



**Report of the individual review of the annual submission of
Denmark submitted in 2012**

Note by the secretariat

The report of the individual review of the annual submission of Denmark submitted in 2012 was published on 2 August 2013. For purposes of rule 10, paragraph 2, of the rules of procedure of the Compliance Committee (annex to decision 4/CMP.2, as amended by decision 4/CMP.4), the report is considered received by the secretariat on the same date. This report, FCCC/ARR/2012/DNK, contained in the annex to this note, is being forwarded to the Compliance Committee in accordance with section VI, paragraph 3, of the annex to decision 27/CMP.1.



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* In the symbol for this document, 2012 refers to the year in which the inventory was submitted, and not to the year of publication.

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I. Introduction and summary

1. This report covers the centralized review of the 2012 annual submission of Denmark, coordinated by the UNFCCC secretariat, in accordance with decision 22/CMP.1. The review took place from 3 to 8 September 2012 in Bonn, Germany, and was conducted by the following team of nominated experts from the UNFCCC roster of experts: generalist – Mr. Mario Contaldi (Italy); energy – Mr. Graham Anderson (Australia), Mr. Kaleem Anwar Mir (Pakistan) and Mr. Jongikhaya Witi (South Africa); industrial processes – Ms. Siriluk Chiarakorn (Thailand), Mr. Eilev Gjerald (Norway) and Mr. Samir Tantawi Al-Sayed (Egypt); agriculture – Mr. Amnat Chidthaisong (Thailand) and Ms. Olga Gavrilova (Estonia); land use, land-use change and forestry (LULUCF) – Mr. Lucio Santos (Colombia) and Mr. Nalin Srivastava (India); and waste – Ms. Hlobsile Patricia Sikhosana (Swaziland) and Ms. Masako White (Japan). Mr. Contaldi and Mr. Witi were the lead reviewers. The review was coordinated by Mr. Stylianos Pesmajoglou (UNFCCC secretariat).

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

3. In 2010, the main greenhouse gas (GHG) in Denmark was carbon dioxide (CO₂), accounting for 80.1 per cent of total GHG emissions² expressed in carbon dioxide equivalent (CO₂ eq), followed by nitrous oxide (N₂O) (9.6 per cent) and methane (CH₄) (9.0 per cent). Hydrofluorocarbons (HFCs), perfluorocarbons (PFCs) and sulphur hexafluoride (SF₆) collectively accounted for 1.4 per cent of the overall GHG emissions in the country. The energy sector accounted for 80.1 per cent of total GHG emissions, followed by the agriculture sector (15.4 per cent), the industrial processes sector (2.7 per cent), the waste sector (1.6 per cent) and the solvent and other product use sector (0.1 per cent). Total GHG emissions amounted to 61,780.80 Gg CO₂ eq and decreased by 11.2 per cent between the base year³ and 2010.

4. Tables 1 and 2 show GHG emissions from Annex A sources, emissions and removals from the LULUCF sector under the Convention and emissions and removals from activities under Article 3, paragraph 3, and, if any, Article 3, paragraph 4, of the Kyoto Protocol (KP-LULUCF), by gas and by sector and activity, respectively. In table 1, CO₂, CH₄ and N₂O emissions included in the rows under Annex A sources do not include emissions and removals from the LULUCF sector.

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

¹ The 2012 annual report of Denmark was published after the submission of the 2013 annual submission.

² In this report, the term “total GHG emissions” refers to the aggregated national GHG emissions expressed in terms of CO₂ eq excluding LULUCF, unless otherwise specified.

³ “Base year” refers to the base year under the Kyoto Protocol, which is 1990 for CO₂, CH₄ and N₂O, and 1995 for HFCs, PFCs and SF₆. The base year emissions include emissions from Annex A sources only.

Table 1
Greenhouse gas emissions from Annex A sources and emissions/removals from activities under Article 3, paragraphs 3 and 4, of the Kyoto Protocol, by gas, base year to 2010^a

	Greenhouse gas	Base year ^a	Gg CO ₂ eq							Change Base year–2010 (%)
			1990	1995	2000	2005	2008	2009	2010	
Annex A sources	CO ₂	53 433.72	53 433.72	440.57	54 334.32	51 650.34	51 399.65	48 959.09	49 462.74	–7.4
	CH ₄	6 054.31	6 054.31	6 137.07	5 879.43	5 649.17	5 623.73	5 527.86	5 546.65	–8.4
	N ₂ O	9 730.88	9 730.88	8 713.81	7 895.42	6 279.96	6 346.44	5 969.54	5 913.23	–39.2
	HFCs	217.75	NA, NE, NO	217.75	608.61	807.81	859.25	805.41	807.02	270.6
	PFCs	0.50	NA, NE, NO	0.50	17.89	13.90	12.79	14.18	13.27	2 542.1
	SF ₆	107.37	44.45	107.37	58.78	21.33	31.19	36.28	37.88	–64.7
KP-LULUCF	Article 3.3 ^b	CO ₂					–274.11	–502.86	40.43	
		CH ₄					NO	NO	NO	
		N ₂ O					0.61	0.00	0.00	
	Article 3.4 ^c	CO ₂	4 855.70				3 050.17	–398.42	–2 231.90	–146.0
		CH ₄	0.00				0.01	0.01	0.01	663.8
		N ₂ O	0.00				12.23	12.05	12.05	542 416.4

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 CO₂, CH₄ and N₂O, and 1995 for HFCs, PFCs and SF₆. The “base year” for activities under Article 3, paragraphs 3 and 4, of the Kyoto Protocol is 1990.

^b Activities under Article 3, paragraph 3, of the Kyoto Protocol, namely afforestation and reforestation, and deforestation. Only the inventory years of the commitment period must be reported.

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

Table 2
Greenhouse gas emissions by sector and activity, base year^a to 2010

		<i>Gg CO₂eq</i>								<i>Change</i>
		<i>Base year^a</i>	<i>1990</i>	<i>1995</i>	<i>2000</i>	<i>2005</i>	<i>2008</i>	<i>2009</i>	<i>2010</i>	<i>Base year–2010 (%)</i>
<i>Sector</i>										
Annex A	Energy	52 723.95	52 723.95	60 715.45	53 530.20	50 939.86	50 891.46	48 828.66	49 466.62	–6.2
	Industrial processes	2 520.69	2 239.52	2 726.81	3 389.83	2 447.39	2 262.76	1 772.05	1 691.29	–32.9
	Solvent and other product use	93.62	93.62	109.54	102.54	88.07	78.18	82.70	76.62	–18.1
	Agriculture	12 470.93	12 470.93	11 523.15	10 402.78	9 792.60	9 894.80	9 548.99	9 529.10	–23.6
	Waste	1 735.36	1 735.36	1 542.12	1 369.09	1 154.60	1 145.85	1 079.94	1 017.16	–41.4
	LULUCF	NA	4 423.51	3 413.87	5 894.42	4 637.14	2 789.03	–876.25	–2 169.29	NA
	Total (with LULUCF)	NA	73 686.88	80 030.94	74 688.87	69 059.65	67 062.08	60 436.11	59 611.51	NA
Total (without LULUCF)	69 544.54	69 263.37	76 617.07	68 794.45	64 422.51	64 273.05	61 312.35	61 780.80	–11.2	
Other ^b		NA	NA	NA	NA	NA	NA	NA	NA	NA
KP-LULUCF	Article 3.3 ^c	Afforestation and reforestation					–313.57	–542.06	0.37	
		Deforestation					39.47	39.82	40.69	
		Total (3.3)					–274.10	–502.24	41.05	
	Article 3.4 ^d	Forest management					–691.66	–3 048.44	–5 677.31	
		Cropland management	4 650.44				3 577.87	2 488.53	3 284.59	–29.4
		Grazing land management	205.26				176.20	173.55	172.88	–15.8
		Revegetation	NA				NA	NA	NA	NA
		Total (3.4)	4 855.70	4 855.70				3 062.41	–386.36	–2 219.84

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

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

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

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

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

Table 3
Information to be included in the compilation and accounting database in t CO₂ eq for the year 2010, including the commitment period reserve

	<i>As reported</i>	<i>Revised estimates</i>	<i>Adjustment^a</i>	<i>Final^b</i>
Commitment period reserve	249 155 060			249 155 060
Annex A emissions for current inventory year				
CO ₂	49 462 745			49 462 745
CH ₄	5 546 653			5 546 653
N ₂ O	5 913 231			5 913 231
HFCs	807 016			807 016
PFCs	13 270			13 270
SF ₆	37 882			37 882
Total Annex A sources	61 780 797			61 780 797
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	367			367
3.3 Afforestation and reforestation on harvested land for current year of commitment period as reported	IE, NA, NO			IE, NA, NO
3.3 Deforestation for current year of commitment period as reported	40 687			40 687
Activities under Article 3, paragraph 4, for current inventory year^c				
3.4 Forest management for current year of commitment period	-5 677 311			-5 677 311
3.4 Cropland management for current year of commitment period	3 284 590			3 284 590
3.4 Cropland management for base year	4 650 443			4 650 443
3.4 Grazing land management for current year of commitment period	172 884			172 884
3.4 Grazing land management for base year	205 261			205 261
3.4 Revegetation for current year of commitment period				
3.4 Revegetation in base year				

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

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

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

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

Table 4

Information to be included in the compilation and accounting database in t CO₂ eq for the year 2009

	<i>As reported</i>	<i>Revised estimates</i>	<i>Adjustment^a</i>	<i>Final^b</i>
Annex A emissions for 2009				
CO ₂	48 959 086			48 959 086
CH ₄	5 527 865			5 527 865
N ₂ O	5 969 538			5 969 538
HFCs	805 408			805 408
PFCs	14 177			14 177
SF ₆	36 277			36 277
Total Annex A sources	61 312 351			61 312 351
Activities under Article 3, paragraph 3, for 2009				
3.3 Afforestation and reforestation on non-harvested land for 2009 as reported	-542 058			-542 058
3.3 Afforestation and reforestation on harvested land for 2009 as reported	IE, NA, NO			IE, NA, NO
3.3 Deforestation for 2009 as reported	39 821			39 821
Activities under Article 3, paragraph 4, for 2009^c				
3.4 Forest management for 2009	-3 048 441			-3 048 441
3.4 Cropland management for 2009	2 488 528			2 488 528
3.4 Cropland management for base year	4 650 443			4 650 443
3.4 Grazing land management for 2009	173 552			173 552
3.4 Grazing land management for base year	205 261			205 261
3.4 Revegetation for 2009				
3.4 Revegetation in base year				

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

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

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

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

Table 5
**Information to be included in the compilation and accounting database in t CO₂ eq for
the year 2008**

	<i>As reported</i>	<i>Revised estimates</i>	<i>Adjustment^a</i>	<i>Final^b</i>
Annex A emissions for 2008				
CO ₂	51 399 653			51 399 653
CH ₄	5 623 729			5 623 729
N ₂ O	6 346 444			6 346 444
HFCs	859 246			859 246
PFCs	12 791			12 791
SF ₆	31 186			31 186
Total Annex A sources	64 273 049			64 273 049
Activities under Article 3, paragraph 3, for 2008				
3.3 Afforestation and reforestation on non-harvested land for 2008 as reported	-313 570			-313 570
3.3 Afforestation and reforestation on harvested land for 2008 as reported	IE, NA, NO			IE, NA, NO
3.3 Deforestation for 2008 as reported	39 473			39 473
Activities under Article 3, paragraph 4, for 2008^c				
3.4 Forest management for 2008	-691 663			-691 663
3.4 Cropland management for 2008	3 577 872			3 577 872
3.4 Cropland management for base year	4 650 443			4 650 443
3.4 Grazing land management for 2008	176 201			176 201
3.4 Grazing land management for base year	205 261			205 261
3.4 Revegetation for 2008				
3.4 Revegetation in base year				

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

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

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

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

II. Technical assessment of the annual submission

A. Overview

1. Annual submission and other sources of information

6. The 2012 annual inventory submission was submitted on 13 April 2012; it contains a complete set of common reporting format (CRF) tables for the period 1990–2010 and a national inventory report (NIR). Denmark officially submitted revised emission estimates on 2 May 2012. The Party also submitted information required under Article 7, paragraph 1, of the Kyoto Protocol, including information on: activities under Article 3, paragraphs 3 and 4, of the Kyoto Protocol, accounting of Kyoto Protocol units, changes in the national system and in the national registry, and the minimization of adverse impacts in accordance with Article 3, paragraph 14, of the Kyoto Protocol. The standard electronic format (SEF) tables were submitted on 14 April 2012. The annual submission was submitted in accordance with decision 15/CMP.1.

