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Report of the individual review of the annual submission of Denmark submitted in 2010*

* In the symbol for this document, 2010 refers to the year in which the inventory was submitted, and not to the year of publication.

Contents

I. Introduction and summary

1. This report covers the in-country review of the 2010 annual submission of Denmark, coordinated by the UNFCCC secretariat, in accordance with decision 22/CMP.1. The review took place from 6 to 11 September 2010 in Copenhagen, Denmark, and was conducted by the following team of nominated experts from the UNFCCC roster of experts: generalist – Ms. Batima Punsalmaa (Mongolia); energy – Mr. Darío Gómez (Argentina); industrial processes – Mr. Mauro Meirelles de Oliveira Santos (Brazil); agriculture – Ms. Anna Romanovskaya (Russian Federation); land use, land-use change and forestry (LULUCF) – Mr. Nalin Srivastava (India) and Mr. Robert Waterworth (Australia); and waste – Ms. Medea Inashvili (Georgia). Ms. Romanovskaya and Mr. Gómez were the lead reviewers. The review was coordinated by Mr. Harald Diaz-Bone (UNFCCC secretariat). Ms. Valentina Germani (UNFCCC secretariat) participated in the review as an observer.

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.

3. In 2008, the main greenhouse gas (GHG) in Denmark was carbon dioxide (CO_2), accounting for 79.1 per cent of total GHG emissions[1] expressed in CO_2 eq, followed by nitrous oxide (N_2O) (10.6 per cent) and methane (CH_4) (8.8 per cent). Hydrofluorocarbons (HFCs), perfluorocarbons (PFCs) and sulphur hexafluoride (SF_6) collectively accounted for 1.4 per cent of the overall GHG emissions in the country. The energy sector accounted for 78.5 per cent of total GHG emissions, followed by the agriculture sector (16.0 per cent), the industrial processes sector (3.6 per cent) and the waste sector (2.0 per cent). Total GHG emissions amounted to 64,897.93 Gg CO_2 eq and decreased by 7.3 per cent between the base year[2] and 2008.

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 Article 3, paragraph 4, of the Kyoto Protocol (KP-LULUCF), by gas and by sector, respectively. In table 1, CO_2, CH_4 and N_2O emissions included in the rows under Annex A sources do not include emissions and removals from the LULUCF sector.

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.

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

[2] "Base year" refers to the base year under the Kyoto Protocol, which is 1990 for CO_2, CH_4 and N_2O, and 1995 for HFCs, PFCs and SF_6. The base year emissions include emissions from 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 2008[a]

			Gg CO_2 eq								*Change*
		Greenhouse gas	*Base year*[a]	*1990*	*1995*	*2000*	*2005*	*2006*	*2007*	*2008*	*Base year–2008 (%)*
Annex A sources		CO_2	53 476.31	53 476.31	61 439.35	54 275.71	51 479.78	59 343.21	54 549.11	51 350.69	–3.97
		CH_4	5 563.73	5 563.73	5 834.20	5 765.10	5 610.22	5 694.93	5 772.31	5 742.61	3.21
		N_2O	10 657.39	10 657.39	9 545.15	8 542.87	6 874.79	6 745.70	6 650.16	6 900.99	–35.24
		HFCs	217.75	NA NE NO	217.75	608.61	807.81	828.81	855.96	859.25	294.60
		PFCs	0.50	NA NE NO	0.50	17.89	13.90	15.68	15.36	12.79	2 446.78
		SF_6	107.37	44.45	107.37	59.23	21.76	36.00	30.35	31.60	–70.57
KP-LULUCF	Article 3.3[b, c]	CO_2								–207.21	
		CH_4								NA	
		N_2O								0.41	
	Article 3.4[d]	CO_2	2 577.28							3 030.54	17.59
		CH_4	NA							NA	NA
		N_2O	15.66							12.22	–21.97

Abbreviations: KP-LULUCF = land use, land-use change and forestry emissions and removals from activities under Article 3, paragraphs 3 and 4, of the Kyoto Protocol, NA = not applicable, 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 CO_2, CH_4 and N_2O, and 1995 for HFCs, PFCs and SF_6. 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] The table does not reflect the adjusted estimates for afforestation and reforestation activities under Article 3, paragraph 3, of the Kyoto Protocol (see section II.H of this report) after the adjustment procedures under decision 20/CMP.1 were applied. It reflects the estimates contained in the 22 October 2010 resubmission that were subject to these adjustments. The adjustment led to an increase in total net GHG emissions for 2008 of 126.0 Gg CO_2 eq.

[d] Elected activities under Article 3, paragraph 4, of the Kyoto Protocol, including forest management, cropland management and grazing land management. For cropland management and grazing land management, 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 2008

			Gg CO_2 eq								*Change*
		Sector	*Base year[a]*	*1990*	*1995*	*2000*	*2005*	*2006*	*2007*	*2008*	*Base year–2008 (%)*
Annex A		Energy	52 793.04	52 793.04	60 786.17	53 544.46	50 851.13	58 707.61	53 871.71	50 916.36	–3.55
		Industrial processes	2 520.69	2 239.52	2 726.62	3 390.50	2 447.82	2 529.73	2 549.02	2 263.18	–10.22
		Solvent and other product use	135.37	135.37	107.34	99.09	88.79	108.67	100.36	92.32	–31.80
		Agriculture	13 277.90	13 277.90	12 220.20	10 977.55	10 216.93	10 064.21	10 105.26	10 359.99	–21.98
		Waste	1 296.07	1 296.07	1 304.01	1 257.81	1 203.59	1 254.12	1 246.90	1 266.08	–2.31
		Other	NA	NA	NA	NA	NA	NA	NA	NA	NA
		LULUCF	2 826.24	2 826.24	1 570.67	1 431.65	2 432.49	2 631.17	3 453.98	2 664.83	–5.71
		Total (with LULUCF)	**72 849.30**	**72 568.13**	**78 715.00**	**70 701.06**	**67 240.75**	**75 295.50**	**71 327.24**	**67 562.76**	**–7.26**
		Total (without LULUCF)	**70 023.06**	**69 741.89**	**77 144.33**	**69 269.41**	**64 808.26**	**72 664.34**	**67 873.26**	**64 897.93**	**–7.32**
KP-LULUCF	Article 3.3[b, c]	Afforestation & reforestation								–230.09	
		Deforestation								23.30	
		Total (Art. 3.3)								**–206.79**	
	Article 3.4[d]	Forest management								264.69	
		Cropland management	3 377.88							2 759.65	–18.30
		Grazing land management	24.29							18.41	–24.20
		Revegetation	NA							NA	NA
		Total (Art. 3.4)	**3 402.17**							**3 042.76**	**NA**

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

[a] "Base year" for Annex A sources refers to the base year under the Kyoto Protocol, which is 1990 for CO_2, CH_4 and N_2O, and 1995 for HFCs, PFCs and SF_6. The "base year" for 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] The table does not reflect the adjusted estimates for afforestation and reforestation activities under Article 3, paragraph 3, of the Kyoto Protocol (see section II.H of this report) after the adjustment procedures under decision 20/CMP.1 were applied. It reflects the estimates contained in the 22 October 2010 resubmission that were subject to these adjustments. The adjustment led to an increase in net GHG emissions from activities under Article 3, paragraphs 3 and 4, of the Kyoto Protocol for 2008 of 277.97 Gg CO_2 eq.

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

Table 3
Information to be included in the compilation and accounting database in t CO_2 eq

	As reported	*Adjustment*[a]	*Final*[b]	*Accounting quantity*[c]
Commitment period reserve	249 155 060		249 155 060	
Annex A emissions for current inventory year				
CO_2	51 350 688		51 350 688	
CH_4	5 742 606		5 742 606	
N_2O	6 900 993		6 900 993	
HFCs	859 246		859 246	
PFCs	12 791		12 791	
SF_6	31 602		31 602	
Total Annex A sources	64 897 927		64 897 927	
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	–230 091	47 875	47 875	47 875
3.3 Afforestation and reforestation on harvested land for current year of commitment period as reported	NA		NA	NA
3.3 Deforestation for current year of commitment period as reported	23 297		23 297	23 297
Activities under Article 3, paragraph 4, for current inventory year[d]				
3.4 Forest management for current year of commitment period	264 692		264 692	264 692
3.4 Cropland management for current year of commitment period	2 759 653		2 759 653	–618 231
3.4 Cropland management for base year	3 377 884		3 377 884	
3.4 Grazing land management for current year of commitment period	18 414		18 414	–5 878
3.4 Grazing land management for base year	24 292		24 297	
3.4 Revegetation for current year of commitment period	NA		NA	NA
3.4 Revegetation in base year	NA		NA	

Abbreviation: NA = not applicable.
[a] "Adjustment" is relevant only for Parties for which the ERT has calculated one or several 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.

6. The GHG inventory is in line with the *Revised 1996 IPCC Guidelines for National Greenhouse Gas Inventories* (hereinafter referred to as the Revised 1996 IPCC Guidelines) and the Intergovernmental Panel on Climate Change (IPCC) *Good Practice Guidance and*

Uncertainty Management in National Greenhouse Gas Inventories (hereinafter referred to as the IPCC good practice guidance) but not fully in line with the IPCC *Good Practice Guidance for Land Use, Land-Use Change and Forestry* (hereinafter referred to as the IPCC good practice guidance for LULUCF) (see section II.E of this report).

7. In its 2010 submission, Denmark submitted for the first time:

(a) Under the requirements of the Kyoto Protocol, a set of common reporting format (CRF) tables for the period 1990–2008 with the integrated emissions from mainland Denmark and Greenland under the relevant sectors;

(b) Under the requirements of the Convention, a set of CRF tables for the period 1990–2008 with the integrated emissions from mainland Denmark, Greenland and the Faroe Islands under the relevant sectors.

8. In previous submissions, Denmark had submitted emissions from mainland Denmark only under the relevant sectors of the CRF tables, with emissions from Greenland and the Faroe Islands reported under other (sector 7). The expert review team (ERT) commends Denmark for having implemented recommendations from previous review reports (2007–2009). In the 2010 submission, Denmark submitted CRF tables for mainland Denmark only, which reflects Denmark's submission to the European Community under the burden-sharing agreement of the European Union (EU) for meeting commitments under the Kyoto Protocol. The Party also submitted independent sets of CRF tables for Greenland only and the Faroe Islands only.

9. The 2010 inventory submission is generally of a high quality, shows significant improvement in the major issues and covers all sectors and most categories. Nevertheless, the ERT identified a need for further improvements in the following areas: clarification of the legal basis for the functioning of the national system; transparency of the inventory (particularly in the LULUCF, agriculture and waste sectors); uncertainty analysis (particularly for soil emissions in the agriculture and LULUCF sectors); consistency, particularly in the usage of data from the European Union emissions trading scheme (EU ETS) in the energy and industrial processes sectors; completeness (e.g. in the agriculture and LULUCF sectors); and recalculations (which have not been provided for the integrated inventory for Denmark and Greenland in CRF table 8(a)).

10. Denmark acknowledged these findings during the review and undertook actions to address some of the above areas for improvement; for example, reviewing the agreement between Greenland and the National Environmental Research Institute (NERI) that has improved coordination between single elements of the national system. Furthermore, the Party carried out some improvements to its GHG inventory during the review by providing the ERT with estimates for missing subcategories in the agriculture sector. The ERT commends the efforts of Denmark during the review.

11. By providing the additional information requested by the ERT and involving data suppliers in meetings and discussions, Denmark has demonstrated sufficient capacity to comply with 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).

12. Denmark has submitted all supplementary information required under Article 7, paragraph 1, of the Kyoto Protocol in accordance with chapter I of the annex to decision 15/CMP.1.

13. Denmark has chosen to account for activities under Article 3, paragraph 3, of the Kyoto Protocol annually. The Party elected forest management, cropland management and grassland management under Article 3, paragraph 4, of the Kyoto Protocol and chose annual accounting. Denmark has reported information on activities under Article 3,

paragraph 3, of the Kyoto Protocol and elected activities under Article 3, paragraph 4, of the Kyoto Protocol in accordance with decisions 15/CMP.1, 16/CMP.1 and 6/CMP.3. During the review, the ERT noted several potential problems with the reporting under Article 3, paragraphs 3 and 4, of the Kyoto Protocol, in particular a lack of completeness across several categories, the incorrect use of averaging of emissions and the overestimation of litter mass under afforestation. Denmark responded to the potential problems within the required time frames. However, some of the potential problems were not sufficiently addressed in the revised estimates. These issues are documented in sections II.E, II.G and II.H below.

14. 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 has used the standard electronic format (SEF) tables, as required by decision 14/CMP.1.

15. The national system continues to perform its required functions as set out in the annex to decision 19/CMP.1. Denmark reported a change in its national system. The national inventory report (NIR) provides a description of the change in Denmark's national system, indicating that the system has been strengthened by the signing of a formal data delivery agreement with the Government of Greenland. The data agreement ensures that Greenland will make a complete set of CRF tables reporting emissions and removals and send the data to NERI, which is responsible for reporting the national inventory of Denmark to the UNFCCC and is also the designated body with overall responsibility for the national inventory under the Kyoto Protocol for mainland Denmark and Greenland. Within this framework, NERI is responsible for aggregating the emissions from Denmark and Greenland and submitting integrated CRF tables under the Kyoto Protocol.

16. The agreement with the Government of Greenland was drafted on 28 September 2008 and signed on 2 February 2009. The agreement established that Greenland will provide the CRF tables summary 2 and 5.A. During the in-country visit, the ERT indicated that providing these tables was not sufficient and that Greenland had to be required to provide a complete set of CRF tables and send the data to NERI. The ERT was informed on the last day of the in-country visit that the agreement between NERI and Greenland had been revised as recommended by stipulating that Greenland will provide NERI with a complete set of CRF tables of emissions and removals and the documentation report. The ERT welcomes the swift and efficient action of the Party to revise and update the agreement in a way that further strengthens the national system.

17. The national registry of Denmark continues to perform the functions set out in the annex to decision 13/CMP.1 and the annex to decision 5/CMP.1, and continues to adhere to the technical standards for data exchange between registry systems in accordance with relevant decisions of the Conference of the Parties serving as the meeting of the Parties to the Kyoto Protocol (CMP).

18. Denmark has reported information on the minimization of adverse impacts in accordance with Article 3, paragraph 14, of the Kyoto Protocol, as requested in chapter I.H of the annex to decision 15/CMP.1, in its NIR. The Party submitted this information on 15 April 2010 and resubmitted it on 27 May 2010. This is in line with the deadline for annual submissions.

II. Technical assessment of the annual submission

A. Overview

1. Annual submission and other sources of information

19. The 2010 annual inventory submission was submitted on 15 April 2010; it contains a complete set of CRF tables for the period 1990–2008 and an NIR. The NIR and CRF tables under the Convention (v1.6), CRF under the Kyoto Protocol (v1.7) and KP-LULUCF tables (v1.4) were resubmitted on 27 May 2010. The CRF tables under the Convention (v1.7) were resubmitted on 26 July 2010. 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 in accordance with Article 3, paragraph 14, of the Kyoto Protocol. The SEF tables were submitted on 15 April 2010 and resubmitted on 19 May 2010. The annual submission was submitted in accordance with decision 15/CMP.1.

20. Denmark officially submitted revised emission estimates on 22 October 2010 in response to questions raised by the ERT during the course of the in-country visit. Where necessary, the ERT also used the previous years' submissions during the review.

21. 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]

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

Completeness of inventory

23. The inventory is complete in terms of years and geographical coverage and covers almost all source and sink categories, including the reporting of actual and potential emissions of fluorinated gases (F-gases) from industrial processes. The ERT noted that a number of carbon pools in the LULUCF sector were not estimated ("NE") and recommends that Denmark improve the completeness of its LULUCF reporting in the next annual submission. Denmark provided inventory data for the period 1990–2008 and included almost all of the required CRF tables; only table 7 was not filled in. Notation keys are used throughout the tables.

