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

* In the symbol for this document, 2011 refers to the year in which the inventory was submitted, and not to the year of publication.

Contents

I. Introduction and summary

A. Overview

1. This report covers the centralized review of the 2011 annual submission of Norway, coordinated by the UNFCCC secretariat, in accordance with decision 22/CMP.1. The review took place from 12 to 17 September 2011 in Bonn, Germany, and was conducted by the following team of nominated experts from the UNFCCC roster of experts: generalists – Ms. Karin Kindbom (Sweden) and Ms. Riitta Pipatti (Finland); energy – Mr. Pierre Boileau (Canada); industrial processes – Mr. Jos Olivier (Netherlands) and Ms. Sonia Petrie (New Zealand); agriculture – Mr. Donald Kamdonyo (Malawi) and Mr. Marcelo Rocha (Brazil); land use, land-use change and forestry (LULUCF) – Mr. Mattias Lundblad (Sweden) and Mr. Richard Volz (Switzerland); and waste – Mr. Seungdo Kim (Republic of Korea). Ms. Pipatti and Mr. Rocha were the lead reviewers. The review was coordinated by Mr. Javier Hanna and Ms. Kyoko Miwa (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 Norway, which provided comments that were considered and incorporated, as appropriate, into this final version of the report.

B. Emission profiles and trends

3. In 2009, the main greenhouse gas (GHG) in Norway was carbon dioxide (CO_2), accounting for 83.5 per cent of total GHG emissions[1] expressed in CO_2 eq, followed by methane (CH_4) (8.3 per cent) and nitrous oxide (N_2O) (5.9 per cent). Hydrofluorocarbons (HFCs), perfluorocarbons (PFCs) and sulphur hexafluoride (SF_6) collectively accounted for 2.2 per cent of the overall GHG emissions in the country. The energy sector accounted for 75.8 per cent of total GHG emissions, followed by the industrial processes sector (13.3 per cent), the agriculture sector (8.2 per cent), the waste sector (2.4 per cent) and the solvent and other product use sector (0.3 per cent). Total GHG emissions amounted to 51,292.43 Gg CO_2 eq and increased by 3.1 per cent between the base year[2] and 2009. The trends for the different gases and sectors are reasonable.

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

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

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

[2] "Base year" refers to the base year under the Kyoto Protocol, which is 1990 for all gases. 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, by gas, of the Kyoto Protocol, base year to 2009[a]

			Gg CO_2 eq								*Change*
		Greenhouse gas	*Base year*[a]	*1990*	*1995*	*2000*	*2005*	*2007*	*2008*	*2009*	*Base year–2009 (%)*
Annex A sources		CO_2	34 802.94	34 802.94	37 777.12	41 740.00	43 281.33	45 298.78	44 417.83	42 842.66	23.1
		CH_4	4 665.63	4 665.63	4 864.06	4 722.93	4 424.60	4 423.28	4 296.93	4 259.61	–8.7
		N_2O	4 728.66	4 728.66	4 378.39	4 433.30	4 575.60	4 057.44	3 571.07	3 038.86	–35.7
		HFCs	0.02	0.02	25.82	238.36	481.80	565.00	623.92	707.68	3 861 171.2
		PFCs	3 370.40	3 370.40	2 007.74	1 317.90	828.65	820.91	772.74	379.16	–88.8
		SF_6	2 199.78	2 199.78	607.79	934.42	312.03	76.24	65.40	64.47	–97.1
KP-LULUCF	Article 3.3[b]	CO_2							**778.90**	**382.53**	
		CH_4							IE, NO	IE, NO	
		N_2O							IE, NO	IE, NO	
	Article 3.4[c]	CO_2	NA						–37 613.32	–27 853.13	NA
		CH_4	NA						NO, NA	NO, NA	NA
		N_2O	NA						NO, NA	NO, NA	NA

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

[a] "Base year" for Annex A sources refers to the base year under the Kyoto Protocol, which is 1990 for all gases. The "base year" for activities under Article 3, paragraphs 3 and 4, of the Kyoto Protocol is 1990.