7. The expert review team (ERT) also used the 2011 and 2010 annual submissions during the review. In addition, the ERT used the standard independent assessment report (SIAR), parts I and II, to review information on the accounting of Kyoto Protocol units (including the SEF tables and their comparison report) and on the national registry.⁴

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

Completeness of inventory

9. The inventory covers all source and sink categories for the period 1990–2010 and is complete in terms of years and geographical coverage. Owing to the national circumstances of Denmark, separate sets of CRF tables are available within the submission for Denmark (as part of the annual submission compiled for the European Union (EU)), for Denmark and Greenland (for the reporting under the Kyoto Protocol), as well as for Denmark, Greenland and the Faroe Islands (for the reporting under the Convention).

10. The set of CRF tables submitted by Denmark for the reporting under the Kyoto Protocol is almost complete, with the exception of CRF table 8(b), which was not fully completed and did not clearly reference the NIR with respect to the recalculations performed by the Party. The CRF tables were therefore not completed in accordance 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). In response to a question raised by the ERT during the review, the Party explained that CRF table 8(b) is available for Denmark, but that the explanatory information on the recalculations was not copied to the aggregated submission of Denmark and Greenland (for the reporting under the Kyoto Protocol). However, the Party explained that detailed information on the recalculations is provided in chapters 10, 16 and 17 of the NIR, as well as in the sector chapters. The ERT

⁴ The SIAR, parts I and II, is prepared by an independent assessor in line with decision 16/CP.10 (paras. 5(a), and 6(c) and (k)), under the auspices of the international transaction log administrator using procedures agreed in the Registry System Administrators Forum. Part I is a completeness check of the submitted information relating to the accounting of Kyoto Protocol units (including the SEF tables and their comparison report) and to national registries. Part II contains a substantive assessment of the submitted information and identifies any potential problem regarding information on the accounting of Kyoto Protocol units and the national registry.

recommends that Denmark provide a complete set of CRF tables in its next annual submission, including complete information in CRF table 8(b), in accordance with the requirements of the UNFCCC reporting guidelines.

11. The ERT commends Denmark for including all of the required information in CRF table 7 in the 2012 annual submission, in response to a recommendation in the previous review report.

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

Overview

12. The ERT concluded that the national system continues to perform its required functions.

13. The Party described the changes to the national system since the previous annual submission. These changes are discussed in chapter II.G of this report.

Inventory planning

14. The NIR describes the structure of the national system for the preparation of the inventory. The Danish Energy Agency, on behalf of the Ministry of Climate and Energy, has overall responsibility for the approval of the national inventory, while the Department of Environmental Science (ENVS), on behalf of the Ministry of the Environment and the Ministry of Climate and Energy, is responsible for data collection, the calculation and preparation of the national emissions inventory for Denmark and the compilation of the inventory submission under the Kyoto Protocol for Greenland and Denmark. ENVS has taken on the functions of the former National Environmental Research Institute (NERI) and is also the entity designated with overall responsibility for the national inventory under the Kyoto Protocol for Greenland and Denmark.

15. Following the recommendation in the previous review report, Denmark has described in detail the other agencies and organizations involved in the preparation of the inventory and their legal status. The list includes major providers of activity data (AD), such as: the Danish Energy Agency; the Danish Environmental Protection Agency; the Danish Nature Agency; Statistics Denmark; the Faculty of Agricultural Sciences of Aarhus University; the Danish Road Directorate; the Danish Centre for Forest, Landscape and Planning of Copenhagen University; the Civil Aviation Agency of Denmark; and the Danish State Railway. The Danish Centre for Forest, Landscape and Planning is responsible for the preparation of the reporting of the KP-LULUCF activities.

16. The Government of Greenland has overall responsibility for the preparation of the GHG inventory of Greenland. In particular, Statistics Greenland is responsible for completing the CRF tables for Greenland and for documenting the inventory preparation process.

Inventory preparation

Key categories

17. Denmark has reported a key category tier 1 analysis, both level and trend assessment, as part of its 2012 annual submission. The key category analysis performed by the Party and that performed by the secretariat produced similar results. The differences are due to the Party's use of a more detailed disaggregation of the categories for some sectors (e.g. in the agriculture and LULUCF sectors), which led to slightly different results in the

overall identification of the key categories. Denmark has included the LULUCF sector in its key category analysis, which was performed in accordance with the Intergovernmental Panel on Climate Change (IPCC) *Good Practice Guidance and Uncertainty Management in National Greenhouse Gas Inventories* (hereinafter referred to as the IPCC good practice guidance) and the IPCC *Good Practice Guidance for Land Use, Land-Use Change and Forestry* (hereinafter referred to as the IPCC good practice guidance for LULUCF).

18. According to the information provided in the NIR, a tier 2 key category analysis including and excluding LULUCF, both level and trend assessment, has been provided for mainland Denmark only, while a tier 1 key category analysis including and excluding LULUCF, both level and trend assessment, has been provided for Greenland. The ERT noted that Denmark states in the NIR (chapter 1.6) that the key category analysis is used to prioritize future inventory improvement plans. The ERT encourages the Party to make efforts to conduct a tier 2 key category analysis for the aggregated inventory of Denmark and Greenland for future annual submissions.

19. Denmark has identified CO₂ emissions from afforestation and reforestation under Article 3, paragraph 3, of the Kyoto Protocol and forest management, cropland management and grazing land management under Article 3, paragraph 4, of the Kyoto Protocol as key categories both for the level and for the trend assessment for 2010. The results of the analysis are presented both in KP-LULUCF CRF table NIR-3 and in the NIR.

Uncertainties

20. Denmark has prepared a tier 1 uncertainty analysis for the aggregated inventory of Denmark and Greenland in accordance with the IPCC good practice guidance. The uncertainty estimates cover all source and sink categories, including the LULUCF sector. The uncertainty estimates for the AD and emission factors (EFs) are based on: country-specific information, including empirical data; default values from the *Revised 1996 IPCC Guidelines for National Greenhouse Gas Inventories* (hereinafter referred to as the Revised 1996 IPCC Guidelines), the IPCC good practice guidance and the *2006 IPCC Guidelines for National Greenhouse Gas Inventories* (hereinafter referred to as the 2006 IPCC Guidelines); and expert judgement.

21. The cumulative uncertainty of the total estimated GHG emissions for 2010 is 6.8 per cent and the trend uncertainty is 19.8 per cent; the major contributors to the overall uncertainty are categories in the agriculture, LULUCF and waste sectors. The total uncertainty excluding LULUCF for 2010 is 4.8 per cent and the trend uncertainty is 11.4 per cent.

22. Additionally, in response to a recommendation in the previous review report, Denmark has provided an updated tier 2 uncertainty analysis that excludes the LULUCF sector. However, the analysis is for Denmark only (i.e. excluding Greenland). The cumulative uncertainty of the net total estimated GHG emissions for 2010 is 5.4 per cent and the trend uncertainty is 11.1 per cent. The ERT commends Denmark for having implemented a higher-tier method for the uncertainty analysis.

Recalculations and time-series consistency

23. Recalculations have been performed and reported in accordance with the IPCC good practice guidance. The ERT noted that the recalculations reported by the Party of the time series 1990–2009 have been undertaken to take into account changes in the CO₂ EF for the subcategory “other fuels” under energy industries and the revised EF for combustion of straw and wood; the use of an improved methodology for manufacturing industries; an update of the AD for transport (the mileage of vehicles and the distribution of engine sizes in agriculture/forestry/fisheries); and the recalculation of the AD for fugitive emissions

from refineries. The impact of the recalculations is an increase in estimated total GHG emissions in the base year (0.8 per cent) and a decrease in 2009 (0.5 per cent). The rationale for the recalculations is provided in the NIR for each sector; however, the corresponding information has not been reported in CRF table 8(b) (see para. 10 above).

Verification and quality assurance/quality control approaches

24. Denmark has provided information on its quality assurance/quality control (QA/QC) procedures in the NIR, in line with the UNFCCC reporting guidelines. The QA/QC plan is in accordance with decision 19/CMP.1 and the IPCC good practice guidance, and is applied to the inventories of both Denmark and Greenland. According to the NIR, an updated version of the QA/QC manual is currently being elaborated and will be published by the end of 2012. The ERT welcomes the planned update and encourages Denmark to describe the changes in the QA/QC manual in the next annual submission.

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

Transparency

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

27. The ERT noted some improvements in the 2012 annual submission compared to the previous annual submission, such as the inclusion of more explanatory information in the general parts of the NIR (e.g. on the use of EU ETS data, the key category analysis, the tier 2 level uncertainty analysis, the recalculations and the aggregated GHG inventory), and in the sector chapters of the NIR (e.g. on the analysis of the CO₂ EF for coal based on the net calorific values (NCVs) used and the development and implementation of tier 2 country-specific methodologies to estimate emissions for most livestock categories).

Inventory management

28. Denmark has a centralized archiving system, which includes the archiving of disaggregated EFs and AD, and documentation on how these factors and data have been generated and aggregated for the preparation of the inventory. The archived information also includes internal documentation on QA/QC procedures, external and internal reviews, and documentation on annual key categories and key category identification and planned inventory improvements. The archive is maintained by ENVIS, which provided the ERT with the requested additional archived information in a timely manner during the review.

3. Follow-up to previous reviews

29. The NIR includes detailed information on the follow-up to the recommendations in the 2010 and 2011 annual review reports in the sector chapters and also in a dedicated section of the NIR (chapter 10.4) that summarizes all the recommendations and relevant actions taken by the Party. Denmark underlines the fact that, as the draft annual review

report for the review of the 2011 annual submission was available on 9 February 2012 only, the recommendations contained therein have been included in the 2012 annual submission to the extent possible. The ERT commends the Party for this very transparent reporting of the follow-up to previous recommendations.

