 4, for current inventory year^d | | | | | |
| 3.4 Forest management for current year of commitment period | -2 579 126 | | | -2 579 126 | -2 579 126 |
| 3.4 Cropland management for current year of commitment period | 1 369 299 | | | 1 369 299 | -1 819 319 |
| 3.4 Cropland management for base year | 3 188 617 | | | 3 188 617 | |
| 3.4 Grazing land management for current year of commitment period | 184 169 | | | 184 169 | -129 036 |
| 3.4 Grazing land management for base year | 313 205 | | | 313 205 | |
| 3.4 Revegetation for current year of commitment period | NA | | | NA | 0 |
| 3.4 Revegetation in base year | NA | | | NA | |

Abbreviations: IE = included elsewhere, NA = not applicable, NO = not occurring.

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

^b "Final" includes revised estimates, if any, and/or adjustments, if any.

^c "Accounting quantity" is included in this table only for Parties that chose annual accounting for activities under Article 3, paragraph 3, and elected activities under Article 3, paragraph 4, if any.

^d 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 2011 annual inventory submission was submitted on 15 April 2011; it contains an almost complete set of common reporting format (CRF) tables (not submitted are CRF tables 7 (key categories) and 8(b) (explanations on recalculations)) for the period 1990–2009 and a national inventory report (NIR). The NIR and the CRF tables under the Kyoto Protocol, including the KP-LULUCF CRF tables, were resubmitted on 16 May 2011. Denmark 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 minimization of adverse impacts under Article 3, paragraph 14, of the Kyoto Protocol. The standard electronic format (SEF) tables were submitted on 15 April 2011. The annual submission was submitted in accordance with decision 15/CMP.1.

7. Denmark officially submitted revised emission estimates on 16 October 2011, in response to the list of potential problems and further questions raised by the expert review team (ERT) in the course of the review, including information on KP-LULUCF under both the Convention and the Kyoto Protocol. The Party submitted revised estimates for: CH₄ emissions from enteric fermentation for swine; and CO₂ emissions from carbon (C) stock changes in mineral soils under deforestation. The values in this report are those submitted by the Party on 16 October 2011.

8. Where necessary, 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.³

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

Completeness of inventory

10. The inventory is complete in terms of years and geographical coverage and covers all source and sink categories for which there are estimation methodologies available in the Intergovernmental Panel on Climate Change (IPCC) *Revised 1996 IPCC Guidelines for National Greenhouse Gas Inventories* (hereinafter referred to as the Revised 1996 IPCC Guidelines), in the IPCC *Good Practice Guidance and Uncertainty Management in National Greenhouse Gas Inventories* (hereinafter referred to as the IPCC good practice guidance) or in the IPCC *Good Practice Guidance for Land Use, Land-Use Change and Forestry* (hereinafter referred to as the IPCC good practice guidance for LULUCF).

³ The SIAR, parts I and II, is prepared by an independent assessor in line with decision 16/CP.10 (paras. 5(a), 6(c) and 6(k)), under the auspices of the international transaction log (ITL) 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.

11. The ERT noted that Denmark has improved the completeness of its inventory by providing estimates of emissions for categories that were reported as not estimated (“NE”) in previous annual submissions and for which there are no methodologies and/or emission factors (EFs) in the Revised 1996 IPCC Guidelines and/or the IPCC good practice guidance, including: CH₄ emissions from enteric fermentation for poultry, ostriches and pheasants; and CH₄ and N₂O emissions from compost production in the waste sector (under category other).

12. The ERT encourages the Party to continue its efforts to include emission estimates or revise the use of the notation keys for other categories still reported as “NE” and for which there are no methodologies and/or EFs in the Revised 1996 IPCC Guidelines and/or the IPCC good practice guidance, including: CH₄ emissions from manure management (for ostriches and pheasants); CH₄ emissions from direct and indirect soil emissions; N₂O emissions from fire extinguishers and aerosol cans; CH₄ emissions from drainage of soils and wetlands; CO₂ emissions from managed waste disposal on land; and N₂O emissions from accidental fires (under other waste).

13. Denmark has provided an almost complete set of CRF tables, with only CRF tables 7 and 8(b) not being provided, and notation keys are used throughout the tables. During the review, Denmark explained to the ERT that, in its view, CRF table 7 is not suitable for the reporting of its key categories, since they are identified at a more disaggregated level than the CRF categories. The Party also explained that providing the required information in CRF table 7 would require substantial manual work, and noted that the necessary information is provided in the NIR: in annex 1 for Denmark; in chapter 16 for Greenland; and in chapter 17 for the aggregate area of Denmark and Greenland. Regarding CRF table 8(b), the Party explained that this table is available for Denmark, but that the explanations were not copied to the aggregated submission of Denmark and Greenland. However, detailed information on recalculations is provided in chapters 10, 16 and 17 of the NIR as well as in the sectoral chapters. The ERT recommends that Denmark provide a complete set of CRF tables in its next annual submission, including providing information in CRF tables 7 and 8(b) in accordance with 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).

14. Denmark has also provided the KP-LULUCF CRF tables for 1990, 2008 and 2009, including information on activities under Article 3, paragraph 3, of the Kyoto Protocol and on the activities under Article 3, paragraph 4, of the Kyoto Protocol that were elected by Denmark: forest management, cropland management and grassland management. The KP-LULUCF CRF tables are complete and notation keys are used throughout. However, during the review, the ERT noted that the estimates of CO₂ emissions from deforestation reported in CRF table 5(KP-I)A.2 did not include the emissions from forest land converted to settlements. Responding to the list of potential problems and future questions of the ERT, Denmark provided revised estimates, including estimates of CO₂ emissions from forest land converted to settlements, and the ERT considers the issue to be solved (see paras. 122–124 below).

15. In its 2011 annual submission, Denmark included, for the first time, a chapter dedicated to the aggregated inventory of Denmark and Greenland, including trends, key category analysis, uncertainty analysis, recalculations, quality assurance and quality control (QA/QC) and a technical description of the aggregation. The ERT commends the Party for these improvements in the completeness of its reporting, which respond to a recommendation included in the previous review report.

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

Overview

16. The ERT concluded that the national system continued to perform its required functions, and that the structure and functioning of the national system is in accordance with the annex to decision 19/CMP.1. The ERT welcomes the improved description in the NIR of the process for the official approval of the annual submission, following a recommendation made in the previous review report.⁴

17. The Party described the changes in the national system since the previous annual submission. These changes include a new data collection agreement between the National Environment Research Institute (NERI) and the Danish Energy Agency (DEA), and a new data agreement signed between NERI and the Government of Greenland (see para. 144 below).

Inventory planning

18. The NIR describes the structure of the national system for the preparation of the inventory. The Danish Energy Agency, on behalf of the Ministry of Climate and Energy, has overall responsibility for the approval of the national inventory, while NERI, on behalf of the Ministry of the Environment and the Ministry of Climate and Energy, is responsible for data collection, the calculation and preparation of the national emission inventory for Denmark and the compilation of the inventory submission under the Kyoto Protocol for Greenland and Denmark. NERI is also the entity designated with overall responsibility for the national inventory under the Kyoto Protocol for Greenland and Denmark.

19. Other agencies and organizations are also involved in the preparation of the inventory, including major activity data (AD) providers such as: the Danish Energy Agency; the Danish Environmental Protection Agency (EPA); the Danish Nature Agency; Statistics Denmark; the Faculty of Agricultural Sciences of Aarhus University; the Danish Road Directorate; the Danish Centre for Forest, Landscape and Planning of Copenhagen University; the Civil Aviation Agency of Denmark; and Danish State Railways. Information on audited green accounts and direct information gathered from producers and agency enterprises is also used for the inventory. Finally, the Danish Centre for Forest, Landscape and Planning is responsible for the preparation of the reporting on KP-LULUCF.

20. Responding to the ERT during the review, Denmark provided additional information on the legal status of the formal agreements for data provision between NERI and other agencies, and stressed that all data exchange agreements do specify the deadlines for when NERI has to receive the data. The ERT recommends that Denmark provide this additional information in the NIR of its next annual submission.

21. The Government of Greenland has overall responsibility for the preparation of the GHG inventory of Greenland. In particular, Statistics Greenland is responsible for completing the CRF tables for Greenland and for documenting the inventory process. A revised formal agreement between the Government of Greenland and NERI was signed in 2011 to ensure the timely submission of a complete GHG inventory under the Kyoto Protocol. In a similar manner, the Faroe Islands' Environmental Agency is responsible for the provision of the GHG inventory for that region to NERI.

⁴ FCCC/ARR/2010/DNK, paragraph 25.

Inventory preparation

Key categories

22. Denmark has reported a tier 1 key category analysis, both level and trend assessment, as part of its 2011 annual submission under the Kyoto Protocol for 1990 and 2009 (including Denmark and Greenland), which was performed in accordance with the IPCC good practice guidance. Denmark has included the LULUCF sector in its key category analysis, in accordance with the IPCC good practice guidance for LULUCF. The ERT noted that Denmark used the key category analysis to prioritize plans for future improvements to the inventory.

23. The key category analysis performed by the Party and that performed by the secretariat⁵ produced similar results, the only difference being that two categories related to fugitive emissions (CO₂ from flaring gas and CO₂ from railways) are identified by the Party as key categories, but not by the secretariat. This difference is due to the use by the Party of a more detailed disaggregation of the categories used in the analysis for some sectors (agriculture and LULUCF) that caused slight different results for the overall identification of key categories.

24. According to the information provided in the NIR, a tier 2 key category analysis, including and excluding LULUCF, for level and trend assessment, has been provided for mainland Denmark only, while a tier 1 key category analysis, including and excluding LULUCF, for level and trend assessment, has been provided for Greenland. The ERT encourages Denmark to make efforts to conduct a tier 2 key category analysis for the aggregated inventory of Denmark and Greenland for future annual submissions.

25. Denmark has identified key categories for KP-LULUCF activities for the aggregate area of Denmark and Greenland, and has reported this information in KP-LULUCF CRF table NIR-3. However, Denmark did not provide explanatory information on the key category analysis for these activities in the NIR for the aggregate area of Denmark and Greenland. Responding to the ERT during the review, Denmark clarified that the impact of Greenland's emissions on the total emissions/removals from these activities is miniscule, and therefore the KP-LULUCF key categories for mainland Denmark, for which explanations are included in the NIR, are identical to the key categories for the aggregated reporting. Denmark informed the ERT that it is planning to provide specific information on the key category analysis for the areas under the Kyoto Protocol in its 2012 annual submission, and the ERT supports this intention of the Party.

Uncertainties

26. Denmark has prepared a tier 1 uncertainty analysis for the aggregated inventory of Denmark and Greenland in accordance with the IPCC good practice guidance. The estimate of uncertainty covers all source and sink categories, including the LULUCF sector. The estimates of uncertainty for AD and EFs are based on: country-specific information, including empirical data; default values from the Revised 1996 IPCC Guidelines, the IPCC good practice guidance and the *2006 IPCC Guidelines for National Greenhouse Gas*

⁵ 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 LULUCF. 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.

Inventories (hereinafter referred to as the 2006 IPCC Guidelines); and also expert assumptions.

27. Detailed information on methodologies and data used for the uncertainty analysis is included in the sectoral chapters of the NIR for Denmark, and for Greenland in a dedicated chapter on uncertainty analysis.

28. The cumulative uncertainty of the total estimated GHG emissions for 2009 is 5.6 per cent and the trend uncertainty is 16.1 per cent, with the major contributions to the overall uncertainty being categories within the agriculture and LULUCF sectors.