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

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

Table 2
Greenhouse gas emissions by sector and activity, base year to 2009[a]

			Gg CO_2 eq								*Change*
		Sector	*Base year*[a]	*1990*	*1995*	*2000*	*2005*	*2007*	*2008*	*2009*	*Base year–2009 (%)*
Annex A		Energy	29 581.29	29 581.29	32 236.15	35 672.38	38 056.67	40 277.00	39 088.98	38 865.26	31.4
		Industrial processes	13 684.99	13 684.99	10 947.47	11 554.02	10 049.12	9 227.85	9 008.97	6 830.61	–50.1
		Solvent and other product use	191.18	191.18	186.74	181.74	192.69	185.29	180.27	159.33	–16.7
		Agriculture	4 491.37	4 491.37	4 564.26	4 498.50	4 351.72	4 301.27	4 263.16	4 202.67	–6.4
		Waste	1 818.60	1 818.60	1 726.30	1 480.27	1 253.80	1 250.24	1 206.50	1 234.56	–32.1
		LULUCF	NA	–8 556.34	–11 210.58	–18 529.92	–29 612.86	–28 279.72	–34 303.19	–25 328.50	NA
		Total (with LULUCF)	**NA**	**41 211.09**	**38 450.34**	**34 857.00**	**24 291.15**	**26 961.93**	**19 444.69**	**25 963.93**	**NA**
		Total (without LULUCF)	**49 767.43**	**49 767.43**	**49 660.92**	**53 386.92**	**53 904.00**	**55 241.65**	**53 747.88**	**51 292.43**	**3.1**
		Other[b]	NA	NA	NA	NA	NA	NA	NA	NA	**NA**
KP-LULUCF	Article 3.3[c]	Afforestation and reforestation							–100.34	–239.27	
		Deforestation							879.25	621.80	
		Total (3.3)							**778.90**	**382.53**	
	Article 3.4[d]	Forest management							–37 613.32	–27 853.13	
		Cropland management	NA						NA	NA	NA
		Grazing land management	NA						NA	NA	NA
		Revegetation	NA						NA	NA	NA
		Total (3.4)	**NA**						**–37 613.32**	**–27 853.13**	**NA**

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

[a] "Base year" for Annex A sources refers to the base year under the Kyoto Protocol, which is 1990 for all gases. The "base year" for activities under Article 3, paragraphs 3 and 4, of the Kyoto Protocol is 1990.

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

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

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

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

	As reported	*Revised estimates*	*Adjustment*[a]	*Final*[b]	*Accounting quantity*[c]
Commitment period reserve	225 519 117			225 519 117	
Annex A emissions for current inventory year					
CO_2	42 842 660			42 842 660	
CH_4	4 259 609			4 259 609	
N_2O	3 038 856			3 038 856	
HFCs	707 677			707 677	
PFCs	379 162			379 162	
SF_6	64 467			64 467	
Total Annex A sources	**51 292 431**			**51 292 431**	
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	–232 751			–232 751	
3.3 Afforestation and reforestation on harvested land for current year of commitment period as reported	–6 519			–6 519	
3.3 Deforestation for current year of commitment period as reported	621 803			621 803	
Activities under Article 3, paragraph 4, for current inventory year[d]					
3.4 Forest management for current year of commitment period	–27 853 130			–27 853 130	
3.4 Cropland management for current year of commitment period					
3.4 Cropland management for base year					
3.4 Grazing land management for current year of commitment period					
3.4 Grazing land management for base year					
3.4 Revegetation for current year of commitment period					
3.4 Revegetation in base year					

[a] "Adjustment" is relevant only for Parties for which the expert review team has calculated one or more adjustment(s).
[b] "Final" includes revised estimates, if any, and/or adjustments, if any.
[c] "Accounting quantity" is included in this table only for Parties that chose annual accounting for activities under Article 3, paragraph 3, and elected activities under Article 3, paragraph 4, if any.
[d] Activities under Article 3, paragraph 4, are relevant only for Parties that elected one or more such activities.