30. The ERT concluded that most of the recommendations from the previous review report have been implemented by the Party; however, the implementation of some of the recommendations is ongoing (e.g. the provision of information on imports and exports of cement for the years 1990–1997; the inclusion of a description of the use of biogas and the associated energy output; the correction of the milk yield provided in CRF table 4.A to 22.50 kg/day; the improvement of the QA/QC processes for the LULUCF sector; and the reporting of the inventory improvements in the NIR).

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

31. During the review, the ERT identified a number of areas for improvement. These are listed in table 7 below.

32. Recommended improvements relating to specific categories are presented in the relevant sector chapters of this report and in table 7 below.

B. Energy

1. Sector overview

33. The energy sector is the main sector in the GHG inventory of Denmark. In 2010, emissions from the energy sector amounted to 49,466.62 Gg CO₂ eq, or 80.1 per cent of total GHG emissions. Since 1990, emissions have decreased by 6.2 per cent. The key drivers for the fall in emissions are the decrease in emissions from energy industries (–9.5 per cent), from other sectors (–40.0 per cent) and from manufacturing industries and construction (–21.8 per cent). Within the sector, 48.8 per cent of the emissions were from energy industries, followed by 27.0 per cent from transport, 13.9 per cent from other sectors and 9.1 per cent from manufacturing industries and construction. Fugitive emissions from oil and natural gas accounted for 0.9 per cent and other (energy) accounted for 0.2 per cent. Fugitive emissions from solid fuels are reported as not occurring (“NO”).

34. Denmark has made recalculations for the energy sector between the 2011 and 2012 annual submissions following changes in AD and EFs. The impact of these recalculations on the energy sector is a decrease in estimated GHG emissions of 0.1 per cent for 2009. The main recalculations took place in the following categories:

(a) CO₂, CH₄ and N₂O emissions from energy industries: emissions from other fuels under public electricity and heat production have increased as a result of the use of a revised CO₂ EF for fossil waste incineration. The recalculations have resulted in an increase in emissions of 126.99 Gg CO₂ eq, or 0.5 per cent, for 2009;

(b) CO₂, CH₄ and N₂O emissions from manufacturing industries and construction: based on a new improved methodology, significant changes have been made to the estimates of CO₂ emissions from liquid fuels and gaseous fuels under this category, resulting in an increase in emissions of 68.78 Gg CO₂ eq, or 1.7 per cent, for 2009;

(c) CO₂, CH₄ and N₂O emissions from transport: the use of revised data for the total mileage per vehicle under road transportation has resulted in an increase in emissions of 38.68 Gg CO₂ eq, or 0.3 per cent, for 2009.

35. The CRF tables and the NIR are complete. Notation keys have been used throughout the CRF tables. The ERT commends Denmark for reporting GHG emission estimates for

all categories for which the Revised 1996 IPCC Guidelines and the IPCC good practice guidance provide methodologies and EFs for the estimation of emissions.

36. The sector-specific QA/QC measures are very well described in the NIR and are in line with the UNFCCC reporting guidelines. The tier 1 uncertainty analysis has been performed in accordance with the IPCC good practice guidance for the aggregated inventory of Denmark and Greenland. A tier 2 uncertainty analysis has also been performed, but for Denmark only. The ERT commends Denmark for implementing a higher-tier method for the uncertainty analysis and encourages the Party to implement a tier 2 uncertainty analysis for the aggregated inventory of Denmark and Greenland as well.

2. Reference and sectoral approaches

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

37. For 2010, the fuel consumption estimated using the reference approach was 0.7 per cent higher than the fuel consumption estimated using the sectoral approach, and the CO₂ emissions were 0.8 per cent higher. For the period 1990–2010, both the fuel consumption and the CO₂ emissions differ by less than 2.0 per cent. The differences are below 1.0 per cent for all years of the time series except for 1998, 2000 and 2001, due to large statistical differences in the Danish energy statistics for these years for liquid fuels. In the 2011 annual submission, the difference in energy consumption between the two approaches was 1.9 per cent for 2009. However, the improvements made to the Danish energy statistics have resulted in a lower statistical difference and have led to a lower difference between the reference approach and the sectoral approach for 2009 in the 2012 annual submission (0.9 per cent). The ERT commends Denmark for including information in its NIR on the results of the efforts made to lower the statistical difference for 2009.

38. The ERT noted that there are discrepancies between the data reported in the CRF tables and the data provided by the International Energy Agency (IEA) as a result of the incorporation of the emissions of Greenland in the emission estimates for mainland Denmark. This is due to the fact that the emissions from aviation and navigation resulting from movements between Greenland and mainland Denmark are considered as international by IEA, but as domestic in the CRF tables. The ERT encourages the Party to provide clear explanations of the reasons for these discrepancies in its NIR to improve transparency.

International bunker fuels

39. The ERT found that CRF table 10 contained information on large inter-annual fluctuations in the CO₂ emission estimates for international bunkers between the years 2008 (5,626.86 Gg CO₂), 2009 (3,938.22 Gg CO₂) and 2010 (4,712.05 Gg CO₂). In response to a question raised by the ERT during the review, Denmark clarified that the emissions trend is directly related to the fuel sale statistics for international navigation and aviation compiled by the Danish Energy Agency. The inter-annual emission fluctuations between 2008, 2009 and 2010 are predominantly due to the fuel sold for international navigation, since fuel sales for international aviation fluctuate less. Further, Denmark indicated that the documentation on fuel sale statistics for international navigation and aviation will be improved in the NIR of the next annual submission. The ERT recommends that the Party improve this documentation in its next annual submission.

40. The ERT noted an error in the data on fuel quantities. The international bunker fuel consumption data for lubricants have not been included in CRF table 1.C; these data should be equal to the data in CRF table 1.A(b) (100.56 TJ). The ERT recommends that Denmark correct this error and improve its QC procedures to prevent this type of error from occurring, in its next annual submission.

Feedstocks and non-energy use of fuels

41. In CRF table 1.A(d), Denmark reports that three fuels are used for non-energy purposes: lubricants, bitumen and white spirit. The total consumption for non-energy purposes is relatively low – 11.13 PJ for 2010. Following a recommendation in the previous review report, the Party has included an explanation in the NIR (chapter 3.4.1) for the CO₂ emissions from bitumen, lubricants and white spirit used under the categories mineral products, other industrial processes, and solvent and other product use. In addition, the ERT noted that Denmark plans to improve the data collection procedures for these fuels in the near future. The ERT encourages the Party to implement this improvement and to include, in CRF table 1.A(d) of its next annual submission, a reference to the specific section of the NIR where the explanations are provided, in order to improve transparency.

42. The ERT noted that Denmark has used the notation key “IE” (included elsewhere) to report CO₂ emissions from white spirit but has not specified where those emissions are reported. In response to a question raised by the ERT during the review, the Party indicated that the notation key “IE” used to report the associated CO₂ emissions from white spirit in CRF table 1.A(d) is not correct. The Party confirmed that a reference to CRF table 3.A-D will be included in the NIR of its next annual submission. The ERT recommends that Denmark include the reference in the next annual submission, in order to improve transparency.

43. The ERT noted that the carbon storage factor used by the Party (1.00) differs from the IPCC default value (0.50). In response to a question raised by the ERT during the review, Denmark clarified that the reason for using a carbon storage factor of 1.00 is that no lubricants are included in the sectoral approach for fuel combustion. To ensure that the comparison between the reference and sectoral approaches is correct, all the carbon was excluded. The ERT noted that not all carbon in lubricants is stored, as some of it will be oxidized during use. While there is no specific guidance in the Revised 1996 IPCC Guidelines or the IPCC good practice guidance on estimating emissions from the use of lubricants, Denmark has estimated the emissions using the general methodology provided in the 2006 IPCC Guidelines and has included the emissions under the category other (industrial processes). The calculation is documented in chapter 4.8 of the NIR. The ERT notes the clarification made by Denmark and recommends that the Party document and justify why it uses a carbon storage factor of 1.00, in its next annual submission.

3. Key categories

Stationary combustion: solid and liquid fuels – CO₂

44. As described in the 2011 annual submission, Denmark has performed an analysis of the CO₂ EF for coal based on the NCVs used, with the aim of obtaining an improved time series of EFs. However, the analysis did not result in any significant correlation between the NCVs and the CO₂ EF (94.6 kg/GJ). In response to a question raised by the ERT during the review on the possible extension of this analysis to other fuels, Denmark explained that it had attempted to perform the same analysis for fuel oil based on EU ETS data for 2011 but that it was not possible to estimate the time series of the CO₂ EF based on the time series of the NCV of fuel oil. Denmark indicated that these findings will be included in the 2013 NIR. The ERT commends Denmark for its efforts, recommends that the Party reflect the results of this analysis in the NIR of its next annual submission, and encourages it to implement further improvements, as appropriate.

Road transportation: liquid fuels – CO₂, CH₄ and N₂O

45. Following an encouragement in the previous review report regarding the inclusion of brief descriptions of the methods used to obtain the fleet and mileage data necessary for

the COPERT IV model in the 2012 NIR, Denmark explained during the review that, due to limited resources, it had not been possible to include this information in the 2012 annual submission. The Party has noted the encouragement of the ERT and will consider including this information in the NIR when resources become available in the future. The ERT recommends that Denmark include the information in its next annual submission.

4. Non-key categories

Stationary combustion: liquid fuels – N₂O

46. In response to a recommendation in the previous review report regarding the N₂O EFs for liquid fuels used in manufacturing industries and construction, Denmark has provided the rationale for changing the EF from the value provided in the *EMEP/CORINAIR Emission Inventory Guidebook 2007*⁵ (3.05 kg/TJ) to the default values from the Revised 1996 IPCC Guidelines (0.6 kg/TJ). Denmark explained that it prefers to use the IPCC default EFs for all categories for which no country-specific values are available. Further, the *EMEP/CORINAIR Emission Inventory Guidebook* was revised in 2009 and no longer contains any guidance on GHGs; therefore, the EFs contained therein will never be updated and, as such, can be considered obsolete. The ERT commends Denmark for providing this clarification.

Manufacture of solid fuels and other energy industries: – gaseous fuels – N₂O

47. The ERT noted a decreasing trend in the time series of the N₂O EF between 1990 (2.2 g/GJ) and 2010 (1.0 g/GJ) (a decrease of 55 per cent). In response to a question raised by the ERT during the review, Denmark indicated that the N₂O EF for the refinery gas fuelled gas turbines has been assumed to be equal to that for natural gas-fuelled gas turbines. The Party informed the ERT that as there is no evidence to suggest that off-shore gas turbines have different emission characteristics for N₂O compared to on-shore natural gas turbines, the EF is considered applicable. The EF for these turbines has therefore been assumed to follow the time series for natural gas fuelled gas turbines in Danish CHP plants. The ERT welcomes this explanation and encourages Denmark to include this information in its next annual submission.