29. Additionally, Denmark has provided tier 2 uncertainty estimates for Denmark only, excluding the LULUCF sector. In the course of the review, Denmark explained to the ERT that the LULUCF sector was not included in the analysis owing to the need to prioritize resources. The ERT encourages Denmark to expand the tier 2 analysis (Monte Carlo simulations) to cover all categories and the aggregated inventory of Denmark and Greenland for future annual submissions.

30. The ERT noted that in the previous review report⁶ Denmark was recommended to investigate the suitability of using log-normal distribution in Monte Carlo simulations for all categories. During the review, Denmark informed the ERT that the use of log-normal distributions is a reasonable choice, since it is possible to truncate the log-normal distribution, thus ensuring that the uncertainty estimates remain within realistic limits. Denmark also informed the ERT that such an approach has been applied for the first time for the 2011 annual submission and for mainland Denmark only. The ERT recommends that Denmark include these explanations in the NIR of its next annual submission.

Recalculations and time-series consistency

31. Recalculations have been performed and reported in accordance with the IPCC good practice guidance. Denmark has performed recalculations for all sectors and for all years in the period 1990–2008, taking into account, for example, the recommendations made in the previous review report.

32. Recalculations are reported in a comprehensive manner in chapter 10 of the NIR and reasons for recalculations include: changes in statistical data (e.g. for stationary combustion and gas distribution in the energy sector); improvements in EFs and parameters (e.g. the CO₂ EFs for stationary combustion are now based on data from the European Union emissions trading scheme (EU ETS); and the methane conversion factor (MCF) used to estimate CH₄ emissions from manure management, the N₂O EF for emissions from histosols, and the nitrogen (N) content of wastewater were revised); the reallocation of emissions (e.g. emissions from venting in gas storage have previously been included under gas transmission but are now included in the gas venting and flaring category (1.B.2.c.ii); and the correction of detected errors (e.g. the N excretion rates for sows in the agriculture sector, and the EF calculation algorithm to estimate direct N₂O emissions from wastewater handling in the waste sector).

33. The impact of all recalculations in the inventory includes a decrease in the estimated total GHG emissions without LULUCF for 1990 (by 1.5 per cent) and a decrease for 2008 (by 0.8 per cent). The rationale for the recalculations is provided in the sectoral chapters and in chapter 10 of the NIR for the inventory of mainland Denmark, in chapter 16 of the NIR for the inventory of Greenland and in chapter 17 of the NIR for the inventory of the aggregate area of Denmark and Greenland. The ERT commends the transparent explanations of recalculations provided by Denmark in the NIR.

⁶ FCCC/ARR/2010/DNK, paragraph 32.

34. The ERT noted that the recalculations performed for the 2011 annual submission for all sectors except LULUCF had no major impact on the consistency of the time series, as they were made for all years of the reported period in a consistent manner. However, recalculations made for the LULUCF sector, particularly for CO₂ emissions, have had a clear impact on the emission trend, since the estimated emissions from the LULUCF sector have increased for the base year (by 328.44 Gg CO₂) and decreased for 2008 (by 4,780.04 Gg CO₂) (see paras. 95 and 96 below).

35. The LULUCF sector and KP-LULUCF activities were subjected to major recalculations, following the recommendations made in the previous review report (see paras. 95–96 and 116 below). Responding to the ERT during the review, Denmark confirmed that the recalculations were also carried out with the intention of revising the two adjustments made to activities under Article 3, paragraph 3, of the Kyoto Protocol in the previous year's review process.⁷ Recalculations for the LULUCF sector and KP-LULUCF activities were also due to improvements in remote sensing AD and the ongoing improvement of the Danish National Forest Inventory (NFI) (see para. 116 below).

Verification and quality assurance/quality control approaches

36. Denmark provides information on QA/QC procedures in the NIR in line with the UNFCCC reporting guidelines. The QA/QC plan is in accordance with decision 19/CMP.1 and the IPCC good practice guidance, and the plan is now applied to the inventories of both Denmark and Greenland, thus responding to a recommendation made in the previous review report.⁸ Additionally, NERI performs QA/QC procedures during the integration of the two inventories, including QC procedures for the data received from Greenland (CRF tables and documentation) and for the aggregated inventory of Denmark and Greenland. QA/QC procedures are described in the corresponding chapters of the NIR in a transparent manner. Software was developed for the integration of the inventories of Denmark and Greenland (NERI CRF Aggregator), thus minimizing the occurrence of manual errors.

37. Denmark provided to the ERT, during the review, information on planned improvements to its QA/QC procedures, including: the development and implementation of further checks to address specific issues identified during internal or external reviews; and ensuring that all additional information for CRF tables is aggregated and reported correctly. Denmark informed the ERT that these improvements will be reflected in a revised version of its *Quality Manual for the GHG Inventory*, which is expected to be published at the end of 2012. The ERT appreciates the efforts made by Denmark in developing and implementing quality checks and recommends that the Party update the related information in the NIR of its 2013 submission to reflect the implemented improvements.

38. Denmark included in the NIR a detailed description of the principles for using EU ETS data in the inventory and provided information on QA/QC procedures implemented at plant level for the use of such data. Procedures include QA measures, reviews and the independent verification of data in accordance with EU ETS guidelines. Additionally NERI performs QC checks to further ensure the consistency and reliability of such data. The ERT commends the efforts made by Denmark to ensure the functioning of its QA/QC system and for the transparent reporting in the NIR.

39. Denmark provides in the NIR information on the QA procedures conducted during the preparation of the 2011 annual submission, including expert peer reviews of the estimates of fugitive emissions from the energy sector and emissions from the solvent and other product use sector. Additionally, a project to evaluate emissions and EFs in cooperation with other countries has been conducted.

⁷ FCCC/ARR/2010/DNK, chapter II.G.

⁸ FCCC/ARR/2010/DNK, paragraph 37.

40. The ERT noted that there is no information on updated QA/QC procedures applied for Greenland in the NIR. In response to a question raised by the ERT during the review, Denmark explained that there is no need to improve the QA/QC procedures for Greenland's inventory. The procedures are continuously evaluated and if a need arises to implement further procedures this will be done. Nevertheless, the ERT encourages Denmark to perform QA procedures for Greenland's inventory, for example by conducting peer reviews.

Transparency

41. The NIR is generally transparent and provides clear descriptions of the national system, key categories, QA/QC procedures, uncertainty assessment, sectoral methodologies, and AD and EFs for most categories. The ERT noted that the NIR is structured in accordance with the outline of the NIR provided in the UNFCCC reporting guidelines and the suggested annotated NIR, and the ERT appreciates the transparent reporting.

42. The ERT noted some improvements in the 2011 annual submission, such as the inclusion of more explanatory information in the general parts of the NIR (e.g. on the official approval of the inventory, usage of EU ETS data, key category analysis, recalculations and aggregated GHG inventory) as well as in the sectoral chapters (e.g. on the energy, agriculture and waste sectors). However, the ERT considers that there is room for further improvements in transparency in the following categories: cement production and consumption of halocarbons and SF₆ in the industrial processes sector (see paras. 72, 74 and 77 below); information on land representation, explanation of trends, descriptions of country-specific methodologies and country-specific EFs used in the LULUCF sector and for KP-LULUCF activities (see paras. 102 and 106 below); information on biogas treatment in agriculture (see para. 81 below), and on the waste sector (see para. 112 above). The ERT recommends that Denmark include this information in the NIR of its next annual submission.

Inventory management

43. Denmark has a centralized 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 archive is maintained by NERI, which provided the ERT in a timely manner with the requested additional archived information during the review.

3. Follow-up to previous reviews

44. The NIR includes detailed information on the follow-up of recommendations made during the 2008, 2009 and 2010 reviews in the sectoral chapters and also in chapter 10.4, and the ERT commends the Party for this very transparent reporting of the follow-up of previous recommendations.

45. The ERT concluded that most previous recommendations have been implemented by the Party or relevant explanations have been provided; for example, the implementation of some of the recommendations made in the 2010 review report is still ongoing, because of the need to prioritize improvements or the need for time for their implementation (e.g. the provision of descriptions of all input data for the model to estimate emissions of HFCs in the industrial processes sector). The major improvements listed include: the inclusion in the NIR of separate chapters with information on the inventory of Greenland and the aggregated inventory of Denmark and Greenland; the detailed description of the use of

EU ETS data; the provision of information on recalculations for the aggregated inventory in the NIR and in the CRF tables; the provision of additional information in the LULUCF and KP-LULUCF chapters of the NIR, updating some parameters and EFs; and improvements in consistency between the reporting on the LULUCF sector and KP-LULUCF activities.

4. Areas for further improvement

Identified by the Party

46. Chapter 10.4 of the NIR identifies several areas for improvement, including:
- (a) Revisiting the CO₂ EFs for gas oil combusted in Greenland;
 - (b) Improving the CO₂ EFs for residual oil and natural gas using EU ETS data;
 - (c) Improving the AD on cement production for the recent years of the time series;
 - (d) Developing QA/QC procedures for checking calculations of emissions related to fluorinated gases (F-gases);
 - (e) Documenting the production of yellow bricks in the industrial processes sector;
 - (f) Compiling export and import data for the years 1990–1994 for the solvent and other product use sector;
 - (g) Collecting information on individual landfill practices in the waste sector.

Identified by the expert review team

47. During the review, the ERT identified cross-cutting issues for improvement. These are listed in paragraph 158 below.
48. Recommended improvements relating to specific categories are presented in the relevant sector chapters of this report.

B. Energy

1. Sector overview

49. The energy sector is the main sector in the GHG inventory of Denmark. In 2009, emissions from the energy sector amounted to 48,761.98 CO₂ eq, or 79.1 per cent of total GHG emissions. Since 1990, emissions have decreased by 7.2 per cent. The key drivers for the overall fall in emissions (–3,791.84 Gg CO₂ eq) are the decreases in emissions in the categories energy industries (–2,107.14 Gg CO₂ eq, or –8.0 per cent, since 1990), other sectors (–2,710.86 Gg CO₂ eq, or –28.7 per cent, since 1990) and manufacturing industries and construction (–14,96.28 Gg CO₂ eq, or –27.2 per cent, since 1990). Since 1990, emissions from transport have increased by 22.8 per cent (2,483.90 Gg CO₂ eq). Within the sector, 49.5 per cent of the emissions were from energy industries, followed by 27.4 per cent from transport, 13.8 per cent from other sectors and 8.2 per cent from manufacturing industries and construction. Fugitive emissions from oil and gas accounted for 0.8 per cent and other (energy) accounted for 0.3 per cent. Fugitive emissions from solid fuels are reported as not occurring (“NO”).

50. Denmark has made recalculations for the energy sector, mostly reflecting changes in AD and EFs. The impact of these recalculations on the energy sector is a decrease in the estimate of CO₂ emissions of 0.2 per cent for 2008 (105.30 Gg CO₂ eq). The main recalculations took place for the following categories:

- (a) Manufacturing industries and construction, as a result of revised AD and EFs;
- (b) Other sectors, as a result of revised AD and EFs;
- (c) Road transportation, as a result of revised vehicle fleet and mileage figures (see para. 59 below).

51. Following recommendations made in previous review reports, Denmark has improved the transparency of its reporting by including in the NIR a more detailed discussion on the use of EU ETS data for preparing emission estimates, and the results of the analysis of CO₂ EF for coal in face of the net calorific values (NCVs)⁹ that are used. The ERT commends Denmark for having improved the transparency of the NIR.