[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 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.

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

Overview

24. The ERT concluded that the national system continues to perform its required functions. Denmark has put in place all of the mandatory requirements for a national system under Article 5, paragraph 1, of the Kyoto Protocol. The Party's national system is prepared in accordance with the guidelines for national systems under Article 5, paragraph 1, of the Kyoto Protocol (decision 19/CMP.1). Institutional arrangements are well described in the NIR. During the review, further clarification was provided regarding the preparation of the inventories of Greenland and the Faroe Islands.

25. The process for the official approval of the inventory was not described in the NIR. However, during the review, Denmark provided this information, indicating that the inventory was finalized by 15 March 2010 and sent for official approval to the Ministry of Climate and Energy. The ERT recommends that the Party provide this information in the NIR of the next annual submission.

26. Previous review reports recommended the incorporation of emissions from Greenland into the respective category discussions in the NIR and under the respective cross-cutting issues and procedures. Denmark has indicated in the NIR and during the in-country visit that, because of its different territorial commitments under the Convention, the Kyoto Protocol and the burden-sharing agreement of the European Union for meeting commitments under the Kyoto Protocol, the Party would need to submit three different NIRs to implement this recommendation. The ERT understands the Party's standpoint; however, the ERT recommends that Denmark include the information concerning the emissions from Greenland at least as a separate chapter in the NIR instead of as an annex, as this is a substantial part of the submission. Denmark also informed the ERT that, in the 2011 submission, it will expand the information in the NIR to also include information on recalculations and quality assurance/quality control (QA/QC) of the integrated emissions of mainland Denmark and Greenland under the Kyoto Protocol. The ERT welcomes these plans, encourages their timely implementation and recommends that this chapter include a discussion on the procedures used by NERI to integrate both inventories, particularly those aspects that are not solved by merely adding figures, such as the treatment required for part of the data reported in the CRF sectoral background tables.

Inventory planning

27. During the in-country visit, Denmark explained the institutional arrangements for the preparation of the inventory. The Ministry of Climate and Energy has overall responsibility for the national inventory. NERI is responsible for the calculation and reporting of the Danish national emissions inventory to the UNFCCC and is the single national entity with overall responsibility for the national inventory under the Kyoto Protocol for mainland Denmark and Greenland. The work concerning the annual GHG inventory is carried out in cooperation with Danish ministries, research institutes, organizations and companies, mostly as data providers. External data providers include: the Danish Energy Agency; the Danish Environmental Protection Agency; Statistics Denmark; the Faculty of Agricultural Sciences of the Aarhus University; the Danish Agricultural Advisory Centre; the Road Directorate; the Danish Centre for Forest, Landscape and Planning; the Civil Aviation Agency of Denmark; and Danish Railways. There are data delivery agreements in place with most essential data suppliers (e.g. Statistics Denmark, the Danish Energy Agency, the Danish Agricultural Advisory Centre and the Ministry of Transport).

28. Denmark has been using data reported under the EU ETS to estimate emissions in the energy and industrial processes sectors since the 2007 submission. More specifically, these data have been used in the following categories: public electricity and heat production (coal, residual fuel oil and gas oil); manufacturing industries and construction (cement production); flaring (oil and gas); and mineral products (cement and other). The European Community (EC) guidelines for the monitoring and reporting of greenhouse gas emissions under the EU ETS (European Commission, 2007) establish a tiered approach consisting of at least three tiers. In general, tier 3 corresponds to plant-specific data, while the lower tiers are not necessarily consistent with the IPCC good practice guidance. A key issue associated with the use of EU ETS data is, therefore, whether these data are consistent with the IPCC good practice guidance requirements. In addition, completeness and time-series consistency deserve specific consideration. The ERT notes that, in general, Denmark has used these data with due attention to these issues. However, the NIR lacks a unifying discussion of the approach employed by the Party regarding the use of these data. To improve transparency, the ERT recommends that Denmark include a brief discussion about this approach in the NIR (e.g. under the section presenting the general description of methodologies and data sources used) focusing on those aspects associated with the IPCC good practice guidance requirements.

29. The Government of Greenland is responsible for finalizing and transferring the inventory for Greenland to NERI. The Faroe Islands Environmental Agency is responsible for finalizing and transferring the inventory for the Faroe Islands to NERI. Data agreements were introduced in 2010, with both Greenland and the Faroe Islands ensuring the data delivery. The ERT commends the efforts of Denmark to introduce and implement these agreements.

30. For the first time, a full series of CRF tables of emissions and removals from Greenland and the Faroe Islands has been included under the relevant sectors, as recommended by previous review reports. The ERT welcomes this achievement.

Inventory preparation

Key categories

31. Denmark has reported key category tier 1 and tier 2 analyses, both level and trend assessment for the Denmark inventory only, and a key category tier 1 analysis, both level and trend assessment for the aggregated inventory of mainland Denmark and Greenland as part of its 2010 submission. The key category analysis performed by Denmark and that performed by the secretariat[4] produced similar results. Denmark has included the LULUCF sector in its key category analysis, which was performed in accordance with the IPCC good practice guidance and the IPCC good practice guidance for LULUCF. The ERT commends Denmark for having undertaken a tier 2 key category analysis as recommended previously. However, the ERT notes that the implemented tier 2 key category analysis considered data for mainland Denmark only. To improve consistency, the ERT encourages Denmark to extend this effort to include the aggregated inventory covering mainland Denmark and Greenland.

[4] 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.

Uncertainties

32. As recommended by the previous ERT, Denmark provided a tier 2 uncertainty analysis. The information provided on uncertainty is generally appropriate, as required by the UNFCCC reporting guidelines and the IPCC good practice guidance. Denmark used a Monte Carlo simulation assuming log-normal distributions for activity data (AD), emission factors (EFs) and estimates and this was carried out at the sectoral level. The ERT encourages the implementation of a Monte Carlo simulation as a move towards a tier 2 uncertainty analysis and recommends that the Party investigate the suitability of using log-normal distribution for AD, EFs and emissions for all of the sectors. Furthermore, the tier 2 approach was used for the inventory of mainland Denmark only. To improve consistency, the ERT encourages Denmark to incorporate the Greenland inventory in its tier 2 uncertainty analysis.

Recalculations and time-series consistency

33. Denmark has reported recalculations for all years, from 1990 to 2007, and for all sectors and gases. Recalculations have been performed and reported in accordance with the IPCC good practice guidance. The recalculations were a result of: updated AD in the energy sector; changes in CH_4 and N_2O EFs based on new research for fuel combustion in combined heat and power (CHP) plants; use of new methodologies (CH_4 emissions from manure management and wastewater handling); inclusion of new categories (field burning, town gas distribution); and correction of errors.

34. The rationale for the recalculations is provided in the NIR in a transparent manner, with descriptions for the overall inventory (chapter 10 of the NIR) and detailed explanations at the category level, where relevant. Recalculations have not been provided for the integrated inventory for Denmark and Greenland in CRF table 8(a).

35. Denmark explains in the NIR that the CRF recalculation tables produced with the CRF Reporter software tool are incorrect for both Denmark under the Convention and Denmark under the Kyoto Protocol. The reason for this is that, every year, Denmark submits to the secretariat three different submissions and the CRF Reporter software provided by the UNFCCC secretariat only compares the current submission with the last submission where the last submission from the previous year does not have the same scope as the first submission made in the subsequent year. Denmark provides in the NIR for the 2010 submission recalculation tables for mainland Denmark based on a spreadsheet file made with links to data actually submitted in 2009 and to data in the 2010 submission. During the in-country visit, Denmark provided manual recalculation tables for the integrated inventory for Denmark and Greenland. However, the ERT decided not to use these tables as the official recalculation. In the NIR, the Party explained that CRF table 8(a) in the 2011 submission will contain the appropriate correct values of recalculations. The ERT welcomes this planned improvement.

Verification and quality assurance/quality control approaches

36. Denmark has developed a QA/QC plan, the *Quality Manual for the GHG Inventory*, which was published in 2006 and which is in accordance with the IPCC good practice guidance. The plan includes all mandatory elements as set out in the IPCC good practice guidance and decision 19/CMP.1. QA procedures have mainly taken the form of expert review of some parts of the inventory (e.g. stationary combustion and agriculture). The ERT was informed that the plan has been revised in order to include recent improvements in the processing and storage of data and is ready for publication. The ERT welcomes the revision of the *Quality Manual for the GHG Inventory* and recommends that Denmark strengthen QA by extending external reviews to other sectors of the inventory.

37. Denmark's *Quality Manual for the GHG Inventory* does not contain QA/QC procedures for the inventory of Greenland. However, there is a statement in the agreement between NERI and Greenland (paras. 15 and 16 above) indicating that Greenland will undertake QA/QC procedures for its inventory. During the review, Greenland informed the ERT that the QA/QC plan for its inventory is under development. In addition, during the in-country visit, Denmark informed the ERT that NERI performs routine QC checks to the Greenlandic inventory before and during the aggregation of the data with those of mainland Denmark. The ERT recommends that Greenland complete the QA/QC plan and implement it in the next annual submission and that Denmark document the QC checks performed during the integration of the Greenlandic inventory into the NIR.

Transparency

38. The NIR is generally prepared in a transparent manner and the Party has made significant improvements since last year's submission according to the recommendations in previous reviews. In particular, the ERT welcomes the inclusion of the Greenland inventory under the relevant sectors of the CRF tables, as recommended in previous reviews. Some additional information could improve the transparency of the NIR (e.g. the use of models and the use of plant-specific data under the EU ETS). The ERT recommends that Denmark include a brief discussion about country-specific approaches (especially models, the use of data under the EU ETS) in the NIR, focusing on those aspects associated with the IPCC good practice guidance requirements. The ERT also noted that the descriptions for AD and methodologies used in the LULUCF sector are not fully transparent and the ERT encourages Denmark to provide more detailed explanations on land areas and the inclusion of each relevant Convention subcategory to activities under Article 3, paragraphs 3 and 4, of the Kyoto Protocol as well as descriptions on the model outputs and their relationship with the entries in the CRF tables in this sector in the NIR of its next submission.

Inventory management

39. 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. NERI keeps the archive and was able to provide archived documents requested by the ERT during the in-country visit. The ERT commends Denmark for its good record-keeping.

3. Follow-up to previous reviews

40. In the NIR, Denmark provides a table indicating its responses to the reviews of the 2007 and 2008 submissions and indicates that the availability of the draft review report of the 2009 submission (22 February 2010) did not allow the Party to fully implement the recommendations for the 2010 submission. The ERT commends Denmark for the transparent way of presenting its follow-up to earlier reviews. In the 2010 submission, the reported improvements include:

(a) Emissions from Greenland are integrated into the relevant sectors of the CRF tables instead of reporting them under sector 7 other;

(b) Tier 2 is used for the uncertainty analysis;

(c) A tier 2 key category analysis is used for both with and without LULUCF for mainland Denmark only.

4. Areas for further improvement

Identified by the Party

41. The 2010 NIR identifies improvements in the solvent and other product use sector (e.g. investigation of N_2O emissions from fire extinguishers) and the agriculture sector (e.g. improvement of the calculation of the GHG emissions reduction from biogas-treated slurry) (see chapters 5 and 6 of the NIR, respectively).

Identified by the expert review team

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

(a) The provision of more precise descriptions of the methodologies that differ from those of the IPCC;

(b) The improvement of transparency regarding the description of models used in different sectors and EU ETS data;

(c) The creation and consistent implementation of a QA/QC management system for Denmark, Greenland and the Faroe Islands;

(d) The improvement in the uncertainty analysis with the correct distribution shapes and ranges of uncertainties;

(e) The improvement in consistency in land-area representation in the LULUCF sector and consistency in the reporting of the LULUCF sector under the Convention and KP-LULUCF reporting;

(f) The improvement in completeness, particularly in the agriculture and LULUCF sectors;

(g) The improvement in time-series consistency in the energy and industrial processes and solvent and other product use sectors;

(h) The improvement in the completeness and consistency in the reporting of land representation and carbon pools under Article 3, paragraphs 3 and 4, of the Kyoto Protocol.

43. Recommended improvements relating to specific categories are presented in the relevant sector chapters of this report.

B. Energy

1. Sector overview

44. The energy sector is the main sector in the GHG inventory of Denmark. In 2008, emissions from the energy sector amounted to 50,916.36 CO_2 eq, or 78.5 per cent of total GHG emissions. Since 1990, emissions have decreased by 3.6 per cent. The key driver for the fall in emissions is the decrease of emissions in the categories energy use in other sectors and energy industries, while transport exhibits a significant increase in emissions. Within the sector, 47.2 per cent of the emissions were from energy industries, followed by 27.6 per cent from transport, 13.4 per cent from other sectors and 10.5 per cent from manufacturing industries and construction. Fugitive emissions from oil and gas accounted for 1.0 per cent and other accounted for 0.2 per cent.

45. The CRF tables and the NIR are complete. The ERT commends Denmark for reporting emissions of GHG for all categories for which the Revised 1996 IPCC Guidelines and the IPCC good practice guidance provide methodologies for estimation.

46. The NIR is generally transparent. Denmark provides complete sets of GHG EFs and the parameters used to estimate emissions and the sources of AD. Following previous recommendations, Denmark has improved the discussion on town gas and the use of plant-specific data under the EU ETS. The ERT commends Denmark for this. However, the ERT notes that there are further opportunities to improve the discussion on the use of data under the EU ETS. Specifically, it is recommended that Denmark discuss more clearly the selection of those plants that are taken from the database under the EU ETS and the QC checks performed to allow the input of these data.

47. The Danish Energy Agency (DEA) compiles the energy statistics, which are prepared simultaneously with international reporting to the United Nations, the International Energy Agency (IEA) and Eurostat. Data collection by DEA is based on legal acts. All data are arranged in time series: for example, the series of energy balances (1972–2008) is available from the website of DEA. In addition, DEA compiles the data coming from the EU ETS. During the in-country visit, staff from DEA provided a thorough description of the principles, methodology, data sources and QC checks associated with the national energy statistics.

48. As part of its description of process-oriented QA/QC procedures, the NIR discusses the specific points of measurement corresponding to data storage (levels 1 and 2) and data processing (level 1) for the three main categories of the energy sector (stationary combustion, mobile combustion and fugitive emissions). The data provided by each external data source are specified in the NIR together with the main attributes of the data source, including the existence or not of a data agreement with NERI. In general, the points of measurement for mobile combustion are more thoroughly discussed than those related to stationary combustion and fugitive emissions. QC checks of the plant-specific EFs for stationary combustion have not been performed thus far. The ERT encourages Denmark to implement QC checks regarding the time series of plant-specific carbon content and net calorific values, as discussed in paragraph 58 below. Three external reviews of the stationary combustion categories were undertaken, in 2005, 2007 and 2009. One of these reviews considered all stationary combustion categories while the other two were of a more specialized nature. For mobile combustion, external reviews were carried out in 2004, 2006 and 2008 and for fugitive emissions from fuels in 2009. The ERT recommends that Denmark continue to carry out regular external reviews of the sectoral reports as a key QA measure.

49. As a result of the incorporation of the Greenlandic emissions into the energy sector, CRF table 8(a) reports differences between the 2010 and 2009 submissions that are not relevant. To compensate for this incorrect information, the NIR reports the consequences of the recalculations for the time series 1990–2007 for mainland Denmark only. Recalculations of emissions from the energy sector of mainland Denmark in 2007 resulted in an overall decrease in reported emissions of 1,628.69 Gg CO_2 eq. The key driver for this decrease is N_2O emissions from energy industries. The update of non-CO_2 EFs for decentralized CHP plants obtained from a Danish emission measurement programme (para. 68 below) led to a revision of the data and the associated emission estimates decreased by 3,722.8 Gg CO_2 eq.