Aviation: liquid fuels – CO₂, CH₄ and N₂O

48. The ERT noted that the CH₄ implied emission factor (IEF) for jet kerosene used in civil aviation has decreased by 66.8 per cent in the 2012 annual submission from 3.11 kg/TJ for 2009 to 1.03 kg/TJ for 2010, while in the 2011 annual submission, the CH₄ IEF had increased by 100.5 per cent from 1.55 kg/TJ for 2008 to 3.11 kg/TJ for 2009. Denmark explained that the reason for this fluctuation was the increase in the number of flights using the representative aircraft type Fokker 28 for 2009, which was subsequently found to be not appropriate as it is an older aircraft type and no longer in use. The Party is planning to select an alternative aircraft type, which would better represent the actual level of emissions. Denmark indicated that its next NIR will include information on the number of domestic landings and take-offs (LTOs) per representative aircraft type for each of the Danish airports, including flights between Denmark and Greenland/the Faroe Islands. The Party stated that it will also provide information on the average LTO fuel consumption and EFs per representative aircraft type, together with a correspondence table between actual aircraft and representative aircraft. The ERT commends Denmark for its efforts and recommends that the Party include this information in its next annual submission, in order to improve transparency.

⁵ European Environment Agency. 2007.

C. Industrial processes and solvent and other product use

1. Sector overview

49. In 2010, emissions from the industrial processes sector amounted to 1,691.29 Gg CO₂ eq, or 2.7 per cent of total GHG emissions, and emissions from the solvent and other product use sector amounted to 76.62 Gg CO₂ eq, or 0.1 per cent of total GHG emissions. Since the base year, emissions have decreased by 32.9 per cent in the industrial processes sector, and decreased by 18.1 per cent in the solvent and other product use sector. The key driver for the fall in emissions in the industrial processes sector is the reduction in emissions from chemical industry, due to the closure of the nitric acid production plant in Denmark in 2004. At the peak of its production in 1990, the emissions from nitric acid production contributed 46.6 per cent of total emissions from the industrial processes sector. From 1990 to 2010, the CO₂ emissions from the production of catalysts/fertilizers increased from 0.80 kt to 2.12 kt, due to an increase in the activity and changes in raw material consumption. Since 2007, cement production has decreased significantly, due to the decrease in construction activity in Denmark. The CO₂ emissions from cement production dropped from 1,458.93 Gg CO₂ eq in 2004 (the peak year) to 672.22 Gg CO₂ eq in 2010, representing a 53.9 per cent reduction. The CO₂ emissions from iron and steel production decreased from 28.45 Gg CO₂ eq in 1990 to 15.58 Gg CO₂ eq in 2005. In 2005, the only steel production plant in Denmark closed down. Emissions from consumption of halocarbons and SF₆ increased from 289.78 Gg CO₂ eq in 1995 to 858.17 Gg CO₂ eq in 2010. HFCs used in refrigeration are a major contributor to halocarbon emissions.

50. Within the industrial processes sector, 50.7 per cent of the emissions were from consumption of halocarbons and SF₆, followed by 47.1 per cent from mineral products, 2.0 per cent from other (industrial processes) and 0.1 per cent from chemical industry. The remaining 0.1 per cent were from other production (sugar production). Denmark reported emissions from metal production and production of halocarbons and SF₆ as “NO”.

51. The Party has made recalculations for the industrial processes sector between the 2011 and 2012 annual submissions in response to the 2011 annual review report and due to changes in stock data. The impact of these recalculations on the industrial processes sector is a decrease in emissions of 0.41 Gg CO₂ eq, or 1.1 per cent, for 2009. The main recalculations took place in the subcategory SF₆ emissions from double-glazed windows.

52. Denmark has also made recalculations for the solvent and other product use sector between the 2011 and 2012 annual submissions following changes in sales data on N₂O emissions. The impact of these recalculations on the solvent and other product use sector is a small decrease in emissions of 0.03 Gg CO₂ eq, or 0.05 per cent, for 2009. The main recalculations took place in relation to the data on N₂O exports and the use of N₂O for race cars and laboratories.

53. The AD, EFs and methodologies used in the industrial processes sector are consistent with the Revised 1996 IPCC Guidelines. A tier 1 and tier 2 uncertainty analysis were performed in accordance with the IPCC good practice guidance. Internal and external QA/QC procedures were applied to ensure the completeness and accuracy of the data sets. The ERT welcomes this continuous improvement in the Party’s inventory for the industrial processes sector.

2. Key categories

Cement production – CO₂

54. In 2010, CO₂ emissions from cement production accounted for 39.7 per cent of emissions from the industrial processes sector. The emissions were calculated for the single

cement-producing plant in the country. Denmark uses three different methods to estimate the emissions for the time series. For the period 1990–1997, the Party uses a tier 1 approach based on the clinker fraction of cement with country-specific EFs for each type of clinker produced. For the period 1998–2005, Denmark uses a tier 2 approach based on the raw materials used, and for the period 2006–2010, the Party applies EU ETS data. In the previous review report, the ERT raised some questions about the declining value of the country-specific IEF for the whole time series and asked the Party to explain whether all three methods used are consistent across the whole time series. The Party provided the additional confidential data to the previous ERT to clarify the fluctuation in the emission estimates. The previous ERT concluded that all three methods are consistent with the IPCC good practice guidance. According to the information and the explanations provided by the Party in the NIR, the ERT agrees with the conclusion in the previous review report.

55. In the previous review report, the ERT recommended that Denmark provide information on the imports and exports of cement for the years 1990–1997, in order to ensure that the tier 1 method is being implemented in accordance with the IPCC good practice guidance. However, no such information has been provided in the 2012 annual submission. In response to a question raised by the ERT during the review, the Party explained that it will include the requested import/export information in its next annual submission. The ERT welcomes the Party's response and strongly recommends that Denmark implement the recommendation in the previous review report regarding the provision of information on imports and exports of cement for the years 1990–1997, in the next annual submission.

56. In response to a question raised by the ERT on the consideration of cement kiln dust (CKD) in the emission estimates for the whole time series, Denmark explained that, during the period 1990–1997, the cement company reported annual CO₂ emissions to the Danish Energy Agency using the methodology approved by the Agency, but that there is no public information available on the methodology used. For the period 1998–2010, the carbonate content of raw materials was determined by using the 'loss on ignition' method (accounting for the loss of CKD during calcination), which is in accordance with the EU ETS guidelines and the UNFCCC reporting guidelines. The ERT recommends that Denmark provide relevant information in its next annual submission to clarify whether CKD is included in the emission estimates for the years prior to 1998.

Consumption of halocarbons and SF₆ – HFCs and PFCs

57. Denmark uses a tier 2 bottom-up approach to estimate the actual emissions from consumption of halocarbons and SF₆.

58. The ERT noted that in CRF table 2(II).F the notation keys used by the Party for the amount of gas remaining in the products at decommissioning (e.g. refrigeration and air conditioning equipment, foam blowing, and aerosols/metered dose inhalers) are reported as not estimated ("NE"). In response to questions raised by the ERT during the review, Denmark explained that, according to Danish law, refrigerators, air-conditioning equipment, and aerosols/metered dose inhalers must be emptied before shredding. Thus, the notation key "NO" should be used for these subcategories. Denmark confirmed that it will use the correct notation key in the next annual submission. With regard to hard foam, Denmark informed the ERT that the HFCs remaining in the products (e.g. insulation for heating pipes) have not been estimated as no methodologies are available to estimate the emissions. However, the Party stated that there are ongoing European Union projects from which an applicable methodology can be applied and, if possible, the methodology will be applied in the next annual submission.

59. In the previous review report, the ERT noted that Denmark had reported the quantity of HFC-134a gas filled in new manufactured hard foam under the subcategory foam

blowing. However, the emissions from manufacturing were reported as not applicable (“NA”). The Party explained that polyurethane foam products were produced in Denmark until 2004. Due to national regulations, since 2005, the foam has been imported from other countries by one company in Denmark that has been filling the gas into containers for export. Thus, no emissions from the filling process occur. As there is no relevant methodology in the Revised 1996 IPCC Guidelines or the IPCC good practice guidance, the ERT accepts this response and encourages the Party to perform QA checks of the assumptions made and report the emissions from the filling process as “NO” in its next annual submission.

60. The recommendations in the previous review report were related to cross-cutting issues for this category, in particular with regard to the improvement of the QA/QC procedures and transparency of the NIR. In response to these recommendations, Denmark has compared the emission estimates of fluorinated gases using different approaches. The tier 1 potential emissions approach has been used to check the tier 2 actual emission estimates for the period 1995–1997. The Party is planning to investigate further the comparison between the tier 2 bottom-up and top-down estimates in the future. The ERT welcomes the Party’s continuous efforts to improve the transparency of this category and encourages Denmark to continue focusing on actual emissions while improving the accuracy of its potential emission estimates.

3. Non-key categories

Solvent and other product use – CO₂ and N₂O

61. In the previous review report, the ERT recommended that Denmark provide information on the AD and methods used to estimate the emissions for the years 1990–1994, which were based on extrapolation. In response to this recommendation, the Party has provided actual data (instead of data based on extrapolation) for the years 1990–1994, and the AD for all subcategories have been revised. Import/export data have been provided by the Danish Customs and Tax Authorities since 1990. The ERT welcomes this improvement in data collection for this category.

62. Denmark has reported N₂O emissions from fire extinguishers as “NO” and “NE”. In response to a question raised by the ERT during the review, the Party explained that the use of N₂O for fire extinguishers does not occur in Denmark or in Greenland and agreed to correct the notation key to “NO” in the NIR and in the CRF tables in the next annual submission.

63. The Party has reported N₂O emissions from aerosol cans as “NE”. In response to a question raised by the ERT during the review, Denmark explained that the source of N₂O emissions is mainly from canned whipped cream. Denmark has attempted to obtain the relevant AD from the Danish foreign trade statistics, but the import and export data are not currently available. The ERT welcomes this initiative by the Party and encourages Denmark to continue its efforts to collect data and report the emissions in its next annual submission.

D. Agriculture

1. Sector overview

64. In 2010, emissions from the agriculture sector amounted to 9,529.10 Gg CO₂ eq, or 15.4 per cent of total GHG emissions. Since 1990, emissions have decreased by 23.6 per cent. The key driver for the fall in emissions is the reduction in N₂O emissions from agricultural soils, which has been largely the result of a decreasing amount of synthetic

fertilizer applied to soils (394.98 Gg nitrogen (N) in 1990 compared to 187.21 Gg N in 2010, or a reduction of 52.6 per cent). This reduction is due to a national environmental policy to prevent loss of N from agricultural soils to the aquatic environment. Specific measures include a ban on manure application during autumn and winter, increasing the area with winter-green fields to capture N, a maximum number of animals per ha and maximum N application rates for agricultural crops. Within the sector, 52.0 per cent of the emissions were from agricultural soils, followed by 30.0 per cent from enteric fermentation and 17.9 per cent from manure management. Field burning of agricultural residues contributed 0.1 per cent to total sectoral emissions. Prescribed burning of savannas and rice cultivation do not occur in Denmark (emissions from prescribed burning of savannas are reported as “NA”, while emissions from rice cultivation are reported as “NO”).