2. Reference and sectoral approaches

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

52. For 2009, the CO₂ emission estimates calculated using the reference approach are 1.25 per cent lower than the emission estimates calculated using the sectoral approach. In addition, in the period 1990–2009 both fuel consumption and estimated CO₂ emissions differ by less than 1 per cent for all years except 1998 (for which the difference between the approaches is 1.8 per cent) and 2009. Additional explanations of the way in which the reference approach was prepared are provided in the documentation box of CRF table 1.A(c), and discussions on the comparison of the reference approach with the sectoral approach for Denmark, Greenland and the aggregate area of Denmark and Greenland are included in the NIR. Denmark indicates, in section 3.4 of the NIR, that the differences for 1998 and 2009 are due to large statistical differences in the official energy statistics for these years, and that the Danish Energy Agency is working on these issues and expects the statistical difference for 2009 to be lower in the next published energy statistics. The ERT commends the efforts that Denmark is making and recommends that the Party include information on the result of these efforts in its next annual submission.

53. The total apparent energy consumption in 2009 reported in the CRF tables (sectoral approach) is 0.8 per cent lower than that from the International Energy Agency (IEA), with major discrepancies occurring for gas/diesel oil and residual fuel oil trade.

54. In addition, as a result of the incorporation of Greenland's emissions, other discrepancies occur between the data in the CRF tables and the data from IEA, which result from the fact that emissions from aviation and navigation resulting from movements between Greenland and mainland Denmark are considered as international by IEA but domestic in the CRF tables.

International bunker fuels

55. The ERT found that imports of jet kerosene (aviation) and gas/diesel oil (maritime) as reported in the CRF tables are 5–10 per cent higher than according to IEA. Although the inclusion of information for Greenland in the CRF tables explains the existence of small differences in comparison with the IEA data (see para. 54 above), the Party clarified that the difference for gas/diesel oil in marine bunkers was due to an error in the IEA data. Denmark indicated that it will correct the IEA data, which the ERT encourages. Nevertheless, the ERT noted that the data in the CRF tables are in agreement with the data published by DEA, and for jet kerosene the import data in the CRF tables are also in agreement with the DEA data. The ERT encourages Denmark to compare the IEA data with the inventory data and, as a way of improving transparency, to include the reasons for the discrepancies, if any, in the NIR of its next annual submission.

⁹ These values are referenced in the NIR as low calorific values.

Feedstocks and non-energy use of fuels

56. Denmark reports in CRF table 1.A(d) three fuel types used for non-energy purposes: bitumen, white spirit and lubricants. The total non-energy use of fuels is 10,564.31 PJ, and 746.94 Gg CO₂ is not emitted. In the same table, Denmark indicates that some CO₂ emissions are included under the categories mineral products (bitumen), other industrial processes (lubricants) and solvent and other product use (white spirit), but the quantities emitted are not reported (the notation keys “NO” and included elsewhere (“IE”) are used) and no explanations are provided either in the NIR or in the CRF tables. The ERT recommends that Denmark provide in the NIR information on how it determines the final carbon storage factors that are reported in CRF table 1.A(d), in order to improve the transparency of the reporting.

3. Key categoriesStationary combustion: solid and liquid fuels – CO₂

57. Following the recommendations made in previous review reports,¹⁰ Denmark has included in the NIR a discussion on the use of EU ETS data to calculate CO₂ emissions for some large power plants, cement plants and oil refineries. The ERT concluded that the methodologies presented in the NIR are in line with the IPCC good practice guidance.

58. In addition, Denmark has performed an analysis of the CO₂ EFs for coal in face of the NCVs that are used, aiming to obtain an improved time series of EFs; however, a significant correlation between the NCVs and CO₂ EF could not be found. The ERT commends Denmark for this improvement in transparency, and encourages Denmark to extend the analysis made for coal to other fuels.

Road transportation: liquid fuels – CO₂, CH₄ and N₂O

59. Denmark has improved the accuracy of the estimates for road transportation by updating the mileage figures per vehicle category and by reclassifying the heavy duty trucks and buses categories according to the COPERT IV model. As a result, recalculations for 2008 resulted in a decrease of 16.7 per cent in the estimate of CH₄ emissions, an increase of 4.5 per cent in the estimate of N₂O emissions and an increase of 0.2 per cent in the estimate of CO₂ emissions. The ERT encourages Denmark to include a brief description of the methods used to obtain the fleet and mileage data necessary for the COPERT IV model in the NIR of its next annual submission.

60. There are discrepancies between the CO₂ implied emission factors (IEFs) for gasoline and diesel for 2009 and those for 1990: the 2009 IEF for diesel (74.00 t/TJ) is higher than the value for 1990 (73.99 t/TJ), while the 2009 IEF (72.99 t/TJ) for gasoline is lower than the value for 1990 (73.00 t/TJ). Denmark explained to the ERT during the review that these small deviations were due to a rounding error made by the reporting software. The ERT recommends that Denmark correct the error and improve its QC procedures for its next annual submission.

61. The ERT noted that Denmark intends to use EFs from the most up-to-date *EMEP/EEA air pollutant emission inventory guidebook* and to improve the QA/QC for mobile sources. The ERT commends Denmark for these efforts.

¹⁰ FCCC/ARR/2010/DNK, paragraph 57.

4. Non-key categories

Stationary combustion: liquid fuels – N₂O

62. The N₂O EF for refinery gas used by Denmark for 2009 for the subcategory petroleum refining (0.1 kg/TJ)¹¹ is low when compared to IPCC defaults for liquid fuels (0.3 – 0.4 kg/TJ). During the review, Denmark informed the ERT that it uses two different N₂O EFs for refinery gas, one when the gas is used in gas turbines and one for its use in boilers. The EF for gas in gas turbines is based on national references, while the EF for gas in boilers is from the Revised 1996 IPCC Guidelines. Denmark states that refinery gas has similar properties to natural gas, namely a similar nitrogen content in the fuel, which means that N₂O formation, as well as that of other nitrogen compounds such as nitrogen oxides (NO_x), is assumed similar under similar combustion conditions. That is the reasoning behind choosing the EFs for natural gas for both turbines and boilers. The ERT recommends that Denmark include the rationale for its selection of this EF in the NIR of its next annual submission.

63. For 2008, in Denmark's 2011 annual submission, the N₂O EF for use of liquid fuels in manufacturing industries and construction (2.56 kg/TJ) has decreased by about 16.0 per cent when compared with that reported in the 2010 annual submission (3.05 kg/TJ). The ERT noted that Denmark has moved from the use of the EF from the *EMEP/CORINAIR Emission Inventory Guidebook 2007* to the use of the default EF from the Revised 1996 IPCC Guidelines, but that it has not provided the rationale for this change in the NIR. Therefore, the ERT recommends that Denmark provide the rationale for changing the EF used in the NIR of its next annual submission.

Aviation: liquid fuels – CO₂, CH₄ and N₂O

64. Emissions from aviation were calculated using a tier 2 approach for mainland Denmark and a tier 1 approach for Greenland. The ERT recommends that Denmark improve the description of the methodology used for estimating emissions from aviation, such as the EF for the representative aircraft types and the number of movements per aircraft type, and additional details on how movements between Greenland and Denmark are considered and provide complementary data on landing and take-off (LTO) and EFs. In response to the draft review report, Denmark informed the ERT that it was not possible, due to time constraints, to follow this recommendation in the 2012 submission. Denmark stated that it will include this as a planned improvement and will follow the recommendation in its 2013 submission.

65. The CH₄ EF for jet kerosene used in civil aviation has increased by 100.5 per cent, from 1.55 kg/TJ for 2008 to 3.11 kg/TJ for 2009. Denmark explained to the ERT during the review that the reason for the sharp increase in the CH₄ IEF for jet kerosene was a substantial increase in the number of flights using the representative aircraft type Fokker 28. Indeed, the EF proposed for this plane in the Emission Factor Database provided in the *EMEP/CORINAIR Emission Inventory Guidebook* is very high, especially for taxiing during the LTO cycle. Later during the review, Denmark recognized to the ERT that the use of Fokker 28 as a representative aircraft type was later considered as not appropriate, since it is a old type of aircraft generally no longer in use. Therefore, Denmark plans to select an alternative representative aircraft type which could better represent the real level of emissions. The ERT encourages Denmark in its effort and, in order to improve transparency, also encourages Denmark to include in the NIR of its next annual submission the correspondence between the actual aircrafts used and the representative aircrafts used for the calculations.

¹¹ Denmark's 2011 NIR, table 3.2.32, page 164.

C. Industrial processes and solvent and other product use

1. Sector overview

66. In 2009, emissions from the industrial processes sector amounted to 1,772.46 Gg CO₂ eq, or 2.9 per cent of total GHG emissions, and emissions from the solvent and other product use sector amounted to 101.94 Gg CO₂ eq, or 0.2 per cent of total GHG emissions. Since the base year, emissions have decreased by 29.7 per cent in the industrial processes sector and decreased by 25.1 per cent in the solvent and other product use sector. The key driver for the fall in emissions in the industrial processes sector is the reduction in emissions from chemical industry (-1,041.57 Gg CO₂ eq, or a 99.8 per cent decrease, since the base year), mostly resulting from the closure of Denmark's single nitric acid production facility in mid-2004. At its peak of production in 1990, nitric acid was responsible for 46.6 per cent of the total emissions from the industrial processes sector. The large decline in emissions from chemical industry, along with smaller reductions in emissions from cement production (-187.81 Gg CO₂ eq, or a 17.6 per cent decrease, since the base year) and metal production (-59.52 Gg CO₂ eq, or a 100.0 per cent decrease, since the base year), were partially offset by a large increase in emissions from consumption of halocarbons and SF₆ (856.27 Gg CO₂ eq increase since the base year). Emissions from consumption of HFCs increased rapidly during the 1990s but, thereafter, increased more modestly owing to a slower increase in the use of HFCs as a refrigerant and a decrease in emissions from foam blowing. Emissions from consumption of halocarbons and SF₆ declined by approximately 5.2 per cent between 2008 and 2009.

67. Within the industrial processes sector, 49.7 per cent of the emissions were from mineral products, followed by 48.3 per cent from consumption of halocarbons and SF₆, 1.8 per cent from other industrial processes (lubricants) and 0.1 per cent each from chemical industry and other production (food and drink). Denmark reports emissions from metal production and production of halocarbons and SF₆ as "NO". Denmark reports CO₂ emissions from lubricants under the category other (industrial processes).

68. The Party has not made substantial recalculations for the industrial processes or solvent and other product use sectors between its 2010 and 2011 annual submissions. Indeed, only very small recalculations of 0.01 Gg CO₂ eq and 0.03 Gg CO₂ eq were reported for 2008 in CRF table 8(a) for these sectors, respectively. Because the NIR did not describe any recalculations for these sectors, the ERT requested information from Denmark to explain the aforementioned changes. Responding to the ERT, Denmark confirmed that no changes had been made to methodology, AD or EFs in the 2011 annual submission compared with the 2010 annual submission, and that some modifications to the Danish database system may have caused the number of decimal places in figures to change, thereby leading to rounding differences. Denmark indicated that it will give this issue further consideration in the preparation of its next annual submission. The ERT welcomes the Party's response and encourages the Party to conduct this QC check and report on it in its next annual submission.