2. Reference and sectoral approaches

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

50. CO_2 emissions from fuel combustion were calculated using the reference approach and the sectoral approach. For 2008, CO_2 emissions estimated by the sectoral approach (49,518.75 Gg) are 0.49 per cent higher than emissions estimated by the reference approach (49,276.85 Gg). The explanation for this difference is provided in the documentation box of

CRF table 1.A(c). In addition, the NIR reports the time series 1990–2008 of the CO_2 emission estimates by both approaches, indicating that in the period 1990–2008 both the fuel consumption and the CO_2 emissions differ by less than 1.6 per cent and that the differences are below 1 per cent for all years except 1998 and 2006.

International bunker fuels

51. The fuels used for all flights inside Denmark are counted as domestic; these include the flights between mainland Denmark and both Greenland and the Faroe Islands. The jet fuel sold in Greenland is allocated under civil aviation (domestic). The NIR notes that this allocation is based on the fact that almost all fuel sales in Greenland are used for flights to mainland Denmark. This allocation is mainly in line with the IPCC good practice guidance, although it may involve an overestimation of civil aviation if there are flights from Greenland to airports outside mainland Denmark.

52. For navigation, the international fuel total, as reported by DEA, accounts for the fuel sold in mainland Denmark to international ferries, international warships, other ships with foreign destinations, tank vessels and foreign fishing boats, together with transport to Greenland and the Faroe Islands. In Greenland, all marine fuel sales are considered to be domestic. In the Faroe Islands, only fuels sold to local ships and fishing vessels are considered to be domestic. The NIR acknowledges that, in order to be in line with the IPCC good practice guidance, the fuels used in navigation between ports in mainland Denmark, Greenland and the Faroe Islands should be considered as domestic. The ERT agrees with this and recommends that Denmark make efforts to acquire the necessary data to allocate these fuels as domestic (see para. 66 below).

Feedstocks and non-energy use of fuels

53. Three fuels are used for non-energy purposes in Denmark: bitumen, lubricants and white spirit. The CO_2 associated with the non-energy use of fuels is considered in the reference approach and the corresponding emissions are estimated and reported under industrial processes (bitumen and lubricants) and under solvent and other product use (white spirit). The ERT commends Denmark for following previous recommendations by having completed CRF table 1.A(d).

Country-specific issues

54. The ERT commends Denmark for reporting emissions from the Greenlandic energy sector under the energy sector of the combined territories of mainland Denmark and Greenland, instead of under the category other, as it had done in previous submissions. During the in-country visit, the ERT observed a close working relationship between the expert in charge of estimating and reporting emissions from the Greenlandic energy sector and the staff at NERI.

55. Emissions from combustion in Greenland have been estimated using the IPCC tier 1 methodology, AD from the Greenlandic energy statistics, IPCC default EFs for liquid fuels and country-specific EFs for municipal solid waste (MSW). The NIR indicates that AD for the time series 2004–2008 are more accurate than AD from previous years because Statistics Greenland has implemented a more detailed data acquisition process. The NIR reports that gas oil is the main fuel used in Greenland and its consumption amounts to 81 per cent of the total. During the review, Denmark informed the ERT that the gas oil consumed in Greenland is of Danish and Swedish origin. To improve accuracy, the ERT recommends that Denmark make efforts to estimate CO_2 emissions from gas oil using country-specific EFs that are already available.

3. Key categories

Stationary combustion: solid, liquid and other fuels – CO_2

56. Public electricity and heat production is the main subcategory in the GHG inventory of Denmark. In 2008, CO_2 emissions from the combustion of solid fuels in public electricity and heat production amounted to 15,255.49 Gg, or 23.6 per cent of total GHG emissions. The emission series 1990–2005 has been estimated using a constant EF value of 95.00 t/TJ, while for the emission series 2006–2008 Denmark has used plant-specific data reported under the EU ETS for a number of thermal power plants. The NIR reports that, for 2008, these data were available from 17 coal-fired power plant units, which account for 95 per cent of the Danish coal consumption and 48 per cent of the total CO_2 emissions from stationary combustion plants. The impact of the use of these plant-specific data reflects in the time series of the CO_2 implied emission factor (IEF) as follows: 95.00 t/TJ/GJ (1990–2005), 94.42 t/TJ (2006), 94.26 t/TJ (2007) and 93.96 t/TJ (2008). Previous reviews (2008 and 2009) have recommended that Denmark provide information to confirm that the plant-specific data are in line with the Revised 1996 IPCC Guidelines and the IPCC good practice guidance.

57. The 2010 NIR indicates that the plant-specific data employed in the Danish inventory only include data from plants using higher tier methods, as defined in the corresponding EU decision (European Commission, 2007), which establishes the specific methods for determining carbon content, oxidation factor and calorific value and includes rules for measuring, reporting and verification. During the review, the inventory team confirmed that: (i) Denmark does not employ the plant information under the EU ETS that has been estimated using tier 1 and tier 2 methods as defined in the corresponding EU decision, which are not necessarily in line with the IPCC good practice guidance; (ii) DEA holds all emission reports submitted under the EU ETS (para. 47 above) and NERI has complete access to this information; and (iii) NERI performs some QA/QC checks on these emission reports, particularly detecting unusual values. The ERT recommends that Denmark improve the discussion of the use of plant-specific information under the EU ETS by providing a more transparent and self-contained explanation about the scope of tier 3 methods for stationary combustion within this framework in such a way that the reader is not forced to consult the EU decision document[5] to understand the implications of the selection of these data.

58. The *Danish Energy Statistics 2008*[6] reports net calorific values (NCVs) for electricity-plant coal in the range 24.30–25.80 GJ/t in the period 1990–2008. The time series of these NCVs exhibits significant variability, most likely associated with the different origins of annually imported coal and the variability of coal itself. It is well known that, on average, there is an inverse relationship between the CO_2 EF and NCV for all fuels. This inverse relationship does not occur for electricity-plant coal between the time series of the CO_2 IEF of the Danish inventory and the time series of the NCV reported by DEA. The ERT recommends that, through DEA, Denmark corroborate the accuracy of the reported NCV. After having confirmed the validity of the NCV reported by DEA, the ERT recommends that Denmark:

(a) Include a QC check for the data reported under the EU ETS that uses the NCV of the fuel to detect the possible existence of unusual values and bias;

(b) Explore the possibility of obtaining a correlation between the carbon content and the NCV of coal reported by the selected facilities that have used tier 3 methods under

[5] European Commission, 2007. Available at <http://ec.europa.eu/environment/climat/emission/implementation_en.htm>.

[6] DEA, 2009.

the EU ETS, taking into account the recent scientific literature (e.g. Fott, 1999; Mazumdar, 2000; Mesroghli et al., 2009).

59. If a satisfactory correlation is obtained, the ERT further recommends that Denmark use this correlation to generate the time series 1990–2005 of CO_2 EFs and recalculate the corresponding emissions.

60. Denmark has also used plant-specific data under the EU ETS to estimate CO_2 emissions from thermal power plants burning liquid fuels reported under public electricity and heat production. The NIR reports that, for 2008, these data were available from 19 power plant units burning residual fuel oil and for five units burning gas oil. The ERT recommends that Denmark explore the relationship between the CO_2 EFs for residual fuel oil and gas oil reported under the EU ETS and the corresponding NCV reported by DEA. The ERT also notes that the recommendations for coal-fired power plants provided in paragraph 59 above apply to liquid fuels.

61. Denmark divides the CO_2 emissions from the incineration of municipal waste in public electricity and heat production into those arising from the combustion of the plastic content of the waste, which are included in the national total, and those arising from the biomass fraction, which are reported as a memo item. Following recommendations from the previous review, Denmark has split the AD for waste incineration into the biomass and the plastic fractions and has reported the corresponding values in the sectoral background table 1.A(a), allowing the estimation of separate IEFs. The ERT commends Denmark for implementing this recommendation, which has improved transparency.

62. During the review, the inventory team and the staff from DEA explained that both teams work together on the disaggregation of the AD of the plastic fraction and the biomass fraction of waste which are reported in the national energy balance. The NIR describes an ongoing project with the Danish Technical University (Danmarks Tekniske Universitet) about the biogenic-carbon content in the Danish solid waste aimed at improving the knowledge concerning the disaggregation of the CO_2 EF into fossil and biomass fractions. The ERT commends Denmark for its effort to improve accuracy.

63. The NIR does not discuss the fate of medical and hazardous wastes. During the review, Denmark informed the ERT that these types of waste are also incinerated with energy recovery. To improve transparency, the ERT recommends that Denmark provide background information in the next NIR on the incineration of medical and hazardous wastes for energy purposes.

64. The emissions arising from fuels used in cement production are reported under the subcategory other (manufacturing industries and construction). Emissions from other fuels are reported as not occurring ("NO") in the period 1990–2002, while the time series of CO_2 IEF values in the period 2003–2008 are as follows: 78.88 t/TJ (2003–2005), 46.97 t/TJ (2006), 66.92 t/TJ (2007) and 93.91 t/TJ kg/GJ (2008). During the review, Denmark explained that a large variety of fuels with different biogenic/fossil shares are combusted in cement production. The ERT recommends that Denmark revise the variability of CO_2 EFs, particularly before and after the introduction of plant-specific data under the EU ETS. To improve transparency, the ERT recommends that Denmark include in the NIR an explanation of the different fuels covered under other fuels.

65. Denmark uses the value 56.9 t/TJ for the EF for refinery gas in the period 1990–2008. This value is the same as the EF for natural gas in the period 1990–1999. It is 0.2 per cent higher than the CO_2 EF for natural gas in the period 2000–2008 (56.77 t/TJ) and 13.9 per cent lower than the default IPCC CO_2 EF for refinery gas (66.07 t/TJ). Denmark indicates in the NIR that the EF used for refinery gas is within the interval of the EF for this fuel (55–66 t/TJ) reported in the *EMEP/CORINAIR Atmospheric Emission Inventory*

Guidebook – 2007[7]. During the review, Denmark informed the ERT of its plan to revise the CO_2 EF for refinery gas. The ERT welcomes this plan and encourages its early implementation. The ERT also suggests that a specific QC check can be incorporated regarding this issue by comparing the chemical composition and CO_2 EF of refinery gas with those of natural gas and liquefied petroleum gas, verifying that the values are consistent from the physical standpoint.

Navigation: liquid fuels – CO_2, CH_4 and N_2O

66. Journeys between ports in mainland Denmark and Greenland and between ports in mainland Denmark and the Faroe Islands are reported under international marine transport. The NIR acknowledges that these allocations are not in line with the IPCC good practice guidance and notes that the amount of fuel involved in these trips is a small part of the fuel already reported under domestic navigation. During the review, Denmark informed the ERT that the inventory team has contacted the shipping companies operating the routes from mainland Denmark to Greenland and the Faroe Islands to collect the necessary data to estimate the AD for these journeys. The ERT welcomes these efforts, which will improve accuracy and completeness, and encourages their prompt implementation.

Oil and natural gas – CO_2

67. CO_2 emissions from flaring in refineries, offshore installations and natural gas plants were estimated using plant-specific CO_2 EF data available under the EU ETS. During the review, Denmark informed the ERT that these CO_2 EFs were estimated according to the tier 3 method based on the carbon content of the flared gas. To improve transparency, the ERT recommends that Denmark provide brief background information about the nature of the estimation of these CO_2 EFs under the EU ETS, focusing on their adequacy in relation to the IPCC good practice guidance.

4. Non-key categories

Stationary combustion: liquid fuels, gaseous fuels, biomass, other fuels – CH_4 and N_2O

68. Denmark has updated the non-CO_2 EFs for decentralized CHP plants in public electricity and heat production with a capacity of less than 25 MWe, based on the results obtained through a survey of emissions undertaken by NERI and the Danish Gas Technology Centre (DGC), FORCE Technology and AnalyTech (Nielsen et al., 2010). The EFs have been estimated for CHP plants using: liquid fuels (residual fuel oil steam turbines); gaseous fuels (natural gas reciprocating engines and turbines); biomass (plants combusting straw or wood, biogas-fuelled engines and reciprocating engines combusting biomass producer gas based on wood); and other fuels (MSW incineration plants). The ERT commends Denmark for this undertaking.

Road transportation: liquid fuels – CH_4 and N_2O

69. Since 2006, bioethanol has been used in gasoline blends for road transportation in Denmark. However, Denmark uses the same non-CO_2 EFs for gasoline and bioethanol–gasoline blends. Previous review reports have suggested that Denmark assess the possibility of changing these EFs. Denmark indicates in the NIR that no data have been found indicating different non-CO_2 EFs for blends of fossil and biogenic fuels. During the review, national experts informed the ERT that research on this issue will be conducted and new EFs will be adopted, if the results indicate that there are differences. In this regard, the ERT notes that Denmark may wish to consult the second national communication to the

[7] European Environment Agency (EEA), 2007.

UNFCCC of Brazil, where different gasoline blends have been used for more than two decades.

Oil and natural gas – CH_4 and N_2O

70. Denmark has updated the CH_4 and N_2O EFs from flaring in refineries. The CH_4 EF is based on the chemical composition of the flared gas provided by one of the two Danish refineries. The NIR reports that the N_2O EFs were adopted from the recently published reference by the European Environment Agency (*EMEP/EEA Air Pollutant Emission Inventory Guidebook 2009. Technical Guidance to Prepare National Emission Inventories*[8]). However, the ERT noted that this reference does not provide EF values for N_2O from flaring in oil refineries. To improve transparency, the ERT recommends that Denmark provide sufficient and accurate background information for the selection of these EFs.

71. CH_4 emissions from the distribution of town gas in the period 1990–2008 have been estimated and reported for the first time. Denmark indicates in the NIR that uncertainties regarding these estimates are expected to be large because of the scarcity of available data associated with the phasing out of town gas use, which is presently only distributed in the cities of Copenhagen and Aalborg. The ERT commends Denmark for this development, which has improved completeness.

5. Areas for further improvement

Identified by the Party

72. Denmark has planned a number of improvements for the energy sectors, including:

(a) For stationary combustion: reporting and referencing EFs; developing and incorporating country-specific uncertainty estimates; CO_2 EFs for municipal waste incineration; and updating those EFs adopted from the *EMEP/CORINAIR Atmospheric Emission Inventory Guidebook – 2007* with the most recent version (2009);

(b) For mobile combustion: improving data to estimate emissions from road transportation, including the provision of more accurate mileage figures split into the different vehicle layers of the emission model and the categorization of fleet data for heavy-duty trucks and buses into the numerous weight classes covered by the COPERT IV model (this will be done on the basis of research on transport in Denmark by the Danish Technical University (Danmarks Tekniske Universitet); and estimating the fuel consumed for domestic navigation between mainland Denmark, Greenland and the Faroe Islands;

(c) For fugitive emissions: improving the emission estimates from storage of fuels in tank facilities and from offshore extraction of oil and gas.

Identified by the expert review team

73. The ERT identified the following areas for improvement:

(a) Transparency (improving the background information, such as improving the discussion of the use of plant-specific information under the EU ETS);

(b) Accuracy (critically reviewing some EFs, e.g. CO_2 for electricity coal and refinery gas in stationary combustion, N_2O from flaring; and estimating emissions from Greenland with country-specific EFs);

(c) QA/QC (incorporating specific QC checks for the data reported under the EU ETS);

[8] EEA, 2009.

(d) Time series-consistency (for those cases where data reported under the EU ETS have been incorporated to estimate emissions in the period 2006–2008, developing country-specific correlations that may be used to recalculate emissions for previous years using a consistent approach).