65. Denmark has made recalculations for the agriculture sector between the 2011 and 2012 annual submissions in order to rectify identified errors. The impact of these recalculations on the agriculture sector is a decrease in emissions of 1.0 per cent for 2009. The main recalculations took place in the following categories:

(a) Enteric fermentation: an error in the calculation of CH₄ emissions from sows was identified in the previous review report. The recalculations resulted in a higher IEF for sows (from 1.62 kg CH₄/head/year to 2.83 kg CH₄/head/year). As a result of the recalculations, CH₄ emissions from enteric fermentation have increased by up to 1.0 per cent for the years 1990–2009. However, the emissions for 2009 have decreased by 1.0 per cent, due to an additional correction to the number of heifers;

(b) Agricultural soils: an update of the ammonia (NH₃) EF for animal waste applied to soil (0.21 kg NH₃-N/ kg N for the years 1990–2009 in the 2012 annual submission compared with 0.25–0.31 kg NH₃-N/kg N for the years 1990–2009 in the 2011 annual submission), which has resulted in a decrease in N₂O emissions from agricultural soils of 1.0 per cent for 2009. The decrease in NH₃ emissions has reduced the value of the fraction of synthetic fertilizer N applied to soils that volatilizes as NH₃ and NO_x (Frac_{GASF}) from 0.019 to 0.015.

66. Since the previous annual submission, Denmark has improved the transparency of its reporting and has provided more detailed AD and explanations of the methodologies used (see para. 67 below). However, the ERT considers that some of the necessary information (e.g. on treated slurry from biogas) was not included in the NIR. In response to a question raised by the ERT during the 2011 annual review, the Party provided more information on the methodology used to estimate emissions from treated slurry from biogas, and the ERT recommended that Denmark provide a more detailed explanation in the NIR of its 2012 annual submission, together with a description of the use of the biogas and the associated energy output. In the 2012 annual submission, however, Denmark has not provided this information. Therefore, the ERT reiterates the recommendation in the previous review report that the Party include a description of the use of the biogas and the associated energy output in the next annual submission.

67. Denmark has developed and implemented tier 2 country-specific methodologies to estimate emissions for most livestock categories, in accordance with the IPCC good practice guidance. The Party has also applied a number of country-specific parameters and EFs for the key categories, such as feeding units (FUs), which cannot easily be converted into energy content and are therefore not directly comparable to the default methodology and parameters provided in the IPCC good practice guidance. Following the recommendations in the previous review report, Denmark has provided a more detailed explanation of the method used to derive the FU data and the method used to estimate the gross energy intake in its 2012 annual submission. The ERT welcomes the continuous efforts made by Denmark to improve the transparency of its emission estimates.

68. The inventory for the agriculture sector is generally transparent in relation to the methodologies, AD and EFs used, and to the presentation of the results of the calculations. However, there are still inconsistencies and errors, such as missing or incorrect data and units; incomplete references to tables in the NIR, which meant that they could not always be located; inconsistencies between the N excretion rates reported in the NIR and in the CRF tables; and lack of an explanation of how the protein content for each harvest crop type is used in the calculation of N₂O emissions from N-fixing crops. The ERT recommends that Denmark improve its QA/QC procedures in order to detect and reduce these inconsistencies and errors in its next annual submission.

2. Key categories

Enteric fermentation – CH₄

69. With respect to the recalculations for this category, Denmark stated in the NIR that the correction to the numbers of heifers has had a greater effect on the reduction of emissions compared to the effect of the increase in emissions due to the recalculation for sows. The ERT requested that the Party provide additional information on this issue. In response to questions raised by the ERT during the review, Denmark explained that, in the 2011 annual submission, the number of animals in the subcategory heifers >6 months was 525,890; this number was corrected to 468,058 in the 2012 annual submission. Since the EF for heifers is 50.8 kg CH₄/head/year, the correction has resulted in a decrease in emissions of 2.90 kt CH₄ (60.90 Gg CO₂ eq). The recalculation for sows has resulted in an increase in emissions of approximately 1.30 kt CH₄ (27.30 Gg CO₂ eq). Therefore, the overall effect has been a net reduction of 1.60 kt CH₄ (33.60 Gg CO₂ eq). The ERT appreciates the additional explanation provided by the Party and encourages Denmark to include this explanation in its next annual submission.

Manure management – CH₄

70. In its NIR, Denmark explained that it treats some of the animal slurry in biogas plants, capturing the CH₄ generated and using it for electricity production and cogeneration. In previous annual submissions, Denmark estimated the CH₄ emissions from manure management on the basis of the content of the volatile solids in the slurry and assuming a CH₄ reduction potential of 23 per cent for cattle slurry and 40 per cent for swine. However, AD on the amount of biogas-treated slurry for 2010 was not available; therefore, an extrapolation of the amount for 2009 was provided for 2010. The parameters used for the calculation for 2009 (including the amount of slurry treated) were also used to estimate the total reduced emissions from treated slurry for 2010. The ERT considers that the use of the same input parameters for 2010 and 2009 is not consistent with the fact that the cattle and swine populations increased in 2010 compared to 2009, and, thus, the amount of manure produced would have increased. The ERT also noted that, in the absence of any other information, the amount of manure produced could be inferred from the annual N excretion rate per head. The methodology used by Denmark to extrapolate the amount of slurry treated is not in line with the method described in the IPCC good practice guidance (section 7.3.2.2). The ERT recognizes that this does not lead to an underestimation of emissions from manure management, but in order to increase transparency, the ERT recommends that Denmark follow the methodology provided in the IPCC good practice guidance, make further efforts to obtain the necessary AD, as outlined in the Party's planned inventory improvements in the 2012 NIR, and make recalculations for 2010 in its next annual submission.

Direct soil emissions – N₂O

71. The ERT noted that the NH₃ IEF for animal waste applied to soils varies from year to year and has decreased significantly in the 2012 annual submission (0.21 kg NH₃-N/kg N

in the 2012 annual submission compared to 0.25–0.31 kg NH₃-N/kg N in previous annual submissions). In response to a question raised by the ERT during the review, the Party explained that the NH₃ emissions from 1990 to 2010 decreased due to a proactive environmental policy in Denmark. During this period, various action plans were introduced to prevent the loss of N from agriculture to the aquatic environment. Examples of such plans include the NPO (Nitrogen, Phosphorus, Organic Matter) Action Plan (1986), Action Plans for the Aquatic Environment (1987, 1998 and 2004), the Action Plan for Sustainable Agriculture (1991), the Ammonia Action Plan (2001) and, most recently in 2009, the Agreement on Green Growth. According to Denmark, the implemented measures have led to a decrease in animal N excretion, especially for pigs, as well as improvements in the use of N in manure. The ERT considers that the explanations provided by the Party are reasonable and consistent with the data provided in table 6.25 of the NIR, and recommends that Denmark include this information in the NIR of its next annual submission.

72. The ERT noted that the Frac_{GASF} for ammonium sulphate, one of the main synthetic fertilizers used in Denmark, changed from 0.019 in the 2011 annual submission to 0.015 in the 2012 annual submission without explanation in the NIR. In response to a question raised by the ERT during the review, Denmark explained that a national review of the NH₃ EFs for synthetic fertilizers had resulted in a decrease in the value of the EFs for some types of synthetic fertilizers (including ammonium sulphate). This review was conducted in cooperation with the Danish Plant Directorate. The ERT recommends that Denmark explain, in the next annual submission, whether the reduction in the value of the EF was the result of the use of different methodologies and protocols for the national review or for other reasons.

73. The ERT noted that in the period 1990–2010, the value of the fraction of total above-ground crop biomass that is removed from the field as a crop product (Frac_R) varied between 0.84 and 0.87, almost double the IPCC default value (0.45). In response to a question raised by the ERT during the review, Denmark confirmed that these Frac_R values are higher than the IPCC default value and explained in the NIR that the large fraction of crop residue removed from fields is for feeding and bedding purposes, as well as for biofuel production in power plants. The ERT strongly recommends that Denmark improve the transparency of its reporting by providing disaggregated data on the amount of crop residues used for each purpose (i.e. feeding, bedding and energy production) in its next annual submission. The ERT notes that this will also help to avoid any double counting or omitted emissions.

74. The ERT noted that the area of N-fixing crops for 2009 (688,030 ha in the 2011 annual submission) is smaller than that reported for 2010 (724,132 ha in the 2012 annual submission). However, despite the use of the same methodology, the emissions for 2010 (0.77 Gg N₂O) were less than the emissions for 2009 (0.80 Gg N₂O). In response to a question raised by the ERT during the review, Denmark explained that the calculation of N₂O emissions from N-fixing crops is mostly based on the crop yield and not directly on the area. Based on the information provided during the review, the major decrease in the crop yield can be observed in the categories grass and clover rotation (107 kg N/ha for 2009 compared with 95 kg N/ha for 2010, while the area has increased from 305,889 ha for 2009 to 320,914 ha for 2010). For the category legumes to maturity, the production has decreased from 132 kg N/ha for 2009 to 122 kg N/ha for 2010, while the area has increased from 6,332 ha for 2009 to 10,349 ha for 2010. A reduction in productivity was also observed for lucerne, crops for silage, grass not in rotation, and peas for conservation. The ERT considers that the explanation provided by Denmark is reasonable and that the data provided are sufficient to substantiate the reduction in emissions from 0.80 Gg N₂O for 2009 to 0.77 Gg N₂O for 2010, and recommends that the Party include this explanation in the next annual submission.

E. Land use, land-use change and forestry

1. Sector overview

75. In 2010, net removals from the LULUCF sector amounted to 2,169.29 Gg CO₂ eq. This represents a substantial change since 1990, when the sector was a net source of emissions, amounting to 4,423.51 Gg CO₂ eq. The key drivers for the rise in removals are the increase in removals from forest land (by 4,857.71 Gg CO₂ eq between 1990 and 2010) and the decrease in emissions from cropland (by 1,459.41 Gg CO₂ eq between 1990 and 2010), grassland (by 218.79 Gg CO₂ eq between 1990 and 2010) and wetlands (by 86.82 Gg CO₂ eq between 1990 and 2010). Within the sector, net removals of 5,676.94 Gg CO₂ eq were from forest land and net emissions of 3,185.96 Gg CO₂ eq were from cropland, followed by net emissions of 187.34 Gg CO₂ eq from grassland and 134.37 Gg CO₂ eq from settlements. Wetlands accounted for net removals of 0.02 Gg CO₂ eq. Emissions and removals from other land were reported as “NA” and “NO”.

76. Denmark has made recalculations for the LULUCF sector between the 2011 and 2012 annual submissions following changes in AD (e.g. updated values from the National Forest Inventory (NFI); a new soil map for organic soils) and in order to rectify identified errors (e.g. the C-TOOL model, which is a three-pooled dynamic soil model). The impact of these recalculations on the LULUCF sector is a decrease in estimated net removals of 241.41 Gg CO₂, or 21.6 per cent, for 2009. The main recalculations took place in the following categories:

- (a) Forest land remaining forest land: an increase in estimated net removals of 469.32 Gg CO₂, or 18.11 per cent;
- (b) Cropland remaining cropland: an increase in estimated net emissions of 1,021.18 Gg CO₂, or 75.68 per cent.