2. Key categories

Cement production – CO₂

69. Cement production is a key category for Denmark. The emissions from cement production account for 43.1 per cent of the emissions from the industrial process sector and originate from one single cement-producing plant in the country. The emission estimates for cement production have been of particular interest in previous reviews, in part because Denmark uses three different methods to estimate emissions within the time series: for the period 1990–1997, a tier 1 approach is used based on the clinker fraction of cement and a

country-specific EF based on the types of clinker produced; for the period 1998–2005, the emissions are estimated on the basis of the raw materials; and for the period 2006–2009, EU ETS data are used. Previous ERTs raised questions about the Party's declining IEF for this category, as to whether this was a real decline or a result of the changing estimation method: the 2009 CO₂ IEF (0.51 t/t clinker produced) is 18.4 per cent lower than the value for 1990 (0.63 t/t clinker produced).

70. Therefore, during the review, the ERT raised several questions about the derivation of the estimates of emissions from cement production, as a follow-up on previous review reports recommendations.¹² Denmark has acknowledged that the cement company is unable to provide additional information for the earlier years of the time series (e.g. on clinker production or on the calcium oxide (CaO) and/or magnesium oxide (MgO) contents of the clinker). Nevertheless, the Party made available to the ERT additional confidential data on cement production to further clarify the derivation of the emission estimates. Having reviewed the information provided, and considering the fact that bottom-up methods based on raw materials and top-down methods based on clinker production are essentially the same (although they cannot be determined to be exactly the same if the CaO and/or MgO contents are not known), as well as the fact that the emissions are from only one plant, the ERT has determined that the use of these different estimation methods over the time series is consistent with the IPCC good practice guidance.

71. The ERT also questioned the Party, during the review, as to whether it accounts for imports and exports for the early years of the time series, which are required to be taken into account when using a tier 1 approach. The Party responded to the ERT that it believes that clinker production at that time was solely for the company's own use, but that it will research this further and confirm in its next annual submission. The ERT recommends that Denmark conduct this research to ensure that the tier 1 approach is being implemented in accordance with the IPCC good practice guidance for estimating emissions for the early years of the time series.

72. The ERT further questioned Denmark on its consideration of cement kiln dust (CKD) in the time series of emission estimates, in particular for the earlier years. Denmark responded that, although it is known that the emission estimates are based on the different types of clinker used, there is no information to indicate whether CKD is included in the emission estimates. The ERT recommends that Denmark continue to pursue any information that could clarify whether CKD is included in the emission estimates for all years of the time series.

Consumption of halocarbons and SF₆ – HFCs, PFCs and SF₆

73. Within the category consumption of halocarbons and SF₆, HFC and PFC emissions from refrigeration and air-conditioning equipment are considered by Denmark to be key categories. Denmark follows a tier 2 bottom-up approach to estimate emissions for the category consumption of halocarbons and SF₆.

74. The ERT noted from CRF table 2(II).F that, for several subcategories (e.g. air-conditioning equipment, foam blowing and aerosols) and for several species of gas, for the quantity of gases remaining in products at decommissioning, Denmark reports "NE" for AD but then reports "NO" for emissions, which is apparently an inconsistency in the reporting, since knowledge of AD is a necessary condition for assessing emissions. Responding to the ERT, Denmark confirmed that the estimates for this category are complete and that no emissions from consumption of halocarbons and SF₆ should be considered "NE". To support its claim, the Party provided the ERT with a report entitled *The greenhouse gases HFCs, PFCs, and SF₆: Danish consumption and emissions, 2008*,

¹² In particular, FCCC/ARR/2010/DNK, paragraph 77.

which states that disposal emissions are not occurring since the Danish legislation ensures that the management and treatment of refrigerants prevent uncontrolled emissions. The ERT concluded that Denmark has provided complete estimates for these disposal emissions. However, the ERT recommends that Denmark be more transparent and provide the rationale for this determination in the NIR of its next annual submission. In addition, the ERT noted that the regulation referred to would affect the IEF for disposal, but not the fluids remaining in products at decommissioning (i.e. the AD). The ERT encourages Denmark to revisit the way in which it reports the AD for fluids remaining in products at decommissioning to ensure that the reporting for this category is fully in compliance with the IPCC good practice guidance.

75. During the review, the ERT noted that Denmark reports in the CRF table 2(II).F for 2009 that 0.06 t HFC-134a was filled into new manufactured hard foams (under the category foam blowing). However, although AD are reported, emissions “from manufacturing” are reported as not applicable (“NA”) in CRF table 2(II).F. Moreover, the AD for this category for 2005 were listed as “NO”, but for prior to 2005 both AD and emissions appear to have been estimated. Responding to the list of potential problems and pending questions elaborated by the ERT, Denmark informed the ERT that it has reassessed the AD for foam blowing and concluded that until 2004 Polyurethane (PUR) foam products were produced in Denmark, but that their use was ended in 2004/2005 owing to national regulation. It also informed the ERT that since 2005 one company in Denmark has been filling the gas into pressure containers for export, but that the foam is actually manufactured in other countries. The company filling the gas into containers indicates that there are no emissions from this filling process. Denmark noted, and the ERT agrees, that emission calculation methods for this specific process are not included in the Revised 1996 IPCC Guidelines or in the IPCC good practice guidance. Therefore, the ERT accepts the response of the Party, but encourages Denmark to perform QA of the assumption that emissions from the filling process are “NO”.

76. In addition, while investigating the above-mentioned issue, Denmark identified errors between 2005 and 2008 in the AD time series and resubmitted the CRF tables for these estimates. The Party also observed some inconsistencies earlier in the time series that it intends on investigating further and, as appropriate, correcting in its next annual submission. The ERT welcomes the improvements in the estimates for the later years of the time series and recommends that the Party recalculate the full time series for the next annual submission, if additional errors are identified through the intended QC process.

77. Previous review reports have provided recommendations on cross-cutting issues related to this category, in particular related to improving QA/QC¹³ and transparency in the NIR.¹⁴ The ERT reiterates these recommendations: with respect to QA/QC, the ERT continues to recommend that Denmark develop QA/QC procedures for the F-gas emission calculations; while, regarding transparency, the ERT reiterates previous recommendations that the Party improve the documentation of methods and assumptions for the F-gas model in the NIR, recognizing that not all model documentation needs to be included for transparency. Responding to the ERT during the review, Denmark indicated that the improved documentation of the model will be included in its 2012 annual submission, and the ERT welcomes this development.

78. The ERT acknowledges that Denmark should focus its resources on actual emissions as opposed to potential emissions. Nevertheless, the ERT encourages Denmark, as part of its QA/QC efforts, to continue to improve its estimates related to potential emissions, as

¹³ FCCC/ARR/2010/DNK, paragraph 80.

¹⁴ FCCC/ARR/2010/DNK, paragraph 81.

these can be a good QA/QC check on the completeness of the inventory for the industrial processes sector.

3. Non-key categories

Solvent and other product use – CO₂

79. The previous review report described the approach that Denmark takes to estimate emissions from solvent and other product use, but indicated that the estimations of total emissions for prior to 1995, which were based on extrapolation, were not well documented, and therefore recommended that Denmark work to improve the data source and time series.¹⁵ The current ERT detected no evident implemented changes in the 2011 annual submission, but Denmark indicated during the review that the data sources and methods used to estimate emissions for the years 1990–1994 will be made consistent with the methods used to estimate emissions for after 1994 and that information thereon will be provided in the 2012 annual submission. The ERT welcomes this improvement and recommends that Denmark reflects the planned changes in its next annual submission.

D. Agriculture

1. Sector overview

80. In 2009, emissions from the agriculture sector amounted to 9,643.35 Gg CO₂ eq, or 15.6 per cent of total GHG emissions. Since the base year, emissions have decreased by 22.3 per cent. Over the period 1990–2009, CH₄ and N₂O emissions decreased by 3.0 per cent and 32.4 per cent, respectively. The key drivers for the fall in emissions are a decrease in the application of synthetic fertilizers, a decrease in the number of cattle and improved feed efficiency due to the introduction of a nitrogen pollution policy which has been in operation in Denmark since 1985. The category agricultural soils shows the largest decrease in emissions over the period (2,462.63 Gg CO₂ eq, or a decrease of 32.6 per cent, since the base year), followed by enteric fermentation (382.22 Gg CO₂ eq, or a decrease of 11.7 per cent, since the base year). Emissions from manure management and field burning of agricultural residues have increased slightly, by 74.24 Gg CO₂ eq (4.7 per cent since base year) and 1.44 Gg CO₂ eq (57.3 per cent since base year), respectively. N₂O was the dominant gas emitted in 2009, contributing 57.2 per cent of the total sectoral emissions, while CH₄ contributed 42.8 per cent. Denmark provided clear explanations in the NIR of the drivers that underpin the sectoral GHG emission trend. Within the sector, 52.8 per cent of the emissions were from agricultural soils, followed by 30.0 per cent from enteric fermentation and 17.2 per cent from manure management. The remaining 0.04 per cent were from field burning of agricultural residues. Prescribed burning of savannas and rice cultivation do not occur in Denmark (emissions from rice cultivation are reported as “NO”, while emissions from prescribed burning of savannas are reported as “NA”).

81. Since the previous annual submission, Denmark has improved the transparency of its reporting and has provided more detailed AD and explanations of methodologies, but the ERT considers that some of the necessary information (e.g. on treated slurry from biogas) was not included in the NIR. Responding to the ERT during the review, the Party provided more information on the methodology for estimating emissions from treated slurry from biogas, and the ERT recommends that Denmark provide this more detailed explanation in the NIR of its next annual submission, together with a description of the use of the biogas and the energy output of the use of the biogas.

¹⁵ FCCC/ARR/2010/DNK, paragraph 87.

82. Denmark has developed and implemented tier 2 country-specific methodologies to estimate emissions for most categories, in accordance with the IPCC good practice guidance. Denmark also applies a number of country-specific parameters and EFs for the key categories. The ERT commends the Party's efforts in this respect and encourages Denmark to explain in more detail the country-specific methodologies in the NIR. As an example, the methodology that is used to convert manure into volatile solid (VS) values is not described in the NIR: Denmark is using feeding units (FUs), which cannot easily be converted into energy content and are therefore not directly comparable to the default methodology and parameters described in the IPCC good practice guidance. The ERT recommends that the Party provide more explanation of the derivation of the FU data, in order to enhance transparency, in its next annual submission.

83. As explained in the NIR (chapter 6.9), Denmark has made recalculations for the agriculture sector, mostly in response to the previous review report, and these resulted from: the MCF for animals housed in deep litter (cattle, sheep and goats) being changed to 10 per cent, in accordance with the IPCC good practice guidance; the MCF for poultry being changed to 1.5 per cent, also in accordance with the IPCC good practice guidance; the EF for histosols being changed to the IPCC default (8 kg N₂O-N/ha); and the MCF for grazing for all animal types being set at 1 per cent. Recalculations also resulted from changes in the methodology used to estimate indirect N₂O emissions from agricultural soils: in line with the Revised 1996 IPCC Guidelines, the methodology now considers separate calculations for three different components: groundwater, rivers and estuaries. Finally, other recalculations were made as a result of adjusting the number of produced animals for poultry and swine, consideration of four types of horses and new data on housing type distribution. In addition, during the review, the ERT identified a recalculation not explained by the Party in the NIR, namely a new method for the calculation of emissions from treated slurry from biogas, for which explanations are not provided in the recalculations section of the NIR. The ERT recommends that the Party provide explanations in relation to this issue in its next annual submission.