C. Industrial processes and solvent and other product use

1. Sector overview

74. In 2008, emissions from the industrial processes sector amounted to 2,263.18 Gg CO_2 eq, or 3.5 per cent of total GHG emissions, and emissions from the solvent and other product use sector amounted to 92.32 Gg CO_2 eq, or 0.1 per cent of total GHG emissions. Since the base year, emissions have decreased by 10.2 per cent in the industrial processes sector, and decreased by 31.8 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 cessation of N_2O emissions due to the discontinuation of nitric acid production in 2004. Within the industrial processes sector, 58.3 per cent of the emissions were from mineral products, followed by 39.9 per cent from consumption of F-gases and 1.5 per cent from lubricant use. The remaining 0.2 per cent was shared by chemical industry and other production which accounted for 0.1 per cent each. The decrease in emissions from the industrial processes sector was slightly higher than the overall decrease of national total emissions. The decrease in emissions from the solvent and other product use sector was higher than the decrease in the industrial processes sector but with little overall impact.

75. The ERT found that there is room to improve transparency in the NIR by providing more detailed background information on AD, EFs and other necessary parameters used for the calculations, particularly for those associated with the key categories. Plant-specific data reported under the EU ETS may not only be used as the basis for emission estimates but also to develop country-specific EFs to ensure time-series consistency.

2. Key categories

Cement production – CO_2

76. The emissions for cement production account for 51.0 per cent of emissions from the industrial processes sector and arise from only one cement-producing plant. Three different methods have been used to estimate the emissions. For the period 1990–1997, a tier 1 approach has been used, based on clinker production with country-specific EFs for a mix of clinker types and white cement; for the period 1998–2005, the emissions have been estimated on the basis of raw materials; and for the period 2006–2008, the EU ETS reports have been used. These reports, made available during the review, indicate that CO_2 emissions have been estimated using a tier 3 method specified in the corresponding EU decision (European Commission, 2007), which is considered to be in line with the IPCC good practice guidance, providing high-quality estimates for the emissions in the last years (2006–2008). However, the different methods used for the period 1990–2008 have led to inconsistency in the time series. In addition, the background documentation on clinker production in the NIR is not sufficient to explain the decreasing trend in the CO_2 IEF.

77. On the basis of the information provided in the EU ETS reports, the ERT recommends that Denmark derive a country-specific EF that could be used throughout the whole time series. In order to allow comparability among Parties, it is essential that AD for clinker production be investigated more deeply, and that the Party provide information on the calcium oxide content of the clinker. The ERT also recommends that a qualitative explanation be included in the NIR regarding the changing nature of the raw materials or the products, wherever decreasing trends are found in the IEF.

Ozone-depleting substances substitutes – HFCs

78. HFC emissions from refrigeration and air-conditioning equipment account for 32.5 per cent of emissions from the industrial processes sector. Calculations are held by the consulting firm PlanMiljø which published a detailed report on F-gases (*The greenhouse gases HFCs, PFCs and SF_6 – Danish consumption and emissions*[9]). Emissions are estimated using a complex model that was made available to the ERT during the review. The NIR does not provide sufficient information regarding AD, EFs, quantity of gas in equipment and basic assumptions. This information, which is needed to understand the input data to the model, is only provided in the report by PlanMiljø. The ERT recommends that Denmark improve the background information for this model in future NIRs.

79. The F-gases report indicates that the comparison between potential and actual emission estimates has been only partly completed. To this end, data from importers (top-down) are assessed against data from users (bottom-up) to ensure that import and consumption correspond. The consumption reported from users is always adjusted in line with the import of substances, which are the data with a lower degree of uncertainty. In 2008, the ratio of potential to actual data for HFC-134a is 0.69 and for all species together this ratio is 0.88, indicating an underestimation of potential emissions or an overestimation of actual emissions. There are no explanations about these figures in the F-gases report or in the NIR. The ERT recommends that the Party improve transparency with regard to this particular key category, as well as for the F-gases in general, by providing more detailed information in the NIR and completing the documentation of the model.

80. According to the F-gases report, no specific QA/QC plan for the F-gas calculation has been developed, although some QC procedures are carried out in the model. The ERT recommends that Denmark improve QA/QC for F-gases.

81. During the review, the ERT was given access to two spreadsheets of emission calculations for F-gases. These were not sufficient to completely clarify the methodologies and data used in the calculations: one spreadsheet had missing links to other spreadsheets; the information was not consistent in both spreadsheets (e.g. in 2008, the stock of HFC-134a for mobile air-conditioning was shown as 231.2 t in one spreadsheet and 230.6 t in the other, which is used to feed the CRF); and data in spreadsheets were poorly documented. Other basic reference materials listed in the F-gases report were available in the Danish language only and were not assessable by the ERT.

82. Figures in the NIR (table 4.16) do not reflect those in the CRF tables from the 2010 submission, except for the year 2008. The ERT recommends that Denmark check its reporting in the NIR and CRF tables for consistency in the next submission.

83. The ERT acknowledges the enlarged and improved information on trends for the F-gases in the 2010 submission, following previous review recommendations.

3. Non-key categories

Limestone and dolomite use – CO_2

84. Completely different time series for AD and EFs were presented in the 2010 submission compared with the 2009 submission, with no explanation regarding the recalculation. The ERT recommends that, in the NIR, the Party explain the changes in assumptions and provide the description of the AD in sectoral background CRF table 2(I).A-G. The ERT also recommends that Denmark ensure time-series consistency, because a different method has been used for the last three years.

[9] Poulsen and Bode, 2008.

Other (industrial processes) – CO_2

85. Emissions from the production of yellow bricks and expanded clay products are estimated and reported under this category. Both of the emission time series are inconsistent because the tier 1 method has been used for the period 1990–2005, while plant-specific data reported under the EU ETS have been used for the period 2006–2008. The ERT recommends that Denmark use this plant-specific information under the EU ETS as a basis for deriving country-specific EFs to be applied to the whole time series.

86. The production of yellow bricks is not well documented and the total production of bricks is not reported in the NIR. The ERT recommends that Denmark improve transparency in this regard.

Solvents and other product use – CO_2

87. Emissions are estimated using a model that cross-checks two sources of data: SPIN (Substances in Preparations in Nordic Countries), for the bottom-up approach, and Statistics Denmark, for the top-down approach, using a mass balance method for consumption of species and EFs for four categories of solvents. Estimations for total emissions before 1995 are not well documented. The ERT recommends that the Party work on the assumptions needed for completing the time series using consistent methodologies.

4. Areas for further improvement

Identified by the Party

88. Emissions from N_2O use in fire extinguishers, aerosol cans and other uses reported as not estimated ("NE") will be further investigated.

89. Emissions from iron foundries are pending investigation and the category is reported as "NE".

Identified by the expert review team

90. The ERT recommends that the Party improve time-series consistency as well as transparency regarding food and drink production, yellow brick production and consumption of electrodes in electric steelworks. The ERT encourages Denmark in its intention to increase the completeness of the inventory as well as to complete the time series for emissions of N_2O from use as anaesthesia for the period 1990–2004 and recommends that the Party clarify emissions from iron foundries as soon as possible.

D. Agriculture

1. Sector overview

91. In 2008, emissions from the agriculture sector amounted to 10,359.99 Gg CO_2 eq, or 16.0 per cent of total GHG emissions. Since 1990, emissions have decreased by 22.0 per cent. Over the period 1990–2008, total CH_4 and N_2O emissions decreased by 3.2 and 30.6 per cent, respectively. The key driver for the fall in emissions is 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 (N) pollution policy which has been in operation in Denmark since 1985. Denmark provided clear explanations in the NIR on the drivers that underpin the GHG emissions trend. N_2O was the dominant gas emitted in 2008, contributing 60.9 per cent to total sectoral emissions, while CH_4 contributed 39.1 per cent. Within the sector, 56.4 per cent of the emissions were from agricultural soils, followed by 27.3 per cent from enteric fermentation and 16.3 per cent from manure management. The

remaining 0.03 per cent were from field burning of agricultural residues. Prescribed burning of savannas and rice cultivation do not occur in Denmark.

92. In the 2010 submission, Denmark provided for the first time estimates for field burning of agricultural residues and additional animal categories such as deer, reindeer, ostrich and pheasant. The ERT commends the Party for its effort. During the review, Denmark announced that it intends to complete these estimates for CH_4 emissions from enteric fermentation of poultry and fur farming, as well as CH_4 emissions from manure management of ostrich and pheasant. The ERT encourages the Party in this intention.

93. The ERT noted that most of the AD (including the number of animals by subcategory, the amount of feed and manure, area and productivity of crops) are not provided in the NIR. The ERT recommends that Denmark provide all the data used for the emission calculations, at least for the latest year of reporting, in its next NIR. The ERT further noted that constant values of average weights of animals are indicated in the CRF tables for all years. In order to increase the transparency of emission trends, the ERT recommends that Denmark provide actual annual data on average weight of animal categories. Methodologies for estimating gross energy (GE) values, volatile solids (VS) production, N excretion (Nex) and N losses during housing and storage are not clear from the NIR. The ERT recommends that the Party improve transparency related to the estimation of these parameters in the next annual submission.

94. Furthermore, the ERT noted that the decreasing trend of IEFs for emissions from enteric fermentation and manure management of some animal categories are not supported by trends in GE and VS values or weight. In the course of the review, Denmark clarified that, for non-dairy cattle and slaughtering pigs, IEFs decreased due to an improvement in feed efficiency and less feed consumption per produced kg of meat. The decrease of Nex rates of sheep, goats, swine and horses is due to policy measures implemented by Denmark since 1985, including several programmes dedicated to the reduction of N pollution from livestock production systems (particularly Aquatic Action Plans I, II and III). The decrease of N content in manure is supported by a decreasing trend of ammonia emissions since 1990 (by 35 per cent). The ERT recommends that the Party provide more explanatory information for the trends of key parameters and emissions in the NIR of the next annual submission.

95. Denmark reported recalculations for all years of the inventory in its 2010 submission, undertaken in response to the recommendations of the previous review. These recalculations arise from: the revision of population data for sheep and goats due to the inclusion of data from small farms; the interpolation of GE values, the amount of feed and N in manure applied to soils of heifers (for 2005–2006), the amount of feed and GE values of piglets and slaughtering pigs (for 1991–1993) and the amount of feed for dairy cattle for 2006; the implementation of the tier 2/country-specific methodology for the estimation of CH_4 from manure management based on manure excretion data and the adjustment of N losses during housing to total ammonium N values; the revision of data for the allocation of manure between stable types; and the use of new data on sewage sludge application to soils for 2002, 2005 and 2007. The recalculations of the 2007 agriculture inventory resulted in a decrease of 3.2 per cent in total sectoral emissions for mainland Denmark. The recalculations performed by the Party in its 2010 submission have had no significant impact on the overall decreasing trend of emissions in this sector in the period 1990–2008.

96. Denmark has developed and implemented tier 2 and country-specific methodologies to estimate emissions from most categories in accordance with the Revised 1996 IPCC Guidelines and the IPCC good practice guidance. Denmark also applies a number of country-specific parameters and EFs for the key categories. The ERT appreciates the Party's effort in this respect.

97. During the review, Denmark provided information about the implementation of sector-specific QC checks for input and output data of the IDA (Integrated Database for Agricultural Emissions) model. Agricultural QA procedures include peer reviews of the Danish GHG inventory for agriculture by independent national experts conducted in 2010. The ERT commends Denmark for its continued efforts to improve the quality of the agriculture inventory and recommends that the Party include the recommendations made by reviewers and actions undertaken to address these in the next NIR.

98. The ERT commends the efforts of Denmark in following-up recommendations from the previous review for agriculture, particularly for confirming the model estimates of CH_4 emissions from enteric fermentation of dairy cattle by using the results of the tier 2 calculations and for improvements in the transparency of the information relating to the reduction of emissions from biogas-treated slurry.

2. Key categories

Enteric fermentation – CH_4

99. In the course of the review, Denmark provided the ERT with AD on feed unit intake by animal subcategories. The ERT noted that, for heifers, feed intake increased by 50 per cent for the years in the period 1990–2008. However, the corresponding GE values increased by only 20 per cent. According to the Party's response, these inconsistencies are caused by the attribution of parameters to the production unit of animals during the period 1990–2002 instead of to the head of average annual population. However, this problem does not influence the emissions for later years. The ERT recommends that Denmark remove any inconsistencies in the estimation of emissions from heifers for the period 1990–2002 in the next annual submission.

100. The ERT noted that AD obtained for the inventory from the Danish normative system (Nex rates, distribution of manure per housing and storage systems, weight of animals, etc.) represent only about 20 per cent of the total population of cattle and 35 per cent of pigs. Denmark clarified that these data are considered to be a conservative base from which to estimate GHG emissions in agriculture; and that the few large farms which are not covered by the Danish normative system were likely to have more effective management of nutrients and less emissions of pollutants. The ERT encourages the Party to provide these explanations in its next annual submission.

101. The ERT noted that the IEF for dairy cattle for 2007 has been recalculated in 2010 and decreased by 0.2 per cent compared to the previous submission. The ERT noted that the rationale for these recalculations was not provided in the NIR. In the course of the review, Denmark indicated that this change is due to an error in calculations and that it will be corrected in the 2011 submission. The ERT supports this intention.

Manure management – CH_4

102. The NIR states that there is a tendency for an increasing proportion of bull-calves, sheep and goats to be raised in stables with deep litter manure management systems (MMS). However, the ERT noted that this type of MMS is not reported in the Danish inventory. The ERT further noted that CH_4 emissions from the storage of poultry wastes without bedding are not reported separately. This could lead to an underestimation of GHG emissions from manure management. The ERT recommended that Denmark provide estimates for these types of MMS. In the course of the review, Denmark provided estimations for these MMS in accordance with the Revised 1996 IPCC Guidelines and applied default EFs. As a result of these recalculations, the CH_4 emissions from manure management increased by 4.4 per cent (8.3 Gg CH_4) for 2008.

Manure management – N_2O

103. The ERT noted that the IEF for N_2O emissions from liquid MMS decreased within the period, from 0.00098 (1990) to 0.00081 (2008) kg N_2O–N/kg N. During the review, Denmark clarified that the reduction of N_2O emissions from the application of biogas-treated slurry in agricultural soils is considered within this category. The decrease in the rate of N_2O emissions from the application of treated slurry in dry soils was confirmed by a number of national and international scientific research projects and peer-reviewed publications. The ERT recommends that Denmark provide more explanatory information on the nature of the reduction in N_2O emissions from treated slurry in the next annual submission, and encourages the Party in its intention to further verify the rates of N_2O reduction in different environmental conditions. The ERT recommends that Denmark include the uncertainty of scientific knowledge concerning the calculation of reduced N_2O emissions from biogas-treated slurry. The ERT further noted that the Nex rates of animals reported in table 4.B(b) represent data for mainland Denmark only; however, AD and emissions are reported for mainland Denmark and Greenland. The ERT recommends that Denmark correct its reporting in the CRF tables in the next annual submission.

Direct N_2O emissions from agricultural soils – N_2O

104. The ERT noted that N input from above-ground biomass of N-fixing crops is estimated in both categories of N-fixing crops and crop residues left on fields. The ERT encourages Denmark to check whether there is double counting of N and to provide relevant explanations or recalculations in the next annual submission. The ERT further noted that Denmark applied an additional country-specific parameter on ploughing frequency for the estimation of N in crop residues, which may lead to an underestimation of N_2O emissions. During the review, Denmark clarified that the AD used for this category are not annual and represent the total N input from above-ground biomass during the production cycle. The ERT recommends that the Party provide explanatory information on this issue in the next annual submission.