77. The ERT reiterates the encouragement in the previous review report that Denmark expand the tier 2 uncertainty analysis to cover the LULUCF sector in its next annual submission.

78. The ERT also reiterates the recommendation made in the previous review report that the Party improve the QA/QC processes for the LULUCF sector and report on the improvements made in its next annual submission, particularly those related to the NFI in terms of sampling procedures and estimation methods.

2. Key categories

Forest land remaining forest land – CO₂

79. As explained in the NIR, recalculations of the carbon stock change estimates for forest land remaining forest land have been made for the 2012 annual submission for the period 1990–2009. The recalculations of the carbon stock for each of the years 1990–1999 are based on a moving average method and on the actual measurements of carbon storage in different species and age classes using the current NFI. The recalculations for each of the years 2000–2009 take into account the measurements taken every five years (from year (t) to year (t-4)), instead of the midpoint method used in the previous annual submission.

80. In response to a question raised by the ERT during the review regarding the method used for the recalculations, Denmark explained that the choice of reference year for the estimates – the midpoint or end year – only leads to minor changes in the statistical uncertainty of the estimates. However, the ERT noted that the impact of the recalculations has led to a change in the trend of net CO₂ emissions/removals for the period 2006–2009 (for 2008, the estimated net removals from forest land have decreased by 3,856.82 Gg CO₂,

or 79.1 per cent, while for 2009, the estimated net removals from forest land have increased by 866.06 Gg CO₂, or 31.7 per cent. In response to the draft review report, Denmark informed the ERT that the recalculations performed were mainly due to an erroneous shift in reporting of the forest carbon pools in the 2012 annual submission and that this had been detected in the preparation of the 2013 annual submission and corrected again leading to recalculations. The ERT welcomes this improvement but still recommends that Denmark make continuous efforts to ensure time-series consistency in its next annual submission.

81. The ERT also noted that in the NIR of the 2011 annual submission, Denmark pointed out that a preliminary forecast until 2020 showed a decreasing trend of the forest carbon stock. However, after the recalculations were performed for the 2012 annual submission, the trend appears to be the opposite. The ERT reiterates the recommendation in previous review reports that Denmark provide additional information in its next annual submission to explain the large inter-annual variations in the carbon stock in forest land remaining forest land (i.e. information on: changes in the composition of tree species and the age structure of forest stands; the area and volume of clear cutting; and the area subject to destructive disturbance).

Cropland remaining cropland – CO₂

82. Denmark has made recalculations for all emission estimates from cropland remaining cropland due to the updating of the soil maps and improvements in the performance of the C-TOOL model for soils containing between 6 per cent and 12 per cent of organic carbon. The impact of these recalculations is an increase in estimated net emissions of 1,021.18 Gg CO₂, or 75.7 per cent, for 2009.

83. During the previous review, Denmark provided justifications for the high level of inter-annual fluctuations in emissions from cropland that were related to the actual yearly crop and variable climatic conditions (e.g. +48.6 per cent for 2001/2002, +31.6 per cent for 2005/2006 and –31.6 per cent for 2008/2009). The ERT reiterates the recommendation in the previous review report that the Party include the underlying data to support these explanations, particularly those that demonstrate the link between temperature and yield, in its next annual submission.

F. Waste

1. Sector overview

84. In 2010, emissions from the waste sector amounted to 1,017.16 Gg CO₂ eq, or 1.6 per cent of total GHG emissions. Since 1990, emissions have decreased by 41.4 per cent. The key driver for the decrease in emissions is the reduction in emissions from managed waste disposal sites by 49.2 per cent from 1990 to 2010, mainly due to the decrease in the amount of solid waste deposited in municipal solid waste disposal sites. Within the sector, 68.5 per cent of the emissions were from solid waste disposal on land followed by 16.9 per cent from wastewater handling and 14.1 per cent from other waste. The remaining 0.6 per cent were from waste incineration. Emissions of CH₄ accounted for 84.1 per cent of total GHG emissions in the waste sector and N₂O emissions accounted for 13.9 per cent. The remaining 2.1 per cent were from CO₂ emissions.

85. The Party did not make any recalculations for the waste sector in the 2012 annual submission.

86. The ERT noted that the provision of documentation on the waste sector could still be improved; for example, the Party did not provide supporting documentation for the CH₄ recovery rate (see para. 91 below). Therefore, the ERT recommends that the Party provide

more complete information on the assumptions made and methodologies used, and on the choice of EFs and AD in its next annual submission, in order to improve transparency.

87. The ERT noted that some of the EFs for the waste sector are based on expert judgement and literature review and that some of the emission estimates are not verified by the inventory team (e.g. the value of the methane conversion factor (MCF) of 0.003 for fugitive emissions from sewer systems was based on expert judgement). The ERT recommends that the Party verify all data used for the estimation of emissions in the waste sector in the next annual submission, including verifying that the provided expert judgement is conservative with reference to the default value for flowing sewers, which is zero according to the IPCC 2006 guidelines. If data are not available to verify that the chosen MCF is conservative, the ERT recommends that the Party perform direct source testing to verify existing relevant literature on fugitive emissions from sewer systems.

2. Key categories

Solid waste disposal on land – CH₄

88. Solid waste disposal on land was identified as a key category both by the level and by the trend assessment using both tier 1 and tier 2 key category analyses. To estimate the emissions from this category, Denmark uses the first order decay (FOD) model, as described in the 2006 IPCC Guidelines, using country-specific AD and a combination of country-specific and IPCC default values for the degradable organic carbon (DOC) and methane generation rate constant (k). The ERT encourages Denmark to conduct research in order to develop country-specific parameters for the FOD model, in order to improve the accuracy of the estimates for this category, in its next annual submission.

89. For the years 1994–2008, Denmark's waste was divided into eight waste categories: domestic waste, bulky waste, garden waste, commercial waste, industrial waste, building waste, sludge, and ash and slag. The Party also assessed data on waste from the Information System for Waste and Recycling database for 2004 and subsequently divided the waste into eight different waste types: food waste, cardboard and paper, wet cardboard and paper, plastics, other combustibles, glass, metal, and other non-combustibles. For the waste category "other combustibles", DOC values from the Danish waste characterisation survey reported by the Danish EPA in 1993 have been used. The data and information provided by the Party indicate that, after 1993, there was no food waste, cardboard, paper or plastics disposed of at waste disposal sites. The Party also informed the ERT that the nature of the "other combustibles" waste type is not well defined in the country. The ERT strongly recommends that the Party analyse and report, in the next annual submission, updated information on the composition of the waste category "other combustibles", divide it into different well characterised waste types, in order to document and assign each type a DOC value, and thereby improve accuracy.

90. Consistent with the encouragement in the previous review report, Denmark has provided, in the NIR, information on the generation of historical AD for the FOD model, the sources of measured data for 1985 and the period 1994–2009, and projected data for 2010. The ERT appreciates the improvement in the supporting documentation provided by the Party.

3. Non-key categories

Wastewater handling – CH₄ and N₂O

91. The ERT noted that Denmark reports a high fixed CH₄ recovery rate (about 99 per cent) across the entire time series for the wastewater treatment plants in the country. This is not in line with the IPCC good practice guidance since the Party does not use the default

value of 0 per cent and the reported value is not based on actual measurements. In response to questions raised by the ERT during the review, the Party explained that the recovery rate is based on expert judgement and, upon request by the ERT, Denmark provided data on the biological oxygen demand from one wastewater treatment plant for the year 2010, which were used together with the IPCC default value for maximum CH₄ producing capacity (B₀) and an MCF value to calculate the potential CH₄ emissions from wastewater treatment. The Party also provided biogas production data from the single biogas production plant and an assumed value for the CH₄ content of biogas. These were used together with the CH₄ density to calculate the amount of CH₄ recovered. The calculation confirmed a 99 per cent CH₄ recovery rate for 2010. Since these data are available from some of the wastewater treatment plants, the ERT strongly recommends that Denmark perform a review of this measurement-based information for the entire time series, consistent with the requirements of the IPCC good practice guidance, and include a time trend for the amount of recovered methane, in its next annual submission in order to improve transparency.

92. The ERT noted that Denmark reported an MCF value of 0.003 for fugitive emissions from sewer systems, primarily settling tanks and biological N and phosphorus removal processes, based on expert judgement. The Party did not provide information on the physical characteristics of the sewer systems in its NIR, but, in response to questions raised by the ERT during the review, Denmark provided further information confirming that all sewer systems in Denmark are closed and are considered to be fast-moving and, therefore, anaerobic conditions are rare. The ERT recommends that the Party include this information in its next annual submission, in order to improve transparency.

93. The ERT noted that Denmark used an EF value of 0.0032 for the estimation of direct N₂O emissions from wastewater treatment plants. However, the Party did not provide any information in the NIR on the rationale for choosing this value, or any related assumptions or relevant documentation. In response to a question raised by the ERT during the review, the Party provided additional information on the methodology used to estimate the EF, which was based on data from the Danish water quality parameter database, the Danish sludge database and literature review. Denmark further explained that there are no measurements of N₂O emissions in the country. The ERT recommends that the Party include this information in its next annual submission, in order to improve transparency.

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

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

Overview

94. Denmark provided supplementary information on activities under Article 3, paragraphs 3 and 4, of the Kyoto Protocol, following the requirements outlined in decision 15/CMP.1, annex, paragraphs 5–9. The information corresponding to the years 1990, 2008, 2009 and 2010 was reported in the KP-LULUCF CRF tables and in chapter 11 of the NIR, following the annotated outline of the NIR. The NIR clearly distinguishes the emissions from these activities from the emissions from sources listed in Annex A to the Kyoto Protocol.

95. Denmark has accounted for all 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

chosen to account for the activities under Article 3, paragraphs 3 and 4, of the Kyoto Protocol annually.

96. The Party has made recalculations for the KP-LULUCF activities between the 2011 and 2012 annual submissions. The impact of these recalculations on each KP-LULUCF activity for 2009 is as follows:

(a) Afforestation and reforestation: an increase in net removals from -145.31 Gg CO₂ eq to -542.06 Gg CO₂ eq (or 273.0 per cent);

(b) Deforestation: an increase in net emissions from 34.74 Gg CO₂ eq to 39.82 Gg CO₂ eq (or 14.6 per cent);

(c) Forest management: an increase in net removals from -2,579.13 Gg CO₂ eq to -3,048.44 Gg CO₂ eq (or 218.2 per cent);

(d) Cropland management: an increase in net emissions from 1,369.30 Gg CO₂ eq to 2,488.53 Gg CO₂ eq (or 81.7 per cent);

(e) Grazing land management: a decrease in net emissions from 184.17 Gg CO₂ eq to 173.55 CO₂ eq (or 5.8 per cent).