84. The Party has provided an overall framework for a specific QA/QC plan which is constructed in six stages. The plan is still under development and not all stages were implemented for the 2011 annual submission. The ERT commends Denmark for its continued efforts to improve the quality of the inventory for the agriculture sector and encourages the Party to implement all stages of the plan. In particular, the ERT appreciates that the sixth stage was partially implemented in order to check the methodology used and calculations made by external reviewers, and encourages the Party to make contact with agriculture experts from other countries with similar agricultural systems.

85. In the 2011 annual submission, and for the first time, Denmark provided estimates for CH₄ emissions from enteric fermentation for poultry, ostriches and pheasants. The ERT commends the Party for this effort to increase the completeness of the emission estimates and encourages the Party to carry through its intention to estimate CH₄ emissions from manure management for ostriches and pheasants.

2. Key categories

Enteric fermentation – CH₄

86. During the review, the ERT noted that the 2009 CH₄ IEF for sows was 1.62 kg CH₄/head/year, while, in accordance with the country-specific methodology described in the NIR, it should be 2.83 kg CH₄/head/year. This difference has an effect on the estimate of total emissions from swine and the respective IEF, and the ERT alerted the Party during the review that there could potentially have been an underestimation of the CH₄ emissions from enteric fermentation for swine. Denmark provided further information during the

review week, clarifying that there was an error in the IEF and the emission for sows, and that it intends to revise the emission estimates using a revised IEF for swine. The ERT took note of Denmark's response, but considered that there had been an underestimation of the CH₄ emissions from sows and included this in the list of potential problems and further questions. Responding to the ERT, Denmark has recalculated the CH₄ emissions from enteric fermentation for swine and revised the IEF to 2.83 CH₄/head/year for 2009. As a consequence of the recalculation, the estimate of GHG emissions from the agriculture sector has increased by 27.61 Gg CO₂ eq for 2009 (0.3 per cent).

87. The ERT found that Denmark calculated the IEF for dairy cattle using a value for gross energy intake estimated using a milk yield of 22.50 kg/day for 2008, but in CRF table 4.A the reported milk yield for 2008 is 23.53 kg/day. Responding to the ERT during the review, the Party explained that the value for milk yield reported in the CRF tables is an error, but that the incorrect value does not influence the calculation of the emission estimates. The ERT recommends that Denmark report the correct value in CRF table 4.A in its next annual submission and improve the QC procedures to detect such issues.

Manure management – CH₄ and N₂O

88. Denmark treats some of its animal slurry in biogas plants, capturing the CH₄ generated and using it for electricity production and cogeneration. For previous annual submissions, Denmark estimated CH₄ emissions on the basis of the content of VS in the slurry and considering a CH₄ reduction potential of 30 per cent for cattle slurry and 50 per cent for swine. The ERT noted that the quantity of biogas collected and not being emitted is based on country-specific studies and that only one reference was provided, and concludes that better documentation is needed to support these country-specific values of CH₄ reduction potential. During the review, the Party explained that inappropriate data were used in the calculation of CH₄ emissions from manure management, and that CH₄ reduction potentials of 23 per cent for cattle and 40 per cent for swine should be used in the calculations. The ERT recommends that Denmark provide recalculations in its next annual submission.

89. During the review, the ERT found that CRF table 4.B(a), concerning the allocation and MCF values for animal waste management systems (AWMS) per animal type, did not contain any data. Responding to the ERT during the review, Denmark provided the table with the data and informed the ERT that it will include the table in its next annual submission, which the ERT welcomes as it will increase the transparency of the reporting.

90. Denmark assumes that N₂O emissions from slurry treated for biogas production are at a lower level than emissions from untreated slurry. The Party considers a potential reduction in emissions of 36 per cent for cattle slurry and 40 per cent for pig slurry. The NIR explains that the lower level of emissions is a result of displacement in the allocation between the fractions of degradable and non-degradable VS: biogas-treated slurry increases the fraction of non-degradable VS, which promote the oxygen content in the soil, and these conditions lead to a reduced potential risk of N₂O emissions, because N₂O emissions occur in environments without oxygen or with very low concentrations of oxygen (Sommer et al., 2001)¹⁶. In a manner similar to that described for CH₄ emissions (see para. 88 above), the Party informed the ERT during the review that a potential N₂O reduction of 41 per cent for swine should be used in the calculations. The ERT recommends that Denmark provide improved explanations in its next NIR, including a table with these potential emission reductions.

¹⁶ Sommer, S.G., Møller, H.B. & Petersen, S.O. 2001: Reduktion af drivhusgasemission fra gylle og organisk affald ved Biogasbehandling. DJF rapport - Husdyrbrug, 31, 53 pp. (In Danish).

Direct N₂O emissions from agricultural soils – N₂O

91. During the review, the ERT requested the Party to justify the claim that the decrease in the N₂O emissions from agricultural soils was due to a reduction in the agricultural area of N-fixing crops. Responding to the ERT, the Party provided a complete table showing the emission trend for the area of N-fixing crops. The ERT recommends that Denmark include this table in its next annual submission.

92. The ERT noted that Denmark reports the fraction of livestock excretion in excrement that is burned for fuel (Frac_{FUEL}) in CRF table 4.D as “NE”. During the review, the Party clarified that manure used as fuel is not occurring in Denmark and that the appropriate notation key is therefore “NO”. The ERT recommends that Denmark revise the notation key used in its next annual submission.

Indirect N₂O emissions from agricultural soils – N₂O

93. Indirect N₂O emissions from atmospheric deposition include different sources of volatilized N: livestock manure; synthetic fertilizer; crop residues and N-fixing crops; ammonia (NH₃)-treated straw used as feed; field burning of crop residues; sewage sludge, plus sludge from industrial production applied to agricultural soils; and NH₃ volatilization due to N excreted on grass by grazing animals. However, the ERT found that the NIR (table 6.40) does not show the quantity of NH₃ due to N excreted on grass by grazing animals (2,000 t/year in 2009). The Party explained during the review that those emissions are included in the data on emissions from livestock manure. The ERT recognizes that the emissions have not been underestimated, but recommends that this be clarified in the NIR of the Party’s next annual submission.

E. Land use, land-use change and forestry**1. Sector overview**

94. In 2009, net removals from the LULUCF sector amounted to 1,117.66 Gg CO₂ eq, offsetting 1.8 per cent of Denmark’s total GHG emissions. This represents a substantial change since the base year, when the sector was a net source of emissions, amounting to 3,154.68 Gg CO₂ eq. The key drivers for the trend are the increase in removals from forest land remaining forest land (which increased by 1,866.24 Gg CO₂ eq between 1990 and 2009) and the decrease in emissions from cropland (by 1,855.66 Gg CO₂ eq between 1990 and 2009), grassland (by 275.77 Gg CO₂ eq between 1990 and 2009) and wetlands (by 81.56 Gg CO₂ eq between 1990 and 2009). Within the sector, net removals of 2,724.44 Gg were from forest land and net emissions of 1,347.51 Gg were from cropland. Net emissions from grassland accounted for 198.28 Gg CO₂ eq and net emissions from settlements for 55.88 Gg CO₂ eq. The remaining 5.12 Gg CO₂ eq net emissions were from wetlands. Emissions and removals from other land were reported as “NA” and “NO”.

95. Denmark has made extensive recalculations for the LULUCF sector between the 2010 and 2011 annual submissions, mostly in response to the previous review report and mostly as a result of changes in AD. The impact of these recalculations on the LULUCF sector was a decrease in the estimated emissions of 4,780.04 Gg CO₂, or –180.2 per cent, for 2008. The main recalculations took place for the following categories: forest land remaining forest land; cropland remaining cropland; and land converted to settlements.

96. Denmark has improved the completeness of the inventory for the LULUCF sector by following recommendations made in the previous review report,¹⁷ by considering AD that were previously not reported (e.g. for other land converted to grassland) and by

¹⁷ FCCC/ARR/2010/DNK, paragraph 109.

including estimates of net carbon stock changes for more pools (i.e. for organic and mineral soils in areas of land converted to forest land). In addition, for its 2011 annual submission, Denmark used recently produced soil maps of organic soils in agricultural areas, allowing the allocation of agricultural soils between mineral soils and organic soils and also its subdivision into cropland and permanent grassland. The ERT commends these improvements.

97. The ERT noted, however, that the LULUCF inventory could not be considered complete, in the original 2011 annual submission, since net carbon stock changes and CO₂ emission from soils in areas subjected to deforestation due to forest land conversion to settlements had not been estimated. Later, Denmark, responding to the list of potential problems and further questions, provided estimates for this pool and category in conjunction with revised estimates for the soils pool for the KP-LULUCF activity deforestation (see paras. 122–124 below).

98. Denmark has performed a tier 1 uncertainty analysis for the LULUCF sector, but the ERT noted that Denmark has performed a tier 2 uncertainty analysis for the other sectors. The ERT encourages Denmark to expand the tier 2 uncertainty analysis to cover also the LULUCF sector for its next annual submission.

99. The ERT reiterates the recommendation made in the previous review report¹⁸ that Denmark improve the QA/QC processes for the LULUCF sector and report on the improvements made, in its next annual submission.

100. Responding to the list of potential problems and further questions, Denmark has prepared revised estimates for certain categories in the LULUCF sector, in the follow-up of changes made to estimates from KP-LULUCF activities, providing revised estimates of N₂O emissions from cropland (which have increased by 0.13 Gg CO₂ eq, or 30.4 per cent, for 2009) and CO₂ emissions from settlements (which have increased by 1.13 Gg CO₂ eq, or 2.1 per cent, for 2009).

2. Key categories

Forest land remaining forest land – CO₂

101. As explained in the NIR, a full recalculation of the estimates of carbon stock changes in forest land remaining forest land has been made for the 2011 annual submission for the period 1990–2009, owing to the use of revised data that were considered more suitable for the inventory. The sources of these data include Denmark's NFI, based on field sampling since 2002, the Forest Census for 1990 and 2000, and the mapping of the forest area based on satellite images for 1990 and 2005. The forest area in 1990 and 2005 was revised and is now estimated to be larger than reported in previous annual submissions. In addition, age-distribution data as reported in the Forest Census for 1990 and 2000 were used in the recalculations. The ERT welcomes the improvements made by Denmark and the transparent reporting in the NIR.

102. However, the ERT recommends that Denmark further improve the transparency of its reporting by including in its NIR additional information on forests that could be useful to explain the carbon stock changes in forest land remaining forest land (i.e. information on changes in tree species composition and the age structure of forest stands; the area and volume of clear cutting; and the area subjected to destructive disturbances).

103. The ERT noted that the time series of net CO₂ emissions/removals is not stable: for the period 1990–1999 reported net removals were around 1,000 Gg/year; net emissions were reported for the period 2000–2005; and finally, net removals were reported for the

¹⁸ FCCC/ARR/2010/DNK, paragraph 115.

period 2006–2009. Furthermore, the value for 2009 (–2,591.16 Gg) is 257.4 per cent higher than the value for 1990 (–724.92 Gg). The ERT noted that this trend in CO₂ emissions basically follows the trend in net carbon stock change in living biomass. Responding to questions raised by the ERT, Denmark attributed this variation over the time series to the use of different sources of data and to changes in the age structure of the forests, and added, as an explanation, that it was difficult to obtain consistency using different data sources. The ERT reiterates the recommendation made in previous review reports¹⁹ that Denmark make efforts to ensure consistency in the time series by addressing issues arising from the use of different data sources (i.e. by using interpolation).