105. The ERT noted that the IEF for N_2O emissions from the cultivation of histosols (3.0 kg N_2O–N/ha) is one of lowest among reporting Parties (1.0–9.2 kg N_2O–N/ha) and lower than the default value (8.0 kg N_2O–N/ha). The ERT further noted that the methodology applied by Denmark is recommended by the IPCC good practice guidance for mineral soils only and that this may lead to an underestimation of emissions. The ERT recommends that Denmark provide recalculated estimates using the default EF. In the course of the review, Denmark provided recalculations for N_2O emissions from the cultivation of histosols in accordance with the IPCC good practice guidance. As a result of these recalculations, the N_2O emissions from histosols increased by 166.0 per cent (0.6 Gg N_2O) for 2008.

3. Areas for further improvement

Identified by the Party

106. During the review, Denmark informed the ERT that several improvements are planned, including: the improvement of data on GHG emission reductions from biogas-treated slurry and on stable types and distribution; and the further implementation of QC checks for inventory calculations.

Identified by the expert review team

107. The ERT identified the following areas for future improvement:

(a) The improvement of the transparency of the reporting in the NIR by providing all AD used in the calculations, at least for the latest year of the reporting, including equations and related descriptions for the methodologies applied;

(b) The improvement of the explanations for the trends in the parameters used for the estimation of emissions from livestock, particularly where there are inconsistencies between correlated parameters;

(c) The correction of the mistakes noted in this report;

(d) The improvement of completeness by including data provided during the course of the review, namely estimations of CH_4 emissions from deep litter MMS and storage of poultry wastes without bedding;

(e) The inclusion of the revised estimates of N_2O emissions from the cultivation of histosols;

(f) Ensuring the accuracy of reporting in the CRF by providing representative parameters for the agricultural inventories of mainland Denmark and Greenland.

E. Land use, land-use change and forestry

1. Sector overview

108. In 2008, net emissions from the LULUCF sector amounted to 2,664.83 Gg CO_2 eq, or 4.1 per cent of total national GHG emissions. Since 1990, when net emissions were 2,826.24 Gg CO_2 eq, net emissions have decreased by 5.7 per cent (in absolute terms). Over this period, CO_2 emissions decreased by 5.5 per cent and N_2O emissions decreased by 32.8 per cent; no CH_4 emissions from LULUCF were reported. The key drivers for the decrease in net emissions are a decrease in emissions from the carbon stock change in forest land remaining forest land and increased removals in carbon stock changes in wetlands and settlements. Within the sector, forest land, cropland and grassland were net sources, contributing 146.03 Gg CO_2 eq, 2,687.70 Gg CO_2 eq and 77.35 Gg CO_2 eq, respectively, while wetlands and settlements were a net sink, contributing 7.11 Gg CO_2 eq and 239.13 Gg CO_2 eq, respectively. The percentages of emissions/removals from forest land, cropland, grassland, wetlands and settlements were 5.5 per cent, 100.9 per cent, 2.9 per cent, –0.3 per cent and –9.0 per cent, respectively. Denmark reported emissions from other land as "NA" or "NO".

109. Denmark has not estimated (reported as "NE") emissions/removals from several carbon pools and categories: AD for organic soils in other land converted to grassland (although the net carbon stock change is reported as included elsewhere ("IE")); AD and the net carbon stock change in all carbon pools for the subcategory "partly covered water" in wetlands remaining wetlands; AD for the subcategory "lakes and rivers" in land converted to wetlands (although carbon stock changes have been reported as either "NA" or "NO"); carbon stock changes in biomass and soil carbon pools for settlements remaining settlements for mainland Denmark (although AD for all subcategories except "low buildings, graveyards, golf courses etc." are reported as "IE"); carbon stock changes in biomass and soil carbon pools for all subcategories except "low buildings, graveyards, golf courses etc.," (those are reported as "IE"); and AD and emissions from flooded lands for N_2O emissions from drainage of soils and wetlands. As well as these, there are many pools that have been reported as either "NA" or "NO", even when they have actually not been estimated ("NE") for reasons such as lack of information. These have been identified under the appropriate categories below. The ERT encourages the Party to improve the completeness of the inventory for those categories that are known to occur within the national boundaries and for which methodologies to estimate emissions and removals exist within the IPCC good practice guidance for LULUCF.

110. For the LULUCF sector, Denmark has used various tier 3 methods involving the use of models and inventory-based approaches. Although the NIR generally contains

transparent information on these models and inventories, it lacks transparent information on the model outputs and their relationship with the entries in the CRF tables. The ERT recommends that Denmark provide transparent information in the NIR on the model outputs and their relationship with the entries in the CRF tables in the next annual submission.

111. The use of notation keys was found to be incorrect and misleading in many places in the CRF tables, leading to a lack of transparency**.** The notation keys "NA" or "NO" have been used in many places in the CRF tables for values that have not been estimated for reasons such as lack of information (e.g. the net carbon stock change in organic soils in forest land remaining forest land). The correct notation key in such cases should have been "NE" and not "NA" or "NO". The ERT recommends that Denmark report using the correct notation keys in the CRF tables in the next submission.

112. In its inventory submission of 15 April 2010, Denmark has not developed a complete and consistent land-representation system for all land-use categories, and this could lead to an over- or underestimation of emission/removal estimates due to double counting or omission of areas. For example, the value for total area of Denmark including Greenland as displayed in the 1990, 1995 and 2008 inventories changes from 2,209,368.9 km^2 over 2,209,320.6 km^2 to 2,209,264.4 km^2. Information from Statistics Denmark shows that the total areas of Denmark and Greenland are 43,098 km^2 and 2,166,086 km^2, respectively, making a total of 2,209,184 km^2. In the course of the review, Denmark corrected this issue and in the latest resubmission of 22 October 2010, the area reported was 2,209,184 km^2 for all years. The ERT welcomes the improvements made and recommends that Denmark include these in the next inventory submission. The previous ERT recommended that Denmark develop land-use-change matrices from 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. In response, Denmark has included a land-use-change matrix between the years 1990 and 2005. However, this does not provide the necessary information to verify the land-area consistency across the time series. The ERT recommends that Denmark report a consistent time series of AD for each land use and land-use change in accordance with the IPCC good practice guidance for LULUCF in its next annual submission.

113. Denmark has performed a tier 1 uncertainty analysis for the LULUCF sector. The ERT noted that Denmark has performed a tier 2 uncertainty analysis for the other sectors. The ERT encourages Denmark to perform a tier 2 uncertainty analysis for the LULUCF sector, as has been done for other sectors, in the next annual submission.

114. Denmark has performed a key category analysis at tier 1 and 2 levels using both trend and level assessments. However, only the tier 1 level assessment has been used for identifying the key categories and guiding methodological choice. The ERT recommends that Denmark use the results of both the level and the trend key category analysis in identifying key categories and guiding methodological choice in the next annual submission.

115. The ERT found many errors and discrepancies in the CRF tables for the LULUCF sector submitted by Denmark. The ERT noted, in particular, the discrepancies between the LULUCF CRF tables for the Convention and the Kyoto Protocol reporting. In the course of the review, Denmark submitted a set of revised CRF tables in response to the ERT's recommendation to remove these discrepancies. However, the ERT notes that there are still some discrepancies in the CRF tables. This indicates that there are problems with the QA/QC procedures for the LULUCF sector in the Danish national inventory system. For example, the ERT found that in the Danish national inventory system, the inventory compilation for forest land is done separately by the Centre of Landscape and Planning, University of Copenhagen and the data are transmitted to NERI (Aarhus University), the

main body responsible for compiling the national inventory, where it is integrated with the rest of the LULUCF sector. The ERT noted that there may be issues with the QA/QC procedures used in the transfer of data between these organizations. The ERT strongly recommends that Denmark improve the QA/QC processes for the LULUCF sector in order to eliminate such inconsistencies in its reporting in the next annual submission.

2. Key categories

Forest land remaining forest land – CO_2

116. Denmark has used two different sources of data for forest land over the time series: a census of forest owners for the years 1990 and 2000; and national forest inventory data from 2007 onwards. The previous review report recommended that the Party ensure time-series consistency by addressing issues arising from the use of these two different data sources. In response to this recommendation, Denmark has performed extensive recalculations using remotely sensed data (Landsat imagery) for all the years. The ERT believes that the recalculations have been performed in a time-series consistent way and appreciates Denmark's efforts in improving the estimates for forest land.

117. For forest land remaining forest land, the net carbon stock change of organic soils is reported as "NA" although there are organic soils in forest land. During the review, Denmark explained that this has not been estimated due to a lack of information on the net carbon stock change of organic soils in forest land. Considering that this is a key category, the ERT recommended that Denmark provide estimates in the next annual submission. In the course of the review, Denmark provided related estimates in its latest resubmission of 22 October 2010. The ERT appreciates these efforts.

Cropland converted to forest land – CO_2

118. For cropland converted to forest land, Denmark estimated the litter (forest floor) accumulation rate using an average value from forests aged 29–40 years. The ERT noted that new data collected from the national soil sampling project, entitled SINKS, indicates that the average rate (0.31 t C/ha/year) overestimates litter accumulation for young conifers (as shown in NIR, figure 7.6, of the 12 points in this range, only 2 are above this value and the others are all below the fitted trend line). As around 60 per cent of the land reported under land converted to forest land relates to conifers, applying this rate may significantly overestimate removals. The ERT recommended that Denmark provide revised estimates for litter accumulation in young conifer forests by one of the following approaches: fitting a linear equation to those forests of less than 20 years of age; using a 'broken stick' (otherwise known as piecewise linear regression) approach to represent age-class effects; or fitting a more complex function or model that accurately accounts for age-class effects. In the course of review, Denmark provided revised estimates using the 'broken stick' approach and setting the carbon accumulation rate to zero for conifer forests ages from 0–20 years**.** As a result of the recalculations, CO_2 emissions from cropland converted to forest land increased by 23.7 per cent (2.24 Gg CO_2) for 2008.

119. For cropland converted to forest land, the net carbon stock change of organic soils is reported as "NA", although there are organic soils in cropland converted to forest land. During the review, Denmark explained that this has not been estimated due to the lack of information on the net carbon stock change of organic soils in cropland converted to forest land. In the course of the review, in response to the ERT's recommendation to provide these estimates, Denmark provided revised estimates by using conservative assumptions about draining of organic soils, namely: 50 per cent of organic forest soils were assumed to be drained in 2008 and all organic forest soils were assumed to be nutrient-rich. As a result of this recalculation, CO_2 emissions from cropland converted to forest land increased by 4.0 per cent (0.38 Gg CO_2) for 2008.

Cropland remaining cropland – CO_2

120. Denmark uses a tier 3 model (C-TOOL) based on modelled dynamics for carbon turnover in soil to estimate carbon stock changes in mineral soils in cropland. The model operates with three different pools: FOM (fresh organic matter), HUM (humified organic matter) and ROM (resilient organic matter). In the course of the review, in response to a recommendation from the ERT, Denmark provided revised estimates for carbon stocks in mineral soils in cropland using a new approach – ignoring the FOM pool and taking into account only the changes in HUM and ROM pools. The ERT recommends that Denmark provide information on the validation of the model predictions using this new approach with field measurements of changes in the HUM and ROM pools in the next annual submission.

Grassland remaining grassland – CO_2

121. For grassland remaining grassland, the net carbon stock change of mineral soils is reported as "NA, NO". During the review, Denmark clarified that the net carbon stock change is reported as "NA" and "NO" as there have been no changes in the management of these areas or nutrient input. Denmark applied the tier 2 approach that resulted in no net carbon stock changes of mineral soils for grassland remaining grassland. Considering that this is a key category, the ERT recommends that Denmark provide these explanations in the next annual submission and change the reporting in the CRF from notation keys to estimated "0".

3. Non-key categories

Land converted to forest land – CO_2

122. For land (grassland, wetlands, settlements and other land) converted to forest land, the net carbon stock change of organic soils is reported as "NA". During the review, Denmark explained that this has not been estimated due to the lack of information on the net carbon stock change of organic soils in land converted to forest land. The ERT recommended that Denmark provide these estimates in the next annual submission. In the course of the review, Denmark provided related estimates in its latest resubmission of 22 October 2010. The ERT appreciates these efforts.

Land converted to cropland – CO_2

123. For land converted to cropland, the net carbon stock change of mineral and organic soils is reported as "IE" for many conversions. During the review, Denmark explained that these have been included in cropland remaining cropland. To improve transparency, the ERT recommended that Denmark report the net carbon stock change of mineral and organic soils separately under cropland remaining cropland and land converted to cropland in the next annual submission. In the course of the review, Denmark provided related estimates in its latest resubmission of 22 October 2010. The ERT appreciates these efforts.

Land converted to grassland – CO_2

124. For land (cropland, wetlands, settlements and other land) converted to grassland, the net carbon stock change of mineral soils is reported as "NA". The ERT recommends that Denmark provide these estimates in the next annual submission.

125. For land (cropland, wetlands, settlements and other land) converted to grassland, the net carbon stock change of organic soils is reported as "IE" and included under the grassland remaining grassland category. To improve transparency, the ERT recommended that Denmark report the net carbon stock change of organic soils under grassland remaining grassland and land converted to grassland separately in the next annual submission. In the

course of the review, Denmark provided related estimates in its latest resubmission of 22 October 2010. The ERT appreciates these efforts.

4. Areas for further improvement

Identified by the Party

126. Denmark has planned a number of improvements for the LULUCF sector including:

(a) QA/QC of the land-use change matrix to ensure land-area consistency across the time series;

(b) For forest land: the introduction of country-specific expansion factors for tree species based on sampling of trees and improved documentation of carbon in soil and litter pools;

(c) For cropland: the introduction of a completely new soil map and verification and development of carbon stock data for the agricultural soils from the new soil sampling programme and the establishment of national EFs for CO_2, CH_4 and N_2O from organic soils;

(d) For grassland: a complete recalculation for organic soils following the availability of a new soil map and updated EFs;

(e) For wetlands: a complete wetlands map of Denmark consisting of fully covered and partly covered areas for both wetlands remaining wetlands and land converted to wetlands and updated values of living biomass and gain in soil carbon for wetlands;

(f) For settlements: improved estimates of living biomass in settlements and further subdivision of the four subcategories.

Identified by the expert review team

127. The ERT identified the following areas for improvement:

(a) Completeness (complete reporting of unreported pools);

(b) Time-series consistency (ensuring time-series consistency of land-area reporting);

(c) Transparency (correct use of notation keys, clear documentation of model outputs in relation to the CRF tables and the inclusion of model C-TOOL validation results);

(d) QA/QC (ensuring that the values entered in the CRF tables are internally consistent, particularly with regard to entries in the CRF tables for the Convention reporting and KP-LULUCF reporting). Further details are provided in section II.H of this report.

F. Waste

1. Sector overview

128. In 2008, emissions from the waste sector amounted to 1,266.08 Gg CO_2 eq, or 2.0 per cent of total GHG emissions. Since 1990, emissions from the waste sector have decreased by 2.3 per cent. The key driver for the decrease in emissions is CH_4 from solid waste disposal on land, which decreased its share in sectoral emissions because of both increased CH_4 recovery and the regulations prohibiting the landfilling of MSW. These limitations are reflected in the increased recovery of gas from waste and wastewater, with its further use for energy production. Within the sector, 83.8 per cent of the emissions were

from CH_4 from solid waste disposal on land, followed by 13.3 per cent from wastewater handling. The remaining 2.9 per cent were from waste incineration.

129. The ERT noted that the estimations in the waste sector are complete and cover all categories and gases. The NIR is consistent with the UNFCCC reporting guidelines.