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

Afforestation and reforestation – CO₂

97. Denmark used a linear regression model in its 2011 annual submission to obtain estimates of the carbon stocks for 2008 and 2009, while explaining that when full five-year measurements from the NFI become available for 2009 and 2010 these would be used in place of the regression-based estimates. These measurements are now available, and the net removals from afforestation/reforestation have been recalculated (see para. 96 above). The ERT noted that the NIR does not contain sufficient information on the rationale for the recalculations made. Therefore, the ERT recommends that Denmark provide further and verified information on the rationale for changing the method used to estimate the carbon pools in its next annual submission.

98. In response to a recommendation in the previous review report on harvested areas and the associated estimation of emissions and removals, Denmark explained that in the 2012 annual submission there are no estimates of “units of land harvested since the beginning of the commitment period”. The Party further explained that it would be possible to provide estimates based on the NFI in its next annual submission, including some indications of the frequency of harvesting/thinning occurring in afforested areas. The Party also pointed out that, given that the afforested area is a relatively small part of the total forest area, a higher level of uncertainty will be associated with the estimates relating to afforested areas compared to the area of forest land remaining forest land. The ERT welcomes the explanations provided by the Party and recommends that Denmark provide any available data on harvested areas and the associated estimation of emissions and removals in its next annual submission.

Deforestation – CO₂ and N₂O

99. In response to a recommendation in the previous review report on the inclusion of the underlying information supporting the revised estimates of CO₂ emissions or removals and N₂O emissions from soils as a result of deforestation due to forest land conversion to settlements, Denmark has included information in the 2012 annual submission explaining that a default value of 120 t carbon (C)/ha is assumed for settlements and that a state of equilibrium will be reached after 100 years for all areas converted from other land uses to settlements. In addition, Denmark provided additional information on the calculation of the

N₂O emissions from the litter layer as well as the carbon stock changes in mineral soils (a C:N ratio of 15 and an EF of 1.25 per cent for 2010). The ERT welcomes this additional information.

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

Forest management – CO₂

100. In the 2012 annual submission, Denmark has made recalculations due to updated values from the NFI on carbon stocks. The ERT noted that the NIR does not contain sufficient information on the rationale for the recalculations made. Therefore, the ERT recommends that Denmark provide complete information on the rationale for changing the method used to estimate the carbon pools in its next annual submission.

Cropland management – CO₂

101. In the 2012 annual submission, Denmark has made recalculations for this activity owing to an updated map of organic soils. The ERT noted that according to the new data map of the organic soils, there is a sharp decrease in the area of organic soils since the last mapping in 1975, when it was estimated that there were around 118,000 ha of organic soil in the cropland and grassland area). The new map shows that there are around 70,000 ha of organic soil in the cropland and grassland area. This is mainly due to the fact that Danish organic soils are very shallow. The reduced area since 1975 has been taken into account with a linear decrease in the area. The impact of these recalculations on the organic soils pool is an increase in net emissions from 1,279.9 Gg CO₂ to 1,778.92 Gg CO₂. The ERT welcomes the improvements made by the Party.

102. As described in paragraphs 76 and 82 above, emissions from cropland were recalculated for soils with between 6 per cent and 12 per cent organic carbon. As the C-TOOL model has not been able to simulate the emissions for soils with a carbon content of between 6 per cent and 12 per cent organic carbon, fixed EFs have been used for these soils for the entire time series. In addition, in response to a question raised by the ERT during the review on the selection of EFs, Denmark explained that in the absence of EFs for organic soils, it had decided to use expert judgement based on information from the National Centre for Agriculture. The ERT welcomes the explanations provided by the Party and recommends that Denmark include all relevant information on the selection of appropriate EFs in the NIR of its next annual submission.

Grazing land management – CO₂

103. Denmark uses the same country-specific methods to estimate emissions and removals from grazing land management as those used to estimate emissions and removals from grassland remaining grassland under the LULUCF sector. In addition, the areas under grazing land management include all areas of grassland and match the area defined as grassland remaining grassland in the LULUCF sector. The ERT concludes that the emission estimates reported for grassland remaining grassland and for grazing land management are consistent.

2. Information on Kyoto Protocol units

Standard electronic format and reports from the national registry

104. 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.⁶ 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.

105. Information on the accounting of Kyoto Protocol units has been prepared and reported in accordance with decision 15/CMP.1, annex, chapter I.E, and reported in accordance with decision 14/CMP.1 using the SEF tables. This information is consistent with that contained in the national registry and with the records of the international transaction log (ITL) and the clean development mechanism registry and meets the requirements referred to in decision 22/CMP.1, annex, paragraph 88(a–j). The transactions of Kyoto Protocol units initiated by the national registry are in accordance with the requirements of the annex to decision 5/CMP.1 and the annex to decision 13/CMP.1. No discrepancy has been identified by the ITL and no non-replacement has occurred. The national registry has adequate procedures in place to minimize discrepancies.

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

106. 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 in accordance with decisions 16/CMP.1 and 6/CMP.3.

107. Table 6 shows the accounting quantities for KP-LULUCF as reported by Denmark 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 CO₂ eq

	2012 submission ^a		Final	2010 and 2011	"Net" accounting quantity ^f
	As reported	Revised estimates		submissions ^b	
			Final	Final	
Afforestation and reforestation	-855 262	–	-855 262	-190 380	-664 882
Deforestation	119 982	–	119 982	68 396	51 585
Forest management	-916 667	–	-916 667	-916 667	0
Article 3.3 offset ^d	0	–	0	0	0
Forest management cap ^e	-916 667	–	-916 667	-916 667	0
Cropland management	-4 600 337	–	-4 600 337	-2 477 771	-2 122 565
Grazing land management	-93 146	–	-93 146	-257 891	164 745
Revegetation		–			

^a The values included under the 2012 submission are the cumulative accounting values for 2008, 2009 and 2010 as reported in the accounting table of the KP-LULUCF CRF tables for the inventory year 2010.

^b The values included under the 2010 and 2011 submissions are the final accounting values as a result of the 2010 and 2011 reviews and are included in table 4 of the 2011 annual review report (FCCC/ARR/2011/DNK, page 33) in the column "2011 annual submission, Final".

⁶ 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.

^c The “net accounting quantity” is the quantity of Kyoto Protocol units that the Party shall issue or cancel under each activity under Article 3, paragraph 3, and paragraph 4, if relevant, based on the final accounting quantity in the 2011 submission and where the quantities issued or cancelled based on the 2010 review have been subtracted (“net accounting quantity” = final 2012 – final 2010 and 2011).

^d “Article 3.3 offset”: for the first commitment period, a Party included in Annex 1 to the Convention that incurs a net source of emissions under the provisions of Article 3, paragraph 3, of the Kyoto Protocol may account for anthropogenic greenhouse gas (GHG) 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 GHG emissions by sources and removals by sinks in the managed forest since 1990 is equal to, or larger than, the net source of emissions incurred under Article 3, paragraph 3.

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

108. Based on the information provided in table 6 for the activity afforestation/reforestation, Denmark shall issue 664,882 removal units (RMUs) in its national registry.

109. Based on the information provided in table 6 for the activity deforestation, Denmark shall cancel 51,585 assigned amount units (AAUs), emission reduction units (ERUs), certified reduction units (CERs) and/or RMUs in its national registry.

110. Based on the information provided in table 6 for the activity forest management, Denmark shall not issue or cancel any units in its national registry.

111. Based on the information provided in table 6 for the activity cropland management, Denmark shall issue 2,122,565 RMUs in its national registry.

112. Based on the information provided in table 6 for the activity grassland grazing land management, Denmark shall cancel 164,745 AAUs, ERUs, CERs and/or RMUs in its national registry.

National registry

113. 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 problems: the need for the Party to include, within the registry, the representative identifier; and the need to implement measures to prevent administrative errors that could result in discrepancies. The ERT recommends that the Party address these problems and report on the results in its next annual submission.

Calculation of the commitment period reserve

114. Denmark has reported its commitment period reserve in its 2012 annual submission. Denmark reported that its commitment period reserve has not changed since the initial report review (249,155,060 t CO₂ 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

115. Denmark reported that there has been a change to its national system since the previous annual submission. On 30 June 2011, NERI, under Aarhus University, ceased to exist. In its place there now exists ENVS, also under Aarhus University. ENVS has assumed the functions of NERI and the staff associated with the task of preparing the GHG emission inventories have become part of ENVS. No changes have been made with respect to the staff carrying out the work, nor has the change in the administrative structure caused any changes to the available resources. The Party described the change in its NIR. 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

116. Denmark reported that there has been a change to its national registry since the previous annual submission. The Danish Emission Trading Registry was updated and the software is continuously patched in an ongoing effort to make the registry as safe and secure as possible. In particular, several software improvements were installed in 2011 concerning security enhancements and the restriction of access to information on transactions due to national/EU regulations. The Party described the change in its NIR. The ERT concluded that, taking into account the confirmed change to the national registry, Denmark's national registry continues to perform the functions set out in the annex to decision 13/CMP.1 and the annex to decision 5/CMP.1, and continues to adhere to the technical standards for data exchange between registry systems in accordance with relevant decisions of the Conference of the Parties serving as the meeting of the Parties to the Kyoto Protocol (CMP).

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

117. Denmark reported that there have been no changes in its reporting of the minimization of adverse impacts since the previous annual submission in accordance with Article 3, paragraph 14, of the Kyoto Protocol. Denmark provided the following information in its previous annual submission:

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

(b) As part of the financial pledges that were made by the EU to developing countries at the fifteenth session of the Conference of the Parties (COP), held in Copenhagen, Denmark, in December 2009, the Party announced a contribution of DKK 1.2 billion for the implementation of fast-start financing;

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

Korea's Global Green Growth Institute regarding the implementation of various emission reduction projects through sustainable growth plans in selected developing countries.

118. The ERT concluded that the information provided continues to be transparent and complete.

III. Conclusions and recommendations

A. Conclusions

119. Denmark made its annual submission on 13 April 2012 and officially submitted revised emissions estimates on 2 May 2012. The annual submission contains the GHG inventory (comprising CRF tables and an NIR) and supplementary information under Article 7, paragraph 1, of the Kyoto Protocol (information on: activities under Article 3, paragraphs 3 and 4, of the Kyoto Protocol, Kyoto Protocol units, changes to the national system and the national registry and the minimization of adverse impacts in accordance with Article 3, paragraph 14, of the Kyoto Protocol). This is in line with decision 15/CMP.1.

120. 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 1990–2010 (with the exception of CRF table 8(b)) and an NIR; these are complete in terms of geographical coverage, years and sectors, as well as complete in terms of categories and gases.

121. 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.

122. Denmark's inventory is in line with the Revised 1996 IPCC Guidelines, the IPCC good practice guidance and the IPCC good practice guidance for LULUCF.

123. Denmark has made recalculations for the inventory between the 2011 and 2012 annual submissions in response to the 2011 annual review report, following changes in AD and EFs, and in order to rectify identified errors. The impact of these recalculations on the national totals is a decrease in emissions of 0.5 per cent for 2009. The main recalculations took place in the following sectors/categories:

(a) Other fuels under stationary combustion in the energy sector, due to the use of a revised CO₂ EF for fossil waste incineration: an increase in emissions of 126.99 Gg CO₂ eq, or 0.5 per cent;

(b) Transport in the energy sector, as a result of the use of revised data for the total mileage per vehicle under road transportation: an increase of 38.68 Gg CO₂ eq, or 0.3 per cent;

(c) Cropland management in the LULUCF sector: an increase in estimated net emissions of 1,042.62 Gg CO₂ eq, or 77.4 per cent.