104. Responding to the recommendation made in the previous review report²⁰ Denmark has, for the first time, provided AD and estimates of carbon stock change for organic soils for the most relevant forest types: broadleaf and coniferous. The ERT commends the improvements made by the Party.

105. The trend in net carbon stock change in organic soils shows a decrease in emissions (the value for 2009, –0.34 Mg C/ha, is 33.3 per cent lower than the value for 1990, –0.51 Mg C/ha). Responding to questions raised by the ERT during the review, Denmark attributed the decreasing trend to the reduction of drainage in Danish forests. The ERT recommends that Denmark provide explanations for this trend, including the underlying reasons for it, in the NIR of its next annual submission.

Cropland remaining cropland – CO₂

106. The trend in net CO₂ emissions/removals is unstable and large inter-annual changes have been identified for all years of the time series: for example for 2001/2002 (+81.9 per cent), 2002/2003 (–32.2 per cent), 2004/2005 (+81.8 per cent) and 2008/2009 (–48.8 per cent). In a similar manner, the trend in net carbon stock change in mineral soils is unstable and similar large inter-annual changes have been identified: for 2001/2002 (–687.2 per cent), 2002/2003 (+61.6 per cent), 2003/2004 (+39.3 per cent), 2004/2005 (–390.4 per cent) and 2008/2009 (+121.4 per cent). Overall, the category cropland remaining cropland ceased being a net source, with net emissions of 3,199.86 Gg CO₂ eq in 1990, and was a net sink in 2009, with net removals of 1,346.97 Gg CO₂ eq. Denmark provided justifications for this to the ERT during the review, explaining that the high level of fluctuation in emissions from cropland is related to the actual yearly crop yield and variable climatic conditions: low yields combined with high temperatures reduce the total amount of carbon in agricultural soils, whereas in years with a high yield and low temperatures the carbon stock in soils is increased. In addition, the Party stated that for 1990 onwards a general decrease in the emissions from cropland is reported owing to a higher incorporation of straw (as a side effect of the ban on field burning), growing quantities of catch crops in the autumn, a change from low-yielding spring barley to high-yielding winter wheat, an increase in carbon stocking in hedgerows, and a reduced consumption of lime. The ERT recommends that the Party include these explanations, together with the underlying data, in its next annual submission.

107. Denmark uses a tier 3 model (an updated version of C-TOOL) based on modelled dynamics for carbon turnover in soils to estimate carbon stock changes in mineral soils in cropland. The model operates with three different pools: fresh organic matter (FOM), humified organic matter (HUM) and resilient organic matter (ROM). Following up a recommendation made in the previous review report,²¹ Denmark provided revised estimates for carbon stock changes in mineral soils in cropland, taking into account only the changes

¹⁹ FCCC/ARR/2010/DNK, paragraph 116.

²⁰ FCCC/ARR/2010/DNK, paragraph 117.

²¹ FCCC/ARR/2010/DNK, paragraph 120.

in the HUM and ROM pools. Denmark provides information in the NIR on the validation of the model with field measurements of changes in the soil organic matter. The ERT welcomes this improvement.

F. Waste

1. Sector overview

108. In 2009, emissions from the waste sector amounted to 1,366.42 Gg CO₂ eq, or 2.2 per cent of total GHG emissions. Since the base year, emissions have decreased by 0.6 per cent. The key driver for the fall in emissions is the decrease in emissions from solid waste disposal on land (-71.24 Gg CO₂ eq, or a decrease of 6.4 per cent since the base year) and the decrease in emissions from wastewater handling (-22.51 Gg CO₂ eq, or a decrease of 11.8 per cent since the base year). This decrease was partially offset by an increase in emissions from accidental fires and compost production (included in the category other), which have increased by 86.53 Gg CO₂ eq, or 138.2 per cent, since the base year. Within the sector, 76.3 per cent of the emissions were from solid waste disposal on land, followed by 12.3 per cent from wastewater handling and 10.9 per cent from other (accidental fires and compost production). The remaining 0.4 per cent were from waste incineration.

109. Recalculations have been performed for the waste sector, in particular for the categories wastewater handling and other, to reflect updated AD and changes in EFs. The recalculations have been reported in the NIR: recalculations for wastewater handling reflect improvements to the methodology for estimating CH₄ emissions as well as smaller corrections made to the national N₂O EF; and emissions from compost production were reported for the first time in the 2011 annual submission. The ERT commends Denmark for the improvement of completeness by including emissions from composting. Denmark has moved the estimates of emissions from building and vehicle accidental fires from the category waste incineration to the category other (waste). The recalculations resulted in increases of 6.0 per cent and 11.1 per cent in the estimates of total GHG emissions from the waste sector for the base year and for 2008, respectively.

110. Denmark provides emission estimates for all categories for which there are estimation methodologies available in the Revised 1996 IPCC Guidelines or in the IPCC good practice guidance. The ERT noted that Denmark reported as "NE" CO₂ emissions from managed waste disposal on land. The ERT also noted that CO₂ emissions from solid waste disposal sites must only be estimated when resulting from the combustion of solid waste as part of management practices at solid waste disposal sites and reported only for non-biogenic waste sources. The ERT encourages the Party to make efforts to report CO₂ emissions from managed waste disposal on land in order to improve the completeness of the inventory in its next annual submission.

2. Key categories

Solid waste disposal on land – CH₄

111. To estimate emissions for this category, Denmark uses the first-order decay (FOD) model as described in the 2006 IPCC Guidelines, using country-specific AD and a combination of country-specific parameters for degradable organic carbon and IPCC default values. The ERT encourages Denmark to conduct research in order to develop country-specific parameters for the FOD model, in order to increase the accuracy of the estimates for this key category.

112. Denmark uses the IPCC default methane generation rate constant (k) (0.05) as the key parameter for the FOD model. According to the IPCC good practice guidance, it would

be necessary to include data on solid waste disposal (amount and composition) for three- to five-year half-lives for the waste deposited at the solid waste disposal sites to achieve accurate emission estimates (i.e. for about 40–70 years), but the ERT could not find that information in the NIR for the period before 1990. During the review, Denmark explained to the ERT that the FOD model calculations are based on data on solid waste disposal for the period 1960–2009, which were based on measurements taken by the Danish EPA and estimated for the whole period using a linear regression: measurements are available for 1985 and 1994–2009 for the total and all eight waste fractions; data for 1986–1993 were interpolated using a linear regression for between 1985 and 1994; for 1970 the Party has information on the total deposited amount of waste but not on the individual waste fractions, which were estimated on the basis of those for 1985; data for 1971–1984 were also determined by assuming a linear development between 1970 and 1985; and finally the 1960–1969 data are assumed constant at the 1970 level. The ERT encourages Denmark to provide these explanations in the NIR, together with the quantities for each waste fraction, in its next annual submission, in order to improve the transparency of the inventory.

Waste incineration – CO₂, CH₄ and N₂O²²

113. Denmark has moved the estimates of emissions from building and vehicle accidental fires from the category waste incineration to the category other (waste). The ERT welcomes this improvement.

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

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

Overview

114. Denmark has accounted for mandatory activities under Article 3, paragraph 3, of the Kyoto Protocol (afforestation and reforestation, and deforestation). Denmark has also elected to account for forest management, cropland management and grazing land management as specified under Article 3, paragraph 4, of the Kyoto Protocol. Denmark has not elected revegetation. Denmark has chosen to account for all activities under Article 3, paragraphs 3 and 4, of the Kyoto Protocol annually.

115. The ERT noted that Denmark has used consistent and complete remote sensing to identify areas of forest land and forest land change. However, it provided incorrect land-transition matrices in its original 2011 annual submission: in table NIR-2 for 2008 Denmark reported an area under cropland management at the end of 2008 of 401.48 kha, while in table NIR-2 for 2009 it reported an area of 4.33 kha at the beginning of 2009. In addition, in table NIR-2 for 2008 Denmark reported an area under grazing land management at the end of 2008 of 0.26 kha, while in table NIR-2 for 2009 it reported an area of 401.27 kha at the beginning of that year. Responding to questions raised during the early stages of the review process, Denmark provided a correct table NIR-2 (land-use conversion matrix) for 2008 and 2009, and it incorporated these revised tables in its resubmission of 16 October 2011. The ERT strongly recommends that Denmark improve its QA/QC procedures for KP-LULUCF in order to avoid such problems in the next annual submission.

²² Not all emissions related to all gases under this category are categories, particularly CO₂ emissions. However, since the calculation procedures for issues related to this category are discussed as whole, the individual gases are not assessed in separate sections.

116. The Party has made recalculations for all KP-LULUCF activities between the 2010 and 2011 annual submissions, in response to recommendations made in the previous review report and in order to lift the adjustments applied for 2008 in the previous annual submission, and also as a consequence of changes made to AD and EFs to rectify identified errors. In particular, recalculations for forest management were connected with the use of new AD and were consistent with the recalculations made for the LULUCF sector (see para. 102 above). The impact of these recalculations on each KP-LULUCF activity for 2008 is as follows:

- (a) For afforestation/reforestation, a decrease in the estimate of net removals from -69.81 to -45.07 Gg CO₂ eq;
- (b) For deforestation, a decrease in the estimate of net emissions from 35.89 to 32.44 Gg CO₂ eq;
- (c) For forest management, a change from net emissions of 293.1 Gg CO₂ eq to net removals of -4,816.98 Gg CO₂ eq;
- (d) For cropland management, an increase in the estimate of net emissions from 863.55 to 2,530.16 Gg CO₂ eq;
- (e) For grazing land management, an increase in the estimate of net emissions from 81.68 to 184.35 CO₂ eq.

117. In addition, Denmark has provided revised estimates of CO₂ emissions from deforestation, in response to the list of potential problems and further questions, together with its resubmission of 16 October 2011 (see paras. 122–124 below). Estimated net CO₂ emissions from deforestation were revised to of the following values: 33.66 Gg CO₂ eq for 2008; and 34.74 Gg CO₂ eq for 2009. The ERT recommends that Denmark provide this information in its next annual submission.

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

Afforestation and reforestation – CO₂

118. Although Denmark includes both plantation and natural regeneration under afforestation, during the review Denmark provided information to the ERT demonstrating that natural regeneration is human induced: as the price of land in Denmark is very high, natural establishment of forest occurs only where and when the land owner decides that the conversion will occur; therefore, areas included as natural regeneration areas under Article 3, paragraph 3, of the Kyoto Protocol in Denmark occur only as a result of a management decision (i.e. a decision to leave the land for the natural establishment of forest).

119. Following recommendations made in the previous review report,²³ Denmark includes estimates of removals and emissions for all carbon pools under afforestation and reforestation in its 2011 annual submission. In addition, it has ensured consistency between pools reported for KP-LULUCF activities (CRF table 5(KP-I)A.1.1) and for land converted to forest land in the LULUCF sector (CRF table 5.A).

120. During the review, Denmark informed the ERT that recalculations were carried out for all pools of the KP-LULUCF activity afforestation/reforestation also with the intention of replacing the adjusted estimates in the previous review report. In particular, Denmark provided estimates of emissions and removals from the pool mineral soils and enhanced transparency of reporting for the estimates of emissions and removals from above- and below-ground biomass, litter and deadwood. The ERT concludes that the revised estimates provided by Denmark for 2008 solve the underlying problem for the adjustments applied in

²³ FCCC/ARR/2010/DNK, paragraphs 178 and 180.

the previous review report, and agree for the Party to replace the adjustments with the recalculations.