130. The ERT noted that the NIR does not provide sufficient background information to allow a thorough follow-up of the calculations to be undertaken (see paras. 138 and 140 below). The ERT reiterates the previous recommendation that Denmark improve transparency in the NIR by providing further descriptions of methodologies, explanations for the logic of the assumptions, investigations and calculations made and justification for the EFs and AD chosen, as specified in paragraphs 138 and 140 below.

131. An uncertainty analysis has been performed for all categories; QC procedures have been developed and performed for all categories, except for waste incineration, and are described in the NIR. Verification of CH_4 emissions from solid waste disposal on land has been performed as a QA procedure. No other QA procedures have been performed for the sector, regardless of changes in methodologies and/or data in the assessment of all the categories of the sector. The ERT recommends that Denmark extend its QA/QC procedures to all categories and ensure the relevant level of rigour of QA/QC procedures for categories where they are required, according to the IPCC good practice guidance.

132. The time series for all categories show fluctuations that may be partly explained by changing practices in gas recovery. However, there are some discrepancies between the data from the CRF tables and from the national energy statistical database (DEA, 2009) (see para. 140 below).

133. Since the 2009 annual submission, Denmark has recalculated all categories except for waste incineration, due to changes in methodologies, AD and EFs. The recalculations led to increased estimates in CH_4 from solid waste disposal on land by 0.4 per cent and N_2O emissions from wastewater handling by 208.0 per cent and a decrease in CH_4 from wastewater handling by 82.0 per cent.

2. Key categories

Solid waste disposal on land – CH_4

134. CH_4 emissions from solid waste disposal on land is a key category by level only. The time series 1990–2008 shows a gradual annual decrease due to an increase in waste incineration. In 2008, these emissions decreased by 4.8 per cent compared with 1990 (53.07 Gg CH_4) and amounted to 50.51 Gg CH_4. CH_4 emissions from solid waste disposal on land are estimated by a tier 2 first order decay (FOD) method with country-specific AD and mostly country-specific EFs, which is consistent with the IPCC good practice guidance. Solid waste disposal sites in Denmark are mostly managed, except in Greenland.

135. The estimation of CH_4 emissions from this category shows improvement from the previous submission. A tier 2 uncertainty analysis was performed. CH_4 recovery values are consistent with the figures from the energy sector database (DEA, 2009). The ERT concluded that QA/QC procedures for the category are in place and commends the effort of the Party in improving these procedures.

136. Denmark has made some changes in the parameters used in the FOD model (oxidation factor, half-life time, fraction of CH_4 in emitted gas, degradable organic carbon content for plastics, fraction of degradable organic carbon dissimilated) according to previous recommendations. The recalculations carried out show a considerable decrease for 1990 (16.0 per cent) and an insignificant increase for 2007 (0.43 per cent) compared with the previous submission. The ERT considers that some of these changes need further

justification and/or investigation. For example, the value for the oxidation factor set to 0.1 requires further justification than stating that solid waste disposal to land is being well managed. The ERT reiterates the previous recommendations that Denmark further investigate landfill practices and choose the value for the oxidation factor parameter according to recent scientific literature.

137. The ERT also found that the increase of the parameter half-life ($t_{1/2}$) from the previous 10 to the default 14 is not relevant for Denmark's wet climate. The ERT encourages the Party to adjust the value and appreciates its plans to further investigate MSW composition and to use individual half-life values for different waste types.

138. The ERT was unable to follow the logic of the calculations and assessments of CH_4 emissions from solid waste disposal on land as presented in the NIR. The ERT reiterates the recommendation from the previous review that the Party provide a table in the NIR showing the different waste types disposed of as MSW or incinerated, together with their main characteristics, to increase transparency. The ERT appreciates Denmark's efforts in using a tier 2 uncertainty analysis. However, due to the complexity of the FOD estimation method for CH_4 emissions, the ERT encourages the Party to further investigate relevant distributions for different parameters in order to increase accuracy.

3. Non-key categories

Wastewater handling – CH_4 and N_2O

139. CH_4 and N_2O emissions from wastewater handling show steady growth throughout the time series (from 151.83 to 168.03 Gg CO_2 eq). The methodology for the estimation of emissions from this category has been changed since the last submission and takes into consideration the portion of sludge removed and treated anaerobically with CH_4 extracted for energy purposes. The ERT considers these changes to be an improvement in estimating emissions from this category.

140. The recalculations show a considerable decrease in CH_4 emissions (about fourfold). There is a considerable discrepancy between the final CH_4 recovered for energy purposes and the corresponding value in the statistical database (DEA, 2009). Data on the sludge fraction treated anaerobically have been verified with sludge database values contained in the statistical database (DEA, 2009), and the Party is planning to reflect the difference and to use an updated (increased) value for the fraction of anaerobically treated sludge in the next annual submission. The ERT encourages the Party to do so and to make recalculations with the new EF. Further, the ERT recommends that Denmark improve the description of the EF for calculating CH_4 emissions in the NIR, and correct the formula used and the corresponding text in order to give a clear explanation of its components and their values, and thus to make it possible to follow the logic of the calculations.

141. N_2O emissions were estimated as the sum of contributions from wastewater treatment processes and from sewage effluents, without treatment (direct and indirect N_2O emissions). Direct emissions include N_2O from both aerobic and anaerobic (biological) treatment of sludge removed. Country-specific EFs for both parts of the N_2O emissions are derived from monitoring data. Recalculations were made according to a new methodology described in the NIR and the results show a significant increase in the emissions. Throughout the time series (from 1990 to 2008), the trend shows an increase of direct (192.2 per cent) and a decrease of indirect N_2O emissions (64.2 per cent), reflecting the technical renovations in wastewater treatment plants and the resulting reduction of N load in wastewater effluent. The ERT commends the Party for the improvements made in estimating N_2O emissions from wastewater handling.

Waste incineration – CO_2, CH_4 and N_2O

142. The incineration practice in Denmark is developing in line with the regulation which limits the amount of landfilling MSW. The incineration of MSW, industrial and clinical waste takes place for energy recovery and only the emissions from the cremation of human bodies, animal carcasses and accidental fires of buildings and vehicles are reported under the waste sector. The separate reporting for biogenic and non-biogenic emissions, consistent with the IPCC good practice guidance, has been based on reasonable assumptions with respect to the biogenic and non-biogenic contents of the incinerated waste types. However, hazardous waste is not mentioned in the NIR. During the review, Denmark informed the ERT that hazardous waste is incinerated with energy recovery and that emissions are therefore reported in the energy sector. The ERT appreciates Denmark's efforts in obtaining data and assessing the emissions from this category at such a disaggregated level, but recommends that the Party improve transparency by including a description of hazardous waste incineration in the next annual submission.

143. The documentation box of CRF table 6.C references particular categories of the energy sector where the recovered emissions are reported. However, the values reported in the referenced categories of the energy sector (public electricity and heat production, manufacturing industries and construction, and commercial/institutional, amounting to 16,937.56 TJ) differ from the figure from DEA for energy consumption from incinerated waste (16,501 TJ). Denmark is recommended to double-check the figures in the CRF tables for the energy sector with the data from energy statistics for the next annual submission.

4. Areas for further improvement

Identified by the Party

144. Denmark is planning the following improvements for its next annual submission:

(a) To obtain data on actual waste composition and use the individual half-life times for the estimation of CH_4 emissions from solid waste disposal on land; and to take into consideration the QA/QC analysis and tier 2 uncertainty analysis;

(b) To document changes in the methodology for estimating emissions from wastewater handling;

(c) To develop category-specific QA/QC procedures and verification for waste incineration;

(d) To move the assessment of GHG emissions from accidental building and vehicle fires from the category waste incineration to the category other (waste);

(e) To analyse thoroughly the uncertainties in the calculations of emissions from waste incineration.

Identified by the expert review team

145. The ERT identified the following areas for improvement for the next annual submission:

(a) To increase transparency in the NIR by improving the descriptions of the methodologies used and assumptions made and by providing all the information needed for tracking the calculations (e.g. a table in the NIR with characteristics of different waste types);

(b) To ensure that the QA/QC system covers the whole sector and that the relevant level of rigour is applied to the procedures performed for the key categories and those non-key categories that are subject to changes;

(c) To investigate further the uncertainty assessment, choosing appropriate probability density functions (under tier 2) for different parameters;

(d) To investigate further the composition of MSW landfilled and to use differentiated half-life values according to waste type.

G. Adjustments

146. The ERT identified and recommended two adjustments for afforestation activities under Article 3, paragraph 3, of the Kyoto Protocol. In accordance with the guidance for adjustments under Article 5, paragraph 2, of the Kyoto Protocol (decision 20/CMP.1), the two adjustments to afforestation activities were prepared by the ERT in consultation with Denmark. Also, in accordance with the guidelines for review under Article 8 of the Kyoto Protocol (decision 22/CMP.1), the ERT officially notified Denmark of the calculated adjustment.

147. The underestimations/overestimations leading to adjustments in 2008 include an underestimation of emissions due to the failure to report emissions from the mineral soil carbon pools and a possible overestimation of removals from the above- and below-ground biomass, litter and deadwood pools due to a lack of transparency.

148. The application of the adjustment leads to a decrease in estimated total removals for afforestation activities under Article 3, paragraph 3, of the Kyoto Protocol by 120.8 per cent (277.97 Gg CO_2 eq):

(a) The adjusted estimate for GHG emissions from the above- and below-ground biomass, deadwood and litter pools under afforestation in 2008 amounts to –178.45 Gg CO_2 eq, compared to the –232.53 Gg CO_2 eq reported by Denmark in its 2010 revised submission;

(b) The adjusted estimate for soil carbon under afforestation in 2008 amounts to emissions of 226.30 Gg CO_2 eq, compared to the 2.44 Gg CO_2 eq reported by Denmark in its 2010 revised submission.

149. In its response to the draft annual review report Denmark notified the secretariat of its intention to accept the calculated adjustments.

150. The ERT notes that Denmark may submit revised estimates for a part of its inventory to which adjustments were applied, in conjunction with its next inventory or, at the latest, with the inventory for the year 2012. The revised estimates will be part of the Article 8 review and if accepted by the ERT the revised estimates will replace the adjustments.

1. The original estimate provided by the Party – above- and below-ground biomass, litter and deadwood pools

151. In its inventory submission of 15 April 2010, Denmark provided an estimate for net CO_2 removals from afforestation in 2008 of 69.81 Gg CO_2. The ERT notes that reforestation is not assumed to take place in Denmark. During the review, the ERT noted a number of inconsistencies between the estimates of carbon stock changes in living biomass, dead organic matter (DOM) and litter pools across all the CRF tables for KP-LULUCF and the CRF tables under the Convention. These inconsistencies were noted not only for afforestation but also for other categories in the KP-LULUCF sector (see section II.H below for further details). On 22 October 2010, in response to the ERT's list of remaining questions and potential problems, Denmark submitted a complete set of revised CRF tables for KP-LULUCF, within the six weeks envisaged by the Article 8 review guidelines.

According to these tables, Denmark revised the estimate for net CO_2 removals from the above- and below-ground biomass, deadwood and litter pools under afforestation in 2008 to 232.53 Gg CO_2, which is 333.1 per cent higher than the original estimate.

2. The underlying problem – above- and below-ground biomass, litter and deadwood pools

152. In various inventory submissions and other documents provided to the ERT during the review process, Denmark provided four different values for net CO_2 emissions from afforestation in 2008, ranging from –230.09 Gg CO_2 to +10.84 Gg CO_2. In particular, the revised estimate submitted on 22 October 2010 included an increase of 520.8 per cent in removals in the above- and below-ground biomass pools (9.83 Gg C in the original estimate compared to 61.02 Gg C in the officially submitted revised estimate). These revisions were not discussed with the ERT during the review and Denmark did not supply sufficient information to justify this recalculation with the revised submission. Having analysed the methodology applied for calculating the revised estimates for net CO_2 emissions and removals from the above- and below-ground biomass, deadwood and litter pools under afforestation, the ERT concluded that these estimates are not in line with the IPCC good practice guidance and the IPCC good practice guidance for LULUCF because of a lack of transparency. The ERT considered that transparency was insufficient because of the large range of values supplied during the review and the insufficient details on the rationale for the recalculations made.

153. Following further requests for information by the ERT, Denmark submitted a letter on 13 November 2010 which included another set of revised numbers (in particular a significant increase in the carbon stocks for the litter pool) along with some explanation as to the reasons for the differences between the submissions. While the response was greatly appreciated by the ERT, it was not possible for the ERT to assess the accuracy of the numbers, given the lack of detail on the data provided and on the further recalculation of the litter pool.

3. The rationale for adjustment – above- and below-ground biomass, litter and deadwood pools

154. The revised estimates for above- and below-ground biomass pools increased significantly compared to the original estimates submitted by the Party. Sufficient explanations for these recalculations were not provided. Further, the additional information received from Denmark on 13 November 2010 included another change in data with the estimates for the carbon stock change in litter increasing from –4.75 GgCO_2 eq to –15.50 Gg CO_2 eq. Having reviewed the revised estimates and all the additional information provided by the Party, the ERT concluded that the estimates made by Denmark and submitted on 22 October 2010 were not in full compliance with the IPCC good practice guidance and the IPCC good practice guidance for LULUCF. The ERT therefore decided to calculate and apply an adjustment.

155. In deciding to apply an adjustment, the ERT noted that Denmark had acknowledged the error and supplied the ERT with revised estimates and a further explanation of the results (13 November 2010).

4. The ERT's recommendation to the Party – above- and below-ground biomass, litter and deadwood pools

156. To resolve the problems that have led to this adjustment, the ERT recommends that:

(a) Denmark increase the transparency in the description of the calculations and data used to estimate changes in all carbon stocks under afforestation, in particular for above- and below-ground biomass;

(b) Ensure that estimates provided for the above- and below-ground biomass, deadwood and litter pools under afforestation are consistent with the relevant subcategories reported under the Convention (i.e. lands converted to forest land);

(c) Improve the QA/QC procedures surrounding the transfer of data between agencies (in particular the Danish Centre for Forest, Landscape and Planning at the University of Copenhagen and NERI) and the importing of data into the CRF Reporter tool.

157. In making this adjustment and stating these recommendations, the ERT notes that Denmark responded to a question of clarification and, in this context, provided the ERT with additional information on 13 November 2010. The ERT thanks Denmark for this clarification and notes that Denmark could provide a revised estimate in its next annual submission using the information provided after the formal resubmission.

5. The assumptions, data and methodology used to calculate the adjustment – above- and below-ground biomass, litter and deadwood pools

158. The adjustment method utilized national data provided by Denmark in its response to the ERT's clarification question of 13 November 2010, and used appropriate conservativeness factors as set out in the annex to decision 20/CMP.1. The ERT considers that the data provided for the above- and below-ground biomass, deadwood and litter pools on 13 November 2010 are the most accurate of the values provided to the ERT during the review. However, given the number and magnitude of the changes between each submission and the limited information provided to the ERT on the reasons and rationale for these changes, the ERT cannot assess which of the values are actually correct. Since the estimates of all pools were subject to large recalculations, the ERT decided to adjust the above- and below-ground biomass, deadwood, and litter pools reported under afforestation. The approach used to calculate the adjustment is in line with the provisions of decision 20/CMP.1, paragraphs 29 (preferential use of national data) and 54 (application of conservativeness factors). The ERT calculated the adjustment using the revised estimates as follows:

(a) Taking the above- and below-ground biomass, deadwood and litter pools, provided by Denmark; and

(b) Applying the appropriate conservativeness factors to each pool. (Table 4a; 0.73 for increments of above- and below-ground biomass and for changes in the carbon stocks for litter, and 0.94 for changes in carbon stocks for deadwood.)