124. The Party has reported information on its accounting of KP-LULUCF in the accounting table, as included in the annex to decision 6/CMP.3. The emissions and removals from afforestation and reforestation, deforestation, forest management, cropland management and grazing land management were estimated in accordance with the IPCC good practice guidance for LULUCF and decisions 15/CMP.1 and 16/CMP.1 and all carbon pools were included.

125. Denmark has made recalculations for the KP-LULUCF activities between the 2011 and 2012 annual submissions following changes in AD (e.g. updated values from the NFI becoming available and a new soil map for organic soils) and in order to rectify identified errors (e.g. updating the C-TOOL model). The impact of these recalculations for 2009 were:

- (a) Afforestation and reforestation: an increase in net removals from –145.31 Gg CO₂ eq to –542.06 Gg CO₂ eq (or 273.0 per cent);
- (b) Deforestation: an increase in net emissions from 34.74 Gg CO₂ eq to 39.82 Gg CO₂ eq (or 14.6 per cent);
- (c) Forest management: an increase in net removals from –2,579.13 Gg CO₂ eq to –3,048.44 Gg CO₂ eq (or 218.2 per cent);
- (d) Cropland management: an increase in net emissions from 1,369.30 Gg CO₂ eq to 2,488.53 Gg CO₂ eq (or 81.7 per cent);
- (e) Grazing land management: a decrease in net emissions from 184.17 Gg CO₂ eq to 173.55 CO₂ eq (or 5.8 per cent).

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

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

128. 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. However, the ERT identified two problems that need to be rectified (see para. 113 above).

129. Denmark has reported information under decision 15/CMP.1, annex, chapter I.H, “Minimization of adverse impacts in accordance with Article 3, paragraph 14” as part of its 2012 annual submission. The information was provided on 2 May 2012. The ERT concluded that the information provided by Denmark continues to be transparent and complete.

B. Recommendations

130. The ERT identifies issues for improvement as listed in table 7 below. The recommendations are to be implemented in the next annual submission, unless otherwise specified.

Table 7

Recommendations identified by the expert review team

<i>Sector</i>	<i>Category</i>	<i>Recommendation</i>	<i>Paragraph reference</i>
General	Completeness	Provide a complete set of CRF tables, including complete information in CRF table 8(b), in accordance with the requirements of the “Guidelines for the preparation of national communications by Parties included in Annex I to the Convention, Part I: UNFCCC reporting guidelines on annual inventories”	10

<i>Sector</i>	<i>Category</i>	<i>Recommendation</i>	<i>Paragraph reference</i>
Energy	International bunker fuels	Provide explanations in the NIR on the large inter-annual variations in CO ₂ emissions from international bunker fuels for the years 2008–2010	39
		Include data on international bunkers for lubricants in CRF table 1.C and improve the associated QC procedures	40
	Feedstocks and non-energy use of fuels	Include a reference in CRF table 3.A-D to clarify the reporting of CO ₂ emissions from white spirits	42
		Document and justify in the NIR why a carbon storage factor of 1.00 has been used	43
	Stationary combustion: solid and liquid fuels – CO ₂	Reflect the results of the analysis of the CO ₂ EFs for fuel oil in the NIR	44
	Road transportation: liquid fuels – CO ₂ , CH ₄ and N ₂ O	Provide brief descriptions of the methods used to obtain the fleet and mileage data necessary for the COPERT IV model	45
Aviation: liquid fuels – CO ₂ , CH ₄ and N ₂ O	Provide information on the number of domestic landings and take-offs (LTOs) per representative aircraft type for each of the Danish airports, including flights between Denmark and Greenland/the Faroe Islands, the average LTO fuel consumption and the EFs per representative aircraft type	48	
Industrial processes	Cement production – CO ₂	Provide information on the imports and exports of cement for the years 1990–1997, in order to ensure that the tier 1 method is being implemented in accordance with the IPCC <i>Good Practice Guidance and Uncertainty Management in National Greenhouse Gas Inventories</i> (the IPCC good practice guidance)	55
		Provide relevant information to clarify whether cement kiln dust is included in the emission estimates for the years prior to 1998	56
Agriculture	Sector overview	Provide a description of the use of the biogas and the associated energy output	66
	Manure management – CH ₄ and N ₂ O	Follow the methodology provided in the IPCC good practice guidance, make further efforts to obtain the necessary AD, as outlined in the planned inventory improvements in the 2012 NIR, and make recalculations for 2010	70
		Provide explanations for the inter-annual changes in the NH ₃ IEF	71
		Explain whether the reduction in the EF for ammonium sulphate was the result of using different methodologies and protocols for the national review of for other reasons	72

<i>Sector</i>	<i>Category</i>	<i>Recommendation</i>	<i>Paragraph reference</i>
	Direct emissions from soils – N ₂ O	Improve transparency by providing disaggregated data on the amount of crop residues that are used for each purpose (i.e. feeding, bedding and energy production)	73
		Include, in the NIR, an explanation to substantiate the reduction in N ₂ O emissions from nitrogen-fixing crops	74
LULUCF	Sector overview	Improve the QA/QC processes for the LULUCF sector and report on the improvements made, particularly those related to the NFI in terms of sampling procedures and estimation methods	78
	Forest land remaining forest land – CO ₂	Make continuous efforts to ensure time-series consistency	80
		Provide additional information to explain the large inter-annual variations in the carbon stock in forest land remaining forest land (i.e. information on changes in the composition of tree species and the age structure of forest stands; the area and volume of clear cutting; and the area subject to destructive disturbance)	81
	Cropland remaining cropland – CO ₂	Include the underlying data that support the explanations of the emissions from cropland remaining cropland, particularly those that demonstrate the link between temperature and yield	83
Waste	Sector overview	Provide more complete information on the assumptions made and methodologies used, and on the choice of EFs and AD	86
		Verify all data used for the estimation of emissions in the waste sector in the next annual submission, including verifying that the provided expert judgement is conservative with reference to the default value for flowing sewers, which is zero according to the IPCC 2006 guidelines. If data are not available, to verify that the chosen MCF is conservative, perform direct source testing to verify existing relevant literature on fugitive emissions from sewer systems	87
	Solid waste disposal on land – CH ₄	Analyse and report, in the next annual submission, updated information on the composition of the waste category “other combustibles”, divide it into different well characterised waste types, in order to document and assign each type a DOC value	89
	Wastewater handling – CH ₄ and N ₂ O	Perform a review of the biogas production data from plants for the entire time series, consistent with the requirements of the IPCC good practice guidance, and include a time trend for the amount of recovered methane, in its next annual submission	91
		Provide information on the physical characteristics of the sewer systems in the NIR	92

<i>Sector</i>	<i>Category</i>	<i>Recommendation</i>	<i>Paragraph reference</i>
		Provide additional information on the methodology used for estimating N ₂ O emissions in the NIR	93
Supplementary information required under Article 7, paragraph 1, of the Kyoto Protocol	Information on activities under Article 3, paragraph 3, of the Kyoto Protocol	Provide further and verified information on the rationale for changing the method used to estimate the carbon pools	97 and 100
		Provide any available data on harvested areas and the associated estimation of emissions and removals	98
		Provide all relevant information on the selection of appropriate EFs	102
Information on Kyoto Protocol units	National registry	Include, within the registry, the representative identifier; and implement measures to prevent administrative errors that could result in discrepancies	113

Abbreviations: AD = activity data, CRF = common reporting format, EF = emission factor, IEF = implied emission factor, IPCC = Intergovernmental Panel on Climate Change, LTO = landing and take-off, LULUCF = land use, land-use change and forestry, NFI = National Forest Inventory, NIR = national inventory report, QA/QC = quality assurance/quality control, UNFCCC = United Nations Framework Convention on Climate Change.

IV. Questions of implementation

131. 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/gp/lulucf/gp_lulucf.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 2012. Available at <<http://unfccc.int/resource/docs/2012/asr/dnk.pdf>>.

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

FCCC/ARR/2011/DNK. Report of the individual review of the annual submission of Denmark submitted in 2011. Available at <<http://unfccc.int/resource/docs/2012/arr/dnk.pdf>>.

UNFCCC. *Standard Independent Assessment Report*, parts I and II. Available at <http://unfccc.int/kyoto_protocol/registry_systems/independent_assessment_reports/items/4061.php>.

B. Additional information provided by the Party

Responses to questions during the review were received from Mr. Ole-Kenneth Nielsen (Department of Environmental Science, Aarhus University), including additional material on the methodologies and assumptions used. The following documents¹ were also provided by Denmark:

ISAG, 2011: The Danish Environmental Protection Agency, database on all registered Danish waste. Available at: <http://www2.mst.dk/databaser/isag/Default.asp?advanced=Yes>

¹ Reproduced as received from the Party.

Annex II

Acronyms and abbreviations

AAU	assigned amount unit
AD	activity data
CER	certified emission reduction unit
CH ₄	methane
C	carbon
CKD	cement kiln dust
CMP	Conference of the Parties serving as the meeting of the Parties to the Kyoto Protocol
COP	Conference of the Parties to the UNFCCC
CO ₂	carbon dioxide
CO ₂ eq	carbon dioxide equivalent
CRF	common reporting format
DOC	degradable organic carbon
EF	emission factor
ENVS	Department of Environmental Science
ERU	emission reduction unit
ERT	expert review team
EU	European Union
EU ETS	European Union Emission Trading System
FOD	first order decay
Frac _{GASF}	fraction of synthetic fertilizer N applied to soils that volatilizes as NH ₃ and NO _x
Frac _R	fraction of total above-ground crop biomass that is removed from the field as a crop product
FU	feeding unit
g	gram
GHG	greenhouse gas; unless indicated otherwise, GHG emissions are the sum of CO ₂ , CH ₄ , N ₂ O, HFCs, PFCs and SF ₆ without GHG emissions and removals from LULUCF
GJ	gigajoule (1 GJ = 109 joule)
HFCs	hydrofluorocarbons
IE	included elsewhere
IEA	International Energy Agency
IEF	implied emission factor
IPCC	Intergovernmental Panel on Climate Change
ITL	international transaction log
k	methane generation rate constant
kg	kilogram (1 kg = 1,000 grams)
KP-LULUCF	land use, land-use change and forestry emissions and removals from activities under Article 3, paragraphs 3 and 4, of the Kyoto Protocol
kt	kiloton (1kt = 1,000 tons)
LTO	landing and take off cycle
LULUCF	land use, land-use change and forestry
MCF	methane conversion factor
N	nitrogen
N ₂ O	nitrous oxide
NA	not applicable
NCV	net calorific value
NE	not estimated
NERI	National Environmental Research Institute
NFI	national forest inventory
NH ₃	ammonia

NIR	national inventory report
NO	not occurring
PFCs	perfluorocarbons
PJ	petajoule (1 PJ = 10 ¹⁵ joule)
QA/QC	quality assurance/quality control
RMU	removal unit
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