II. Technical assessment of the annual submission

A. Overview

1. Annual submission and other sources of information

6. The 2011 annual inventory submission was submitted on 15 April 2011; it contains a complete set of common reporting format (CRF) tables for the period 1990–2009 and a national inventory report (NIR). Norway also submitted information required under Article 7, paragraph 1, of the Kyoto Protocol, including information on: activities under Article 3, paragraphs 3 and 4, of the Kyoto Protocol, accounting of Kyoto Protocol units, changes in the national system and in the national registry, and minimization of adverse impacts under Article 3, paragraph 14, of the Kyoto Protocol. The standard electronic format (SEF) tables were submitted on 15 April 2011. The annual submission was submitted in accordance with decision 15/CMP.1.

7. Norway submitted information on 28 October 2011 on its plans to improve quality assurance/quality control (QA/QC) procedures and transparency in explaining the differences in the figures of the sectoral approach (SA) and reference approach (RA) in the energy sector in response to the list of potential problems and further questions raised by the expert review team (ERT) in the course of the review (see paras. 14, 26, 38 and 39 below). In this response Norway described in more detail its QA/QC project to reduce the differences between the RA and the SA and provided additional information to explain the differences between the SA and the RA estimates of CO_2 emissions for natural gas in the 2011 submission. The project started in 2011 and is planned to last through 2012. The ERT recommends that Norway implement the project as described in the response and provide in the NIR of its next annual submission information on progress made. The ERT also recommends that Norway provide further details of the future improvements mentioned in the NIR of the next annual submission (see paras. 19, 38 and 39 below).

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

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

Completeness of inventory

10. The inventory covers all source and sink categories with the exception of CO_2 from soda ash use in industrial processes (see para. 66 below) and CO_2 from organic soils in the LULUCF sector (see para. 80 below). The ERT recommends that Norway obtain data on soda ash use as well as on organic soils and include corresponding estimates in its 2012 annual submission. The inventory is generally in line with the Intergovernmental Panel on

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

Climate Change (IPCC) *Revised 1996 IPCC Guidelines for National Greenhouse Gas Inventories* (hereinafter referred to as the Revised 1996 IPCC Guidelines), the 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) and is complete in terms of gases, years (1990–2009) and geographical coverage. Norway has reported inventory data in a complete set of CRF tables and used appropriately notation keys. A description of the institutional arrangements for inventory preparation, including the legal and procedural arrangements for inventory planning, preparation and management, is provided in the NIR.

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

Overview

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

12. Norway has included the description of its national system in annex VI to the NIR and reported that no changes have taken place since the previous annual submission.

Inventory planning

13. The NIR described the national system and the institutional arrangements for the preparation of the inventory. The Climate and Pollution Agency has overall responsibility for the national GHG inventory. The Climate and Pollution Agency and Statistics Norway prepare the estimates in collaboration for sectors other than LULUCF, for which the Norwegian Forest and Landscape Institute is responsible. Data collection is also mainly carried out by these organizations. The Climate and Pollution Agency has signed agreements with Statistics Norway and the Norwegian Forest and Landscape Institute to ensure that the organizations comply with their responsibilities. The responsibilities include the implementation of QA/QC and archiving procedures, provision of necessary documentation, making information available for review, and delivery of data and information in a timely manner to meet the reporting deadlines under the Convention and its Kyoto Protocol.