6. The adjusted estimate – above- and below-ground biomass, litter and deadwood pools

159. Table 4 presents the results of the ERT's calculation, including the original estimate as reported by the Party and the adjusted estimate as calculated by the ERT. As shown, the adjusted (conservative) estimate for net CO_2 emissions is –178.45 Gg CO_2, compared to –232.53 Gg CO_2 presented by Denmark as a revised estimate after the in-country visit.

7. Conservativeness of the ERT's calculation of the adjustment – above- and below-ground biomass, litter and deadwood pools

160. To ensure conservativeness, appropriate conservativeness factors were applied to each of the carbon pools (above- and below-ground biomass, deadwood and litter).

161. Based on the above, the ERT considers that the resulting adjusted value is conservative.

Table 4
Description of the adjustment calculation for activities under Article 3, paragraph 3, and, if any, Article 3, paragraph 4, of the Kyoto Protocol

Parameter/Estimate	*Value*	*Unit*	*Source*
Activity: afforestation			
Party's estimate of carbon stock changes in			Letter sent by Denmark on 13 November 2010 in response to a clarification question from the ERT, table 1, carbon stock data for afforested areas in 2007 and 2008
Above-ground biomass[a]	–50.2	Gg C	
Below-ground biomass	–10.8	Gg C	
Deadwood	–1.1	Gg C	
Litter	–4.2	Gg C	
Party's CO_2 emissions/removals estimate from			Letter sent by Denmark on 13 November 2010 in response to a clarification question from the ERT, table 1, carbon stock data for afforested areas in 2007 and 2008
Above-ground biomass[a]	–184.1	Gg CO_2	
Below-ground biomass	–39.7	Gg CO_2	
Deadwood	–4.0	Gg CO_2	
Litter	–15.5	Gg CO_2	
Input data/parameter for calculation of adjustment			
Conservativeness factors for			Decision 20/CMP.1, appendix III, table 4.a
Above-ground biomass[a]	0.73		
Below-ground biomass	0.73		
Deadwood	0.94		
Litter	0.73		
Adjusted conservative CO_2 emissions estimate for			
Above-ground biomass[a]	–134.4	Gg CO_2	
Below-ground biomass	–29.0	Gg CO_2	
Deadwood	–3.8	Gg CO_2	
Litter	–11.3	Gg CO_2	
Adjusted conservative estimate for above- and below-ground biomass, deadwood and litter under afforestation	–178.45	Gg CO_2	
Difference between original and adjusted emissions/removals for afforestation	54.09	Gg CO_2 eq	
	23.3	%	

[a] Net emissions from above-ground biomass also include emissions from removed crops.

8. The original estimate provided by the Party – soil carbon

162. In its inventory submission of 15 April 2010, Denmark did not provide an estimate for changes in carbon stocks in the mineral or organic soil carbon pools under afforestation. During the review, the ERT requested that Denmark provide estimates for all carbon pools under afforestation. On 22 October 2010, in its response to the ERT's list of remaining questions and potential problems, Denmark submitted a complete set of revised CRF tables for KP-LULUCF. This resubmission did include an estimate for organic soils but did not include an estimate for changes in carbon stocks for the mineral soil carbon pool.

9. The underlying problem – soil carbon

163. At the end of the in-country visit, the ERT informed the Party that there was a potential problem with completeness by not reporting changes in soil carbon stocks, leading to a possible underestimation of emissions.

164. Despite the request from the ERT to provide an estimate for the carbon stock changes in soils, an estimate for mineral soils was not included in the formal submission of the revised estimates. Instead, it was reported as "not reported, reported" ("NR, R"). Denmark did provide estimates for the changes in mineral soil carbon stocks under the Convention reporting for lands converted to forest land. These estimates indicated that mineral soils were a large net source of emissions in 2008. Following further requests for information by the ERT, Denmark submitted a letter on 13 November 2010 which acknowledged that omitting the mineral soil pool under afforestation was an oversight and provided new estimates. However, this did not form part of the official revised submission. The ERT therefore concluded that the lack of reporting changes in mineral soil carbon stocks in the official revised submission is not in line with the IPCC good practice guidance and the IPCC good practice guidance for LULUCF because of the lack of completeness leading to the underestimation of emissions.

10. The rationale for adjustment – soil carbon

165. In deciding to apply an adjustment, the ERT noted that the changes in mineral soil carbon stocks reported under the relevant land-use subcategories of the Convention (i.e. lands converted to forest land) led to a significant source of emissions. Mineral soils under afforestation were therefore also a significant source of emissions for lands under afforestation in 2008. As Denmark failed to report the changes in carbon stocks in mineral soils for afforestation in the revised submission, this led to an underestimation of emissions. The ERT therefore concluded that Denmark had not fully implemented the ERT's recommendations to bring the estimate into full compliance with the IPCC good practice guidance and the IPCC good practice guidance for LULUCF. The ERT therefore decided to calculate and apply an adjustment.

166. Therefore, the ERT noted that not reporting the changes in carbon stocks in mineral soils under afforestation represents an underestimation of emissions from this activity in 2008.

167. In deciding to apply an adjustment, the ERT noted that Denmark had acknowledged the error and supplied the ERT with an estimate for changes in mineral soil carbon stocks (13 November 2010).

11. The ERT's recommendation to the Party – soil carbon

168. To resolve the problems that have led to this adjustment, the ERT recommended that Denmark:

(a) Ensure completeness of the reporting and that the changes in carbon stocks for all five carbon pools are reported in future submissions, including the mineral soil carbon pool;

(b) Ensure that estimates provided for afforestation are consistent with the relevant subcategories reported under the Convention (i.e. lands converted to forest land);

(c) Improve the QA/QC procedures surrounding the transfer of data between agencies (in particular the Danish Centre for Forest, Landscape and Planning at the University of Copenhagen and NERI) and the importing of data into the CRF Reporter tool.

169. In making this adjustment and stating these recommendations, the ERT notes that Denmark responded to a question of clarification and, in this context, provided the ERT with additional information on 13 November 2010. This response acknowledged the error in not reporting the carbon stock changes in mineral soil. The ERT thanks Denmark for this clarification and notes that Denmark could provide a revised estimate in its next annual submission using the information provided after the formal resubmission.

12. The assumptions, data and methodology used to calculate the adjustment – soil carbon

170. The adjustment method utilized national data provided by Denmark in its response to the ERT's clarification question of 13 November 2010, and used an appropriate conservativeness factor as set out in the annex to decision 20/CMP.1 (table 4b; factor of 1.37 for emissions of CO_2 during the commitment period). The approach used to calculate the adjustment is in line with the provisions of decision 20/CMP.1, paragraphs 29 (use of national data) and 54 (application of conservativeness factor). The ERT calculated the adjustment by:

(a) Using the estimate of the carbon stock change in mineral soils provided by Denmark in its response to the ERT's clarification question of 13 November 2010; and

(b) Applying the appropriate conservativeness factor.

13. The adjusted estimate – soil carbon

171. Table 5 presents the results of the ERT's calculation, including the original estimate as reported by the Party and the adjusted estimate as calculated by the ERT. As shown, the adjusted (conservative) estimate for net CO_2 emissions is 226.30 Gg CO_2, compared to 2.44 Gg CO_2 presented by Denmark as a revised estimate after the in-country visit.

14. Conservativeness of the ERT's calculation of the adjustment – soil carbon

172. To ensure conservativeness, appropriate conservativeness factors were applied to all soils under afforestation.

173. Based on the above, the ERT considers that the resulting adjusted value is conservative.

Table 5
Description of the adjustment calculation for activities under Article 3, paragraph 3, and, if any, Article 3, paragraph 4, of the Kyoto Protocol

Parameter/Estimate	*Value*	*Unit*	*Source*
Activity: afforestation			
Party's estimate of carbon stock changes in: Mineral soil carbon pool	NR	Gg C	Submitted revised estimates at end of 6-week response period
Organic soil carbon pool	0.67	Gg C	
Party's CO_2 emissions/removals estimate from Mineral soil carbon pool	NR	Gg CO_2	Submitted revised estimates at end of 6-week response period
Soil[a]	165.20	Gg CO_2	
Input data/parameter for calculation of adjustment			
Carbon stock changes in mineral soil pool	44.38	Gg C	Letter sent by Denmark on 13 November 2010 in response to a clarification question from the ERT, table 1, carbon stock data for
Carbon stock changes in organic soil pool	0.67	Gg C	

Parameter/Estimate	*Value*	*Unit*	*Source*
			afforested areas in 2007 and 2008; organic soils from official resubmission
Conservativeness factor for soil	1.37		Decision 20/CMP.1, appendix III, table 4.b
Adjusted conservative CO_2 emissions estimate for soils[a]	226.32	Gg CO_2	
Difference between original and adjusted emissions/removals for soils under afforestation	223.88	Gg CO_2 eq	
	9 161.3	%	

Abbreviations: NR = not reported.

[a] Net emissions from soils include removals from mineral and organic soils.

15. The ERT's calculation of the magnitude of adjustment – afforestation

174. According to decision 18/CMP.1, the ERT calculated the magnitude (M) of the adjustment to afforestation for 2008, as defined in the annex to this decision. The magnitude of the adjustment, as calculated by the ERT, amounts to 13.8 per cent. This figure is based on a value of the "adjusted net estimate for that activity minus the submitted net estimate for the activity" of 277.97 Gg CO_2 divided by the sum of the absolute values of all submitted components for afforestation (362.86 Gg CO_2), then multiplied by 0.18 (see decision 18/CMP.1 for an explanation of the 0.18 value).

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

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

Overview

175. 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, annually.

176. The emissions and removals reported under Article 3, paragraphs 3 and 4, of the Kyoto Protocol by Denmark are directly related to one or more subcategories under the reporting to the Convention. During the review, the ERT found that this had not been transparently documented in the NIR. Denmark did provide the ERT with additional information on the relationship between the categories under the Convention and the activities under the Kyoto Protocol during the review, but several categories/activities still did not match. These are documented further in the sections below (see paras. 178–188 below). The ERT strongly recommends that Denmark increase the transparency of the inventory by further documenting the relationship between Convention reporting and Kyoto accounting in the next annual submission.

177. The ERT notes that Denmark has used consistent, complete remote sensing to identify areas of forest and forest change. This is a significant achievement and the ERT commends Denmark's efforts in this area, but recommends that the Party provide further detail on the programme in the next annual submission. In particular, issues such as how

Denmark ensures that the minimum mapping unit derived from the remote sensing data meets the 0.5 ha minimum forest area criteria applied by Denmark for classifying forests under the Kyoto Protocol need to be addressed. The ERT also encourages Denmark to consider adding additional time slices of data between the two current map dates to provide a more accurate representation of time-series change.

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

Afforestation and reforestation – CO_2

178. In the original submission, the ERT noted that emissions had not been reported for the soil pools under afforestation and reforestation. During the review, Denmark provided the ERT with revised estimates that included emissions of carbon from the mineral soil pool for the Convention reporting, but not for afforestation and reforestation. The ERT strongly recommends that Denmark include all pools under afforestation and reforestation in future annual submissions and also ensure consistency between the relevant Convention categories and Kyoto Protocol activities. The Convention reporting for these areas showed that mineral soil carbon was a large net source of emissions in 2008 (31.70 Gg C). The ERT therefore believes that not reporting changes in mineral soil carbon led to an underestimation of emissions in 2008 (see section II.G above for further details).

179. The ERT notes that Denmark does not currently identify areas of afforestation which have been subject to harvest. During the review, Denmark explained to the 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 recommends that Denmark provide further information to explain this in the next annual submission, or provide estimates of the harvested areas and the associated emissions and removals.

180. The ERT noted inconsistencies between the living biomass pools reported under the Convention reporting and the above- and below-ground biomass pools reported for afforestation and reforestation. During the review, Denmark provided revised estimates for changes in above- and below-ground carbon stocks and noted that the difference was due to a misunderstanding between agencies on the meaning of dates in the data files. However, the ERT found that the revised carbon stock change numbers for living biomass (Convention) and afforestation and reforestation still differed by 0.09 Gg C. The ERT therefore strongly recommends that QC procedures be strengthened in future annual submissions to ensure consistency in reported numbers. The ERT also strongly recommends that Denmark transparently document the improved QC procedures in the next annual submission.

181. The ERT found that the estimates for the carbon stock change in living biomass increased significantly between the original submission (9.83 Gg C) and the revised submission (61.03 Gg C). Denmark provided additional national forest inventory data, which indicated that during the revision an error had occurred. However, the ERT was not able to assess whether the submission was correct without the provision of further information (see section II.G above for further details). The ERT strongly recommends that Denmark clarify the calculations used to estimate changes in above- and below-ground biomass and improve its QA/QC procedures when transferring data between agencies.

Deforestation – CO_2

182. Denmark has used the same country-specific methods to estimate emissions and removals from deforestation as those used for forest land converted to other land (cropland, grassland, settlements and wetlands). The area of deforestation in Denmark is the sum of forest land converted to cropland, forest land converted to grassland, forest land converted to wetlands and forest land converted to settlements as described in the LULUCF chapter.

During the review, the ERT found a lack of consistency between the emission estimates reported under deforestation and the equivalent LULUCF conversion categories for mineral soil, organic soil and DOM. During the review, Denmark provided the ERT with revised estimates for deforestation. However, the ERT noted that the results were still inconsistent in both DOM (1.55 Gg C) and mineral soil (0.33 Gg C). The ERT strongly recommends that Denmark improve its QC procedures on data entry and checking of the CRF tables prior to the next annual submission and that the Party provide information on these procedures in the next annual submission.

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

Forest management – CO_2

183. Denmark has used the same country-specific methods to estimate emissions and removals from forest management as those used for forest land remaining forest land. Forest management in Denmark includes all areas of forest and therefore is the same as forest land remaining forest land as described in the LULUCF chapter. The ERT found a lack of consistency between the emission estimates reported under forest land remaining forest land and forest management. During the review, Denmark provided the ERT with revised estimates for forest management. However, the ERT found that the revised estimates of carbon fluxes were still inconsistent. In particular, the forest management emission estimates include 1.4 Gg C loss in litter that is not included under forest land remaining forest land. While this does not represent a potential underestimate of emissions in forest management, the ERT strongly recommends that Denmark implement further QC checks and document these checks in the next annual submission.

Cropland management – CO_2

184. Denmark has used the tier 3 model C-TOOL to estimate emissions from mineral soils under cropland management. The ERT commends Denmark for moving to higher-tier models for estimating emissions from soil carbon and notes the complexities in applying such models for national inventory submissions. The tier 3 model includes the effects of climate and management of cropland on emissions. To establish the 1990 base for cropland management for the purposes of net-net accounting, Denmark applied a five-year average of emissions from mineral soils from 1988 to 1992. While the use of a five-year average to remove the effect of climate variability is consistent with the IPCC good practice guidance for LULUCF, the ERT noted that this period also included a significant change in management practice. During the review, Denmark proposed a new method to reduce variability while still including management effects that excluded the fast turnover pools from the reporting. The ERT accepted the proposed method and recommends that Denmark provide additional information on this method in the next annual submission, including data on the change in each pool within the C-TOOL model.

185. During the review, Denmark provided the ERT with revised estimates for cropland management. In these revised estimates, the areas reported under cropland management and the relevant Convention subcategories no longer match. There is also a difference in the emission estimates for living biomass (0.18 Gg C) and soil (89.96 Gg C). The ERT strongly recommends that Denmark improve its QC procedures on data entry and checking of the CRF tables prior to the next annual submission and that the Party provide information on these procedures in the next annual submission.

186. During the review, Denmark provided the ERT with additional information on the Convention subcategories which correspond to the activities under Article 3, paragraphs 3 and 4, of the Kyoto Protocol. Upon reviewing this information and the related CRF submission, the ERT noted that some areas and emissions may have been double counted.