121. Denmark has reported changes in carbon stock for units of land subjected to afforestation/reforestation and harvested since the beginning of the commitment period as “IE” (reported under units of land not harvested since the beginning of the commitment period), which the ERT considers not to be in accordance with the UNFCCC reporting guidelines. Denmark explained to the previous ERT that this is because the majority of areas subject to afforestation are on long rotations (>50 years) and therefore will not be harvested during the commitment period. The ERT reiterates the recommendation made in the previous review report²⁴ that Denmark provide further information to explain this in its next annual submission, or provide estimates of the harvested areas and the associated emissions and removals.

Deforestation – CO₂

122. Denmark has used the same country-specific methods to estimate emissions and removals from deforestation as those used to estimate emissions from forest land converted to other land under the LULUCF sector (cropland, grassland, settlements and wetlands). However, the ERT noted that, although deforestation in Denmark includes the conversion of forest land units to cropland, grassland, wetlands and settlements, in its original 2011 annual submission Denmark reported CO₂ emissions from soils as a result of deforestation due to forest land conversion to settlements as “NA”, supporting its decision with the fact there are no available soil organic carbon reference levels (SOCrefs) for settlements provided in the IPCC good practice guidance for LULUCF, and neither are country-specific values available since soil sampling does not take place in urban areas in Denmark. Nevertheless, the ERT indicated to the Party that there was a potential underestimation of emissions for the commitment period, since forest land conversion to settlements results in a reduction in soil organic carbon (SOC) and leads to CO₂ emissions, and listed it as a potential problem and further question. The ERT also indicated to the Party that, in accordance with paragraph 6(e) of the annex to decision 15/CMP.1, Denmark should provide information if any pool, including SOC, is not accounted for, together with verifiable information that demonstrates that such an unaccounted pool is not a net source of anthropogenic GHG emissions.

123. Responding to the list of potential problems and further questions, Denmark has provided revised estimates for CO₂ emissions from soils as a result of deforestation, both for 2008 and 2009, by including soil carbon emissions from forest land converted to settlements. The Party’s revised estimates were based on a SOCref for settlements of 120 t C/ha (0–100 cm) in combination with a transition period of 100 years, which is based on expert judgment. The rationale for the expert judgment was provided to the ERT and can be summarized in the following manner: an average value for SOC in forest soils of 150 t C/ha was considered; the soil carbon stock was divided into three pools, namely FOM, HUM and ROM, with different rates of soil degradation; new settlements can be divided into totally sealed areas and open areas with gardens and other plantations, characterized by different rates of carbon input and degradation; and finally there was the assumption that a new equilibrium state is obtained where ROM remains stable, and 50 per cent of FOM and the HUM pool will disappear.

124. In addition, N₂O emissions associated with the land-use conversion from forest land to settlements and the decrease in organic matter in soils have been included in the emission estimates. For 2009, CO₂ emissions from mineral soils as a result of deforestation have decreased in the revised estimates from 3.25 to 2.12 Gg CO₂ eq while N₂O emissions

²⁴ FCCC/ARR/2010/DNK, paragraph 179.

increased from 0.41 to 0.54 Gg CO₂ eq. The ERT considers that the efforts made by the Party have solved the issue, and recommends that Denmark include the underlying information supporting the revised estimates in the NIR of its next annual submission.

125. During the review, the ERT found that there is not full consistency between the emission estimates reported under deforestation and under the equivalent LULUCF conversion categories for all pools; for example, a gain of 0.30 Gg carbon in soils in forest land converted to other land uses was reported (CRF tables 5.B-F), but a loss of 0.10 Gg carbon from soils under deforestation was also reported (CRF table 5(KP-I)A.2). No explanations for this difference are provided in the NIR. The ERT recommends that Denmark provide explanations for this difference in its next annual submission or make efforts to achieve consistency within its reporting.

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

Forest management – CO₂

126. The country-specific methods that Denmark uses to estimate emissions and removals from forest management are the same as those used to estimate emissions and removals from forest land remaining forest land. In addition, forest management in Denmark includes all areas of forest and corresponds to the areas of forest land remaining forest land considered in the LULUCF sector. Therefore, the ERT found total consistency between the emission and removal estimates reported for all pools for forest land remaining forest land and for the activity forest management reported under the Kyoto Protocol. The ERT commends the Party for having solved the issues raised in the previous review report.²⁵

Cropland management – CO₂

127. Denmark uses the tier 3 model C-TOOL to estimate emissions from mineral soils under cropland management. The ERT commends Denmark for having fulfilled the recommendation made in the previous review report and for having excluded the fast turnover pools from its reporting in order to reduce the variability in time due to changes in management.²⁶ Denmark has provided in the NIR additional explanation of changes made to the model since its previous annual submission and the verification of results using field data. The ERT welcomes the improvements made by the Party.

Grazing land management – CO₂

128. Denmark uses the same country-specific methods to estimate emissions and removals from grazing land management as those that it uses to estimate emissions and removals for the category grassland remaining grassland under the LULUCF sector. In addition, areas under the KP-LULUCF activity grazing land management include all areas of grassland and match the area defined as grassland remaining grassland in the LULUCF sector. The ERT concludes that there is consistency between the emission estimates reported for grassland remaining grassland and grazing land management.

2. Information on Kyoto Protocol units

Standard electronic format and reports from the national registry

129. Denmark 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

²⁵ FCCC/ARR/2010/DNK, paragraph 183.

²⁶ FCCC/ARR/2010/DNK, paragraph 184.

of the findings and recommendations included in the SIAR on the SEF tables and the SEF comparison report.²⁷ The SIAR was forwarded to the ERT prior to the review, pursuant to decision 16/CP.10. The ERT reiterated the main findings and recommendations contained in the SIAR.

130. Information on the accounting of Kyoto units has been prepared and reported in accordance with chapter I.E of the annex to decision 15/CMP.1, 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 set out in paragraph 88(a–j) of the annex to decision 22/CMP.1. 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 and no non-replacement has occurred. The national registry has adequate procedures in place to minimize discrepancies.

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

132. The ERT noted that Denmark did not provide information on how corrective action was undertaken to address a recommendation made by the previous ERT to put in place measures to mitigate and reduce the internal fragmentation of unit blocks. In the course of the review, Denmark clarified that if it becomes a problem, it will implement a procedure to solve the problem, either by dividing the transaction into two or more transactions or by bundling the unit blocks. The ERT recommends that the Party provide this information in the NIR of its next annual submission.

133. The Party provided access to information from its national registry that substantiated or clarified the information reported in its annual submission. This information is provided on the website of the Danish Energy Agency and on the Danish Energy Agency's registry website²⁸ (see also para. 142 below).

Accounting of activities under Article 3, paragraph 3, of the Kyoto Protocol and any elected activities under Article 3, paragraph 4, of the Kyoto Protocol

134. Information on the accounting of KP-LULUCF has been prepared and reported in accordance with decisions 16/CMP.1 and 6/CMP.3.

135. Table 4 shows the accounting quantities for KP-LULUCF as reported by the Party and the final values after the review.

²⁷ The SEF comparison report is prepared by the 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.

²⁸ <<https://www.kvoteregister.dk>>, and <<http://www.ens.dk/en-US/ClimateAndCO2/emissiontrading/DETR/Sider/Forside.aspx>>.

Table 4
Accounting quantities for activities under Article 3, paragraph 3, and, if any, activities under Article 3, paragraph 4, of the Kyoto Protocol, in t CO₂ eq

| | 2011 annual submission ^a | | 2010 annual submission ^b | "Net" accounting quantity ^c | |
|------------------------------------|-------------------------------------|-------------------|-------------------------------------|--|------------|
| | As reported | Revised estimates | Final | Final | |
| Afforestation and reforestation | -190 380 | | -190 380 | 47 875 | -238 255 |
| Deforestation | 65 920 | 68 396 | 68 396 | 23 297 | 45 099 |
| Forest management | -916 667 | | -916 667 | 264 693 | -1 181 360 |
| Article 3.3 offset ^d | 0 | | 0 | 71 172 | NA |
| Forest management cap ^e | -916 667 | | -916 667 | 264 693 | NA |
| Cropland management | -2 477 771 | | -2 477 771 | -618 231 | -1 859 540 |
| Grazing land management | -257 891 | | -257 891 | -5 878 | -252 013 |
| Revegetation | NA | | NA | NA | NA |

Abbreviations: CRF = common reporting format, KP-LULUCF = land use, land-use change and forestry emissions and removals from activities under Article 3, paragraphs 3 and 4, of the Kyoto Protocol, NA = not applicable.

^a The values included under 2011 annual submission are the cumulative accounting values for 2008 and 2009 as reported in the accounting table of the KP-LULUCF CRF tables for the inventory year 2009.

^b The values included under 2010 annual submission are the final accounting values following the 2010 review and are included in table 6 of the 2010 annual review report (FCCC/ARR/2010/DNK, page 45).

^c The "net" accounting quantity is the quantity of Kyoto Protocol units that the Party shall issue or cancel under each activity under Article 3, paragraph 3, and paragraph 4, if relevant, based on the final accounting quantity in the 2011 annual submission and where the quantities issued or cancelled based on the 2010 review have been subtracted ("net" accounting quantity = final 2011 – final 2010).

^d Article 3.3 offset: For the first commitment period, a Party included in Annex I to the Convention that incurs a net source of emissions under the provisions of Article 3, paragraph 3, may account for anthropogenic greenhouse gas emissions by sources and removals by sinks in areas under forest management under Article 3, paragraph 4, up to a level that is equal to the net source of emissions under the provisions of Article 3, paragraph 3, but not greater than 9.0 Mt carbon times five, if the total of anthropogenic greenhouse gas emissions by sources and removals by sinks in the managed forest since 1990 is equal to, or larger than, the net source of emissions incurred under Article 3, paragraph 3.

^e In accordance with paragraph 11 of the annex to decision 16/CMP.1, for the first commitment period only, additions to and subtractions from the assigned amount of a Party resulting from forest management under Article 3, paragraph 4, after the application of paragraph 10 of the annex to decision 16/CMP.1 and resulting from forest management project activities undertaken under Article 6 of the Convention, shall not exceed the value inscribed in the appendix to the annex to decision 16/CMP.1, times five.

136. Based on the information provided in table 4 on afforestation/reforestation, Denmark shall issue 238,255 removal units (RMUs) in its national registry.

137. Based on the information provided in table 4 on deforestation, Denmark shall cancel 45,099 assigned amount units, emission reduction units and/or certified emission reduction units in its national registry.

138. Based on the information provided in table 4 on forest management, Denmark shall issue 1,181,360 RMUs in its national registry.

139. Based on the information provided in table 4 on cropland management, Denmark shall issue 1,859,540 RMUs in its national registry.

140. Based on the information provided in table 4 on grassland management, Denmark shall issue 252,013 RMUs in its national registry.

National registry

141. 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 findings 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.

142. However, the ERT noted that the SIAR reiterated the problems identified in previous years relating to the public availability of information. In particular, the SIAR noted that the national registry has not fulfilled the requirements regarding the public availability of information in accordance with section I.I.E of the annex to decision 13/CMP.1, and recommended that the following information be made available to the public on a website controlled by the Party: account information; and account holding and transaction information (if this information is considered confidential, a note stating this fact should be placed on the public website). Responding to the request made by the ERT for additional comments in response to the SIAR during the review, Denmark clarified that all information is currently available on the Community Independent Transaction Log (CITL) webpage²⁹ and that a link to the CITL webpage on the national registry system's webpage, with a note that publicly available information can be located there, will be published as soon as possible. The ERT supports the Party in this intention and recommends that Denmark report on this improvement in its next annual submission.