In particular, the forest land converted to cropland area appears to have been included in the deforestation reporting as well as in the cropland management reporting. The ERT recommends that Denmark review the inclusion of each relevant Convention subcategory to activities under Article 3, paragraphs 3 and 4, to ensure that there is no double counting of emissions and to ensure the consistent representation of lands as per the IPCC good practice guidance for LULUCF in the next annual submission. In particular, the ERT strongly recommends that Denmark provide a detailed land-area matrix that clearly shows the land areas and the transfers between categories under the Convention and those related to land accounted for under the Kyoto Protocol.

Grazing land management – CO_2

187. Denmark provided the ERT, during the review, with revised estimates for grazing land management. In these revised estimates, the areas reported under grazing land management and the relevant Convention subcategories do not match. There is also a difference in the emission estimates for living biomass (14.99 Gg C) and soil (0.05 Gg C). The ERT strongly recommends that Denmark improve its QC procedures on data entry and checking of the CRF tables prior to the next annual submission and that the Party provide information on these procedures in the next annual submission.

188. During the review, Denmark provided the ERT with additional information on the Convention subcategories which correspond to the activities under Article 3, paragraphs 3 and 4, of the Kyoto Protocol. Upon reviewing this information and the related CRF submission, the ERT noted that some areas and emissions may have been double counted. In particular, the forest land converted to grassland area appears to have been included in the deforestation reporting as well as the grazing land management reporting. The ERT recommends that Denmark review the inclusion of each relevant Convention subcategory to activities under Article 3, paragraphs 3 and 4, to ensure that there is no double counting of emissions and to ensure the consistent representation of lands as per the IPCC good practice guidance for LULUCF in the next annual submission. In particular, the ERT strongly recommends that Denmark provide a detailed land-area matrix that clearly shows the land areas within each category and the transfers between categories.

2. Information on Kyoto Protocol units

Standard electronic format and reports from the national registry

189. 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 of the findings and recommendations included in the SIAR on the SEF tables and the SEF comparison report.[10] 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.

190. The information on the accounting of Kyoto Protocol 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.

[10] 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.

191. 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.

192. The SIAR reiterated the recommendation of the previous ERT that Denmark should put in place measures to mitigate and reduce the internal fragmentation of unit blocks. The Party provided access to information from its national registry that substantiated or clarified the information reported in its annual submission.

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

193. Denmark has reported information on its accounting of KP-LULUCF in the accounting table, as included in the annex to decision 6/CMP.3. Information on the accounting of KP-LULUCF has been prepared and reported, but not in accordance with decisions 16/CMP.1 and 6/CMP.3 (see paras. 175–188 above).

194. Table 6 shows the accounting quantities for KP-LULUCF as reported by the Party and the final values after the review.

Table 6
Accounting quantities for activities under Article 3, paragraph 3, and, if any, activities under Article 3, paragraph 4, of the Kyoto Protocol, in t CO_2 eq

Activity	*Accounting quantity*	
	As reported	*Final*
Afforestation and reforestation	–230 091	47 875
Deforestation	23 297	23 297
Forest management	264 692	264 692
Article 3.3 offset[a]	0	71 172
Forest management cap	264 692	264 693
Cropland management	–618 231	–618 231
Grazing land management	–5 878	–5 878
Revegetation	NA	NA

Abbreviations: NA = not applicable.

[a] Article 3.3 offset: For the first commitment period, a Party included in Annex I 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 megatonnes of carbon times five, if the total 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.

195. Based on the information provided in table 6, Denmark shall issue 288,245 removal units in its national registry.

National registry

196. The ERT took note of the SIAR and its finding that the reported information on the national registry is complete and has been submitted in accordance with the annex to decision 15/CMP.1. The ERT further noted from the SIAR and its finding that the national registry continues to perform the functions set out in the annex to decision 13/CMP.1 and the annex to decision 5/CMP.1, and continues to adhere to the technical standards for data

exchange between registry systems in accordance with decisions 16/CP.10 and 12/CMP.1. The national registry also has adequate security, data safeguard and disaster recovery measures in place and its operational performance is adequate. However, the SIAR identified the following problem: two discrepancies have been identified by the transaction log relating to transactions initiated by the Party, namely response codes 4003 and 4010. These discrepancies have previously occurred for the Party. The final state of transactions with response codes 4003 or 4010 was "terminated". The ERT noted that discrepancies involving response codes 4003 and 4010 are due to a known limitation in the DES message model for external transfers. They are thus outside the influence of the Party.

197. The SIAR reiterated the recommendation of the previous ERT that Denmark should enhance, as detailed in section 4.2 of this SIAR, the availability of public information referred to in paragraph 44 of the annex to decision 13/CMP.1 and report, in its next annual submission, on any changes to that public information.

Calculation of the commitment period reserve

198. Denmark has reported its commitment period reserve in its 2010 annual submission. The Party reported that its commitment period reserve has not changed since the initial report review (249,155,060 t CO_2 eq), as it is based on the assigned amount and not the most recently reviewed inventory. The ERT agrees with this figure.

3. Changes to the national system

199. Denmark reported on changes to its national system since the previous annual submission. The Party described the changes to the national system since the previous annual submission in its NIR and these changes are discussed in section II.A of this report. The changes related to strengthening the legal basis for the functioning of the national system by the signing of a formal data delivery agreement between NERI and the Government of Greenland. 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

200. Denmark reported that there are no changes in its national registry since the previous annual submission. 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 CMP decisions.

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

201. Denmark has reported information on the minimization of adverse impacts in accordance with Article 3, paragraph 14, of the Kyoto Protocol, as requested in chapter I.H of the annex to decision 15/CMP.1, in its 2010 annual submission. The Party submitted this information on 15 April and resubmitted it on 27 May 2010.

202. The reported information is considered complete and transparent. During the review, the Party provided the ERT with additional information.

203. In accordance with the Kyoto Protocol, Denmark strives to implement its commitments under Article 3, paragraph 1, of the Protocol in such a way that adverse effects in other countries are minimized. However, Denmark does not consider that its contributions to international climate efforts have adverse effects in other countries as, on the contrary, the reduction in GHG emissions will contribute to limiting dangerous climate

change in all countries. In its international efforts, Denmark will continue to take the greatest possible account of the special needs and concerns of developing countries and especially the least developed countries. This also applies to adverse effects which can already be ascertained from changes in the climate. The existing strong Danish focus on the special vulnerability of developing countries to climate change underlines this approach.

III. Conclusions and recommendations

204. Denmark made its annual submission on 15 April 2010 and resubmitted it on 27 May 2010. 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.

205. 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 a complete set of CRF tables for the years 1990–2008 and an NIR; these are complete in terms of geographical coverage, years and sectors, and generally complete in terms of categories and gases. However, a number of carbon pools in the LULUCF sector were reported as not estimated (the carbon stock change of organic soils in cropland converted to forest land and the carbon stock change of mineral soils in grassland remaining grassland) and CRF table 7 was not filled in.

206. 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.

207. 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.

208. The Party's inventory is generally in line with the UNFCCC reporting guidelines, the Revised 1996 IPCC Guidelines and the IPCC good practice guidance but not fully in line with the IPCC good practice guidance for LULUCF (see para. 209 below).

209. The ERT identified that coverage of mandatory carbon pools in KP-LULUCF reporting of Denmark under Article 3, paragraphs 3 and 4, of the Kyoto Protocol is largely incomplete. The ERT recommends that Denmark improve the completeness of KP-LULUCF reporting and provide missing estimations or the evidence that the missing pools are not net sources. The ERT noted that inconsistencies between the estimates of carbon stock changes in living biomass, DOM and soils exist across all the KP-LULUCF and Convention CRF tables for the LULUCF sector.

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

211. The national registry continues to perform the functions set out in the annex to decision 13/CMP.1 and the annex to decision 5/CMP.1, and continues to adhere to the technical standards for data exchange between registry systems in accordance with relevant CMP decisions.

212. Denmark has reported the information requested in 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 2010 annual submission. The information was provided on 15

April 2010 and resubmitted as a part of the NIR on 27 May 2010. The reported information is complete and transparent.

213. In the course of the review, the ERT formulated a number of recommendations relating to the completeness of the annual submission, transparency and time-series consistencies. The key recommendations are that Denmark improve:

(a) The descriptions of methodologies that differ from those of the IPCC;

(b) The transparency of the description of models used in different sectors and EU ETS data;

(c) The implementation of a QA/QC management system consistently for Denmark, Greenland and the Faroe Islands;

(d) The uncertainty analysis, with correct distribution shapes and ranges of uncertainties;

(e) The consistency in land-area representation in LULUCF and the consistency in the reporting of the LULUCF sector under the Convention and KP-LULUCF reporting;

(f) Completeness, particularly in the agriculture and LULUCF sectors;

(g) Time-series consistencies, particularly in the energy and industrial processes sectors.

IV. Adjustments

214. The ERT concludes, based on the review of the 2008 inventory, that for afforestation and reforestation activities under Article 3, paragraph 3, of the Kyoto Protocol the methods, AD and EFs used are not fully in line with the IPCC good practice guidance for LULUCF as required by Article 5, paragraph 2 of the Kyoto Protocol. The ERT recommended that the Party submit revised estimates or provide further justifications for its calculations for the identified activities as a way of resolving the identified potential problems. Following the review of the additional information provided by Denmark during and after the in-country review, the ERT concluded that the Party did not satisfactorily correct the problem through the submission of acceptable revised estimates and the ERT decided to calculate and recommend two adjustments in accordance with the guidance for adjustments under Article 5, paragraph 2, of the Kyoto Protocol (decision 20/CMP.1).

215. Denmark, in its communication of 17 January 2011, accepted the calculated adjustments. In accordance with the guidelines for review under Article 8 of the Kyoto Protocol, the ERT applied the calculated adjustments.

216. The application of adjustments by the ERT resulted in a change in the estimate of the 2008 emissions/removals from afforestation and reforestation activities under Article 3, paragraph 3, of the Kyoto Protocol – from –230.09 Gg CO_2 eq, as originally reported by Denmark, to 47.88 Gg CO_2 eq or 120.8 per cent (non-soil pools: change from –232.53 to –178.45 Gg CO_2 eq or –23.3 per cent, soil pools: change from 2.44 to 226.3 Gg CO_2 eq or 9,161.3 per cent). This in turn resulted in a change in the estimated net emissions/removals from activities under Article 3, paragraphs 3 and 4, of the Kyoto Protocol of Denmark for 2008 – from 2,835.97 Gg CO_2 eq, as originally reported by Denmark, to 3,113.94 Gg CO_2 eq or 9.8 per cent.

V. Questions of implementation

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

Annex I

Documents and information used during the review

A. Reference documents

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

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

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

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

"Guidelines for the preparation of national communications by Parties included in Annex I to the Convention, Part I: UNFCCC reporting guidelines on annual inventories". FCCC/SBSTA/2006/9. Available at <http://unfccc.int/resource/docs/2006/sbsta/eng/09.pdf>.

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

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

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

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

Status report for Denmark 2010. Available at <http://unfccc.int/resource/docs/2008/asr/dnk.pdf>.

Synthesis and assessment report on the greenhouse gas inventories submitted in 2010. Available at <http://unfccc.int/resource/webdocs/sai/2010.pdf>.

FCCC/ARR/2009/DNK. Report of the individual review of the greenhouse gas inventory of Denmark submitted in 2009. Available at <http://unfccc.int/resource/docs/2009/arr/dnk.pdf>.

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Danish Energy Agency (DEA). 2009. *The Danish Energy Statistics*. Copenhagen. DEA. Available at

<http://www.ens.dk/graphics/UK_Facts_Figures/Statistics/yearly_statistics/2008/BasicData2008.xls>.

European Environment Agency (EEA). 2007. *EMEP/CORINAIR Atmospheric Emission Inventory Guidebook – 2007, Technical Report No 16/2007*. United Nations Economic Commission for Europe/European Monitoring and Evaluation Programme Task Force on Emissions Inventories and Projections. Copenhagen: EEA. Available at <http://www.eea.europa.eu/publications/EMEPCORINAIR5>.

EEA. 2009. *EMEP/EEA Air Pollutant Emission Inventory Guidebook 2009. Technical Guidance to Prepare National Emission Inventories. EEA Technical Report 9/2009*. Available at <http://www.eea.europa.eu/publications/emep-eea-emission-inventoryguidebook>.

European Commission. 2007. *Commission Decision of 18 July 2007 Establishing Guidelines for the Monitoring and Reporting of Greenhouse Gas Emissions Pursuant to Directive 2003/87/EC of the European Parliament and of the Council*. Brussels. The Commission of the European Communities. Available at <http://ec.europa.eu/environment/climat/emission/implementation_en.htm>.

Fott P. 1999. Carbon emission factors of coal and lignite: analysis of Czech coal data and comparison to European values. *Environmental Science and Policy*. 2: 347–354.

Mazumdar BK. 2000. Theoretical oxygen requirements for coal combustion: relationship with its calorific value. *Fuel*. 79: 1413–1419.

Mesroghli Sh, Jorjani E and Chehreh Chelgani S. 2009. Estimation of gross calorific value based on coal analysis using regression and artificial neural networks. *International Journal of Coal Geology*. 79: 49–54.

Nielsen M, Nielsen O-K and Thomsen M. 2010. *Emissions from Decentralised CHP Plants 2007 – Energinet.DK Environmental Project No. 07/1882. Project Report 5 – Emission Factors and Emission Inventory for Decentralised CHP Production.* Aarhus: National Environmental Research Institute.

B. Additional information provided by the Party

Responses to questions during the review were received from Mr. Ole-Kenneth Nielsen (Department of Policy Analysis, National Environmental Research Institute), including additional material on the methodologies and assumptions used. The following documents[1] were also provided by Denmark:

Poulsen, T.S., I. Bode, 2008. *The greenhouse gases HFCs, PFCs and SF_6 – Danish consumption and emissions*. PlanMiljø – Environmental Project No. 1323 2010 Miljøprojekt.

Statistical Yearbook of 2009 at <http://www.dst.dk/asp2xml/puk/udgivelser/get_file.asp?id=14468&sid=sy2009>.

The copy of the *Agreement with the Government of Greenland* was prepared on 28 September 2008 and signed on 2 February 2009.

[1] Reproduced as received from the Party.

Annex II

Acronyms and abbreviations

AD	activity data
CH_4	methane
CHP	combined heat and power
CO_2 eq	carbon dioxide equivalent
CO_2	carbon dioxide
CRF	common reporting format
DOM	dead organic matter
EF	emission factor
ERT	expert review team
EU ETS	European Union emissions trading scheme
EU	European Union
F-gas	fluorinated gas
FOD	first order decay
FOM	fresh organic matter
GE	gross energy
GHG	greenhouse gas; unless indicated otherwise, GHG emissions are the sum of CO_2, CH_4, N_2O, HFCs,PFCs and SF_6 without GHG emissions and removals from LULUCF
GJ	gigajoule (1 GJ = 109 joule)
HFCs	hydrofluorocarbons
HUM	humified organic matter
IE	included elsewhere
IEA	International Energy Agency
IEF	implied emission factor
IPCC	Intergovernmental Panel on Climate Change
ITL	international transaction log
kg	kilogram (1 kg = 1,000 grams)
LULUCF	land use, land-use change and forestry
m^3	cubic metre
MSW	municipal solid waste
N_2O	nitrous oxide
NA	not applicable
NCV	net calorific value
NE	not estimated
NIR	national inventory report
NO	not occurring
PFCs	perfluorocarbons
QA/QC	quality assurance/quality control
ROM	resilient organic matter
SEF	standard electronic format
SF_6	sulphur hexafluoride
SIAR	standard independent assessment report
TJ	terajoule (1 TJ = 10^{12} joule)
UNFCCC	United Nations Framework Convention on Climate Change
VS	volatile solids