Calculation of the commitment period reserve

143. Denmark has reported its commitment period reserve in its 2011 annual submission to be 249,155,060 t CO₂ eq, and the Party reported that this figure has not changed since the initial report review as it is based on the assigned amount of Denmark (276,838,955 t CO₂ eq.). The ERT agrees with this figure.

3. Changes to the national system

144. Denmark reported in the NIR that there have been changes in its national system since the previous annual submission. These include a new data collection agreement between NERI and the Danish Energy Agency, ensuring that NERI has access to detailed reporting from plants under the EU ETS; and a new data agreement signed between NERI and the Government of Greenland ensuring the timely and complete finalization of the annual submission. The ERT concluded that the Party'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

145. Denmark reported that there have been changes in its national registry since the previous annual submission, including the development and implementation of a two-factor security system in the registry, in order to further improve its security. This new two-factor security system was implemented in February 2011. The ERT concluded that the Party'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.

²⁹ <<http://www.ens.dk/en-US/ClimateAndCO2/emissiontradingcheme/DETR/ToU/Sider/Forside.aspx>>.

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

146. Denmark reported that there are changes in its reporting of the minimization of adverse impacts in accordance with Article 3, paragraph 14, since the previous annual submission. The ERT concluded that the information provided continues to be complete and transparent. In particular, Denmark provided information on new initiatives, which include:

(a) The allocation of specific climate funds through the so-called Climate Pool. In 2008 Denmark allocated 100 million Danish kroner (DKK), of which 88 million DKK were allocated to specific climate change projects covering issues such as adaptation, mitigation, participation of developing countries in UNFCCC negotiations, civil society capacity-building, participation and dialogues, and climate diplomacy;

(b) As part of the financial promises that were given by the European Union to developing countries at the fifteenth session of the Conference of the Parties (COP), held in Copenhagen in December 2009, Denmark announced a contribution of 1.2 billion DKK for the implementation of the accelerated climate financing;

(c) At the sixteenth session of the COP, held in Cancun in December 2010, the Danish Government launched the following projects funded by the Climate Pool: support for the federation of small island developing States (SIDS) for the development and implementation of reduction and adaptation efforts; support for the implementation of nationally appropriate mitigation actions in a number of major developing countries; support for the encouragement of private-sector investment in energy efficiency and renewable energy in emerging economies among developing countries through a fund deposits with mixed public and private investor participation; and collaboration with the South Korean Global Green Growth Institute (GGGI) implementing various emission reduction projects through sustainable growth plans in selected developing countries.

III. Conclusions and recommendations

147. Denmark made its annual submission on 15 April 2011 and resubmitted the CRF tables under the Kyoto Protocol and the KP-LULUCF CRF tables on 16 October 2011. 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 minimization of adverse impacts in accordance with Article 3, paragraph 14, of the Kyoto Protocol). This is in line with decision 15/CMP.1.

148. The ERT concludes that the inventory submission of Denmark has been prepared and reported in accordance with the UNFCCC reporting guidelines. The inventory submission is complete and the Party has submitted an almost complete set of CRF tables for the years 1990–2009 (not submitted are CRF tables 7 (key categories) and 8(b) (explanations on recalculations)) and an NIR; these are complete in terms of geographical coverage, years and sectors, as well as in terms of categories and gases. Denmark included estimates of removals and emissions covering all pools for KP-LULUCF activities in its 2011 annual submission.

149. 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.

150. The Party's inventory is in line with the Revised 1996 IPCC Guidelines, the IPCC good practice guidance and the IPCC good practice guidance for LULUCF. The ERT noted

that the transparency of descriptions of country-specific methodologies and parameters might be improved (see para. 42 above). The ERT commends the efforts made by Denmark to improve its LULUCF and KP-LULUCF reporting since its 2010 annual submission.

151. The Party has made recalculations for the inventory between the 2010 and 2011 annual submissions, in response to the previous review report, as a result of changes in AD and EFs, and to correct errors noticed. The impact of these recalculations on the national totals is a decrease in the estimate of emissions of 0.8 per cent for 2008. The main recalculations took place for the following sectors/categories:

- (a) Fuel combustion in the energy sector, in particular CO₂ emissions from manufacturing industries and construction and energy industries;
- (b) Emissions from road transportation (see para. 59 above);
- (c) Fugitive emissions (gas distribution) in the energy sector;
- (d) N₂O emissions from agricultural soils;
- (e) All categories in the LULUCF sector, in particular CO₂ emissions from forest land.

152. Denmark has reported emissions and removals from activities under Article 3, paragraph 3 and 4, of the Kyoto Protocol for 1990, 2008 and 2009. The emissions and removals from afforestation and reforestation, deforestation, forest management, cropland management and grazing land management were estimated in accordance with the IPCC good practice guidance for LULUCF and decisions 15/CMP.1 and 16/CMP.1 and all carbon pools were included and generally the Party has achieved consistency between reporting for KP-LULUCF activities and for the LULUCF sector.

153. The Party has made extensive recalculations for KP-LULUCF activities between the 2010 and 2011 annual submissions, in response to the previous review report and in order to lift applied adjustments. The impact of these recalculations on each KP-LULUCF activity for 2008 is as follows.

- (a) An increase in the estimated removals from afforestation/reforestation for 2008;
- (b) A revision of the estimates of net emissions/removals from forest management, which were reported as net emissions in the 2010 annual submission and are reported as net removals in the 2011 annual submission;
- (c) An increase in the estimate of net emissions from cropland management for 2008 and a decrease in the estimate of net emissions for 1990;
- (d) An increase in the estimate of net emissions from grazing land management for 2008 and 1990.

154. Denmark has reported information on its accounting of Kyoto Protocol units in accordance with chapter I.E of the annex to decision 15/CMP.1, and used the required reporting format tables as required by decision 14/CMP.1.

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

156. 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 decisions of the CMP.

157. Denmark has reported information under chapter I.H of the annex to decision 15/CMP.1, “Minimization of adverse impacts in accordance with Article 3, paragraph 14”, as part of its 2011 annual submission, including information on new initiatives. The ERT concluded that the information provided by Denmark continues to be complete and transparent.

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

(a) The provision of a complete set of CRF tables in the next annual submission, including CRF tables 7 and 8(b), in accordance with the UNFCCC reporting guidelines;

(b) The improvement of the transparency of documentation for several categories (see para. 42 above) and the improvement of the transparency of the reporting on the industrial processes sector, in particular for cement industry (see para. 72 above) and consumption of halocarbons and SF₆ (see paras. 74 and 77 above), on the agriculture sector (see paras. 81, 83, 89, 91 and 93 above), on the LULUCF sector (see paras. 102 and 106 above) and on the waste sector (see para. 112 above);

(c) The further development of the QA/QC procedures, in particular for fluorinated gases (see paras. 77 and 78 above), the agriculture sector (see paras. 84, 87 and 89 above) and KP-LULUCF activities (see para. 115 above).

159. In the course of the review, the ERT formulated a number of recommendations relating to the transparency of the information presented in Denmark’s annual submission. The key recommendations are that Denmark:

(a) Provide further information on the determination of carbon storage in feedstocks and non-energy use of fuels (see para. 56 above);

(b) Develop land-use change matrices for 1971 onwards for reporting a consistent time series of AD for each land use and land-use change in accordance with the IPCC good practice guidance for LULUCF (see para. 98 above);

(c) Improve further the consistency between the reporting on the LULUCF sector and KP-LULUCF activities (see para. 125 above).

IV. Questions of implementation

160. 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/gpplulucf/gpplulucf.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 Denmark 2011. Available at

<<http://unfccc.int/resource/docs/2011/asr/dnk.pdf>>.

Synthesis and assessment report on the greenhouse gas inventories submitted in 2011.

Available at <<http://unfccc.int/resource/webdocs/sai/2011.pdf>>.

FCCC/ARR/2010/DNK. Report of the individual review of the annual submission of Denmark submitted in 2010. Available at

<<http://unfccc.int/resource/docs/2011/arr/dnk.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>.

B. Additional information provided by the Party

Responses to questions during the review were received from Mr. Ole-Kenneth Nielsen National Environment Research Institute, including additional material on the methodology and assumptions used. The following documents¹ were also provided by Denmark:

Aalborg Portland. 2002. Miljøredegørelse og Grønt Regnskab 2002.

Aalborg Portland. 2004. Miljøredegørelse og Grønt Regnskab 2004.

DTU. 2010. Dokumentation af konvertering af trafiktal til emissionsopgørelser.

NERI & DEA. 2010. *Underskrevet aftale om datalevering og samarbejde mellem Energistyrelsen og Danmarks Miljøundersøgelser* (data agreement between NERI and the Danish Energy Agency).

Thomas, T.S. & I. Bode. 2008. *The greenhouse gases HFCs, PFCs and SF₆. Danish consumption and emissions, 2008*. Environmental Protection Agency.

Thomas, T.S. 2001. *Indsamling og genanvendelse af SF₆ fra elsektoren. Miljøprojekt Nr. 592. Miljøstyrelsen*.

¹ Reproduced as received from the Party.

Annex II

Acronyms and abbreviations

| | |
|--------------------|--|
| AD | activity data |
| AWMS | animal waste management systems |
| C | carbon |
| CaO | calcium oxide |
| CH ₄ | methane |
| CITL | Community Independent Transaction Log |
| CKD | cement kiln dust |
| CO ₂ | carbon dioxide |
| CO ₂ eq | carbon dioxide equivalent |
| COP | Conference of the Parties |
| CRF | common reporting format |
| EF | emission factor |
| ERT | expert review team |
| EU ETS | European Union emissions trading scheme |
| F-gas | fluorinated gas |
| FOD | first-order decay |
| FOM | fresh organic matter |
| FU | feeding unit |
| GHG | greenhouse gas; unless indicated otherwise, GHG emissions are the sum of CO ₂ , CH ₄ , N ₂ O, HFCs, PFCs and SF ₆ without GHG emissions and removals from LULUCF |
| GJ | gigajoule (1 GJ = 10 ⁹ joule) |
| HFCs | hydrofluorocarbons |
| HUM | humified organic matter |
| IE | included elsewhere |
| IEA | International Energy Agency |
| IEF | implied emission factor |
| ITL | international transaction log |
| 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 |
| kg | kilogram (1 kg = 1,000 grams) |
| NCV | net calorific value |
| LTO | landing and take-off |
| LULUCF | land use, land-use change and forestry |
| MCF | methane conversion factor |
| Mg | megagram (1 Mg = 1 tonne) |
| MgO | magnesium oxide |
| Mt | million tonnes |
| N | nitrogen |
| NA | not applicable |
| NE | not estimated |
| NO | not occurring |
| NO _x | nitrogen oxides |
| N ₂ O | nitrous oxide |
| NH ₃ | ammonia |
| NIR | national inventory report |
| PFCs | perfluorocarbons |
| PJ | petajoule (1 PJ = 10 ¹⁵ joule) |

| | |
|-----------------|---|
| QA/QC | quality assurance/quality control |
| RMU | removal unit |
| ROM | resilient organic matter |
| SEF | standard electronic format |
| SF ₆ | sulphur hexafluoride |
| SIAR | standard independent assessment report |
| SOC | soil organic carbon |
| SOCrefs | soil organic carbon reference levels |
| TJ | terajoule (1 TJ = 10 ¹² joule) |
| UNFCCC | United Nations Framework Convention on Climate Change |
| VS | volatile solid |