14. Norway has an integrated inventory system for producing inventories of GHGs and air pollutants (sulphur dioxide, nitrogen oxides, non-methane volatile organic compounds, ammonia (NH_3), carbon monoxide, particulate matter, heavy metals and persistent organic pollutants). The data flow and QA/QC procedures are to a large extent the same for all pollutants. Norway has included the QA/QC plan as part of its description of the national system in the NIR. In addition, a description of the QA/QC procedures performed by the Climate Pollution Agency for GHG emission estimates from industrial plants is included in the NIR (annex III). The QA/QC plan and the descriptions of QA/QC procedures are comprehensive and detail the tasks and responsibilities in a clear way. Not all QA/QC measures are implemented annually, and the ERT noted that the implementation and monitoring of the measures to be implemented periodically (e.g. every five years) were not always performed as planned; for example, in the energy sector a QA and verification project has been delayed many times. The ERT recommends that Norway strengthen its monitoring to ensure that periodically planned QA/QC and other measures are implemented as planned, or provide information in the NIR when those planned activities have not been implemented.

Inventory preparation

Key categories

15. Norway has reported key category tier 1 and tier 2 analyses for 1990 and 2009, both level and trend assessments, as part of its 2011 submission. The tier 2 key category analysis is used as the basis for the key category identification in Norway, and is complemented with a qualitative assessment. Based on this qualitative assessment, those categories that have been identified as key in the tier 1 analysis are included as key categories owing to their importance to the level of emissions. In addition, categories with large uncertainties (e.g. CO_2 emissions from organic soils) and categories for which the emission factor (EF) differs significantly from the IPCC default value (e.g. CH_4 from coal mining), as well as country-specific sources (e.g. CO_2 capture and storage (CCS)), have been identified as key based on the qualitative assessment. The ERT commends Norway for the comprehensive key category analyses, including the qualitative assessment, as well as for the improvements made to the key category reporting in CRF table 7.

16. The key category analysis performed by Norway and that performed by the secretariat[4] produced different results owing to the difference in the method used and the qualitative assessment of key categories by Norway. The Party uses the results of the key category analyses for prioritizing improvements in the inventory.

17. Norway has included the LULUCF sector in its key category analysis, which was performed in accordance with the IPCC good practice guidance and the IPCC good practice guidance for LULUCF.

18. Norway has not identified key categories for activities under Article 3, paragraphs 3 and 4, of the Kyoto Protocol in accordance with the IPCC good practice guidance for LULUCF. Only forest management is identified as a key category in the table KP-NIR-3. In the NIR, the text on key category analysis for the LULUCF activities notes that forest land converted to settlements and land converted to forest land have been identified as key categories in the LULUCF sector, which indicates that afforestation/reforestation and deforestation should also be identified as key categories. However, this is not stated in the NIR. The ERT recommends that Norway include information on the estimation of the key categories for the LULUCF activities as well as the resulting key categories in its next annual submission, following the guidance on establishing the relationship between the activities under the Kyoto Protocol and the associated key categories in the UNFCCC inventory as provided in chapter 5.4.4 of the IPCC good practice guidance for LULUCF.

Uncertainties

19. Norway has provided the results of a tier 2 uncertainty analysis in its NIR for each category and for the inventory as a whole (including and excluding LULUCF). The analysis was performed in accordance with the IPCC good practice guidance and 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). According to the NIR, the total uncertainty for the GHG inventory in 2009 is ±7 per cent for the national total excluding

[4] The secretariat identified, for each Party, the categories that are key categories in terms of their absolute level of emissions, applying the tier 1 level assessment as described in the IPCC good practice guidance for LULUCF. Key categories according to the tier 1 trend assessment were also identified for Parties that provided a full set of CRF tables for the base year or period. Where the Party performed a key category analysis, the key categories presented in this report follow the Party's analysis. However, they are presented at the level of aggregation corresponding to a tier 1 key category assessment conducted by the secretariat.

the LULUCF sector and ±17 per cent for the national total including the LULUCF sector. Previous review reports have noted that the very low uncertainty estimates for CH_4 emissions have not been addressed transparently in the NIR and have recommended that Norway discuss these estimates in the NIR. The ERT reiterates this recommendation, and recommends in addition that Norway provide the reasoning for the low uncertainty estimates for the activity data (AD) used to estimate the CO_2 emissions from the energy sector, noting the very large differences in the SA and RA estimates, and the large statistical error in the energy balance (see paras. 38 and 39 below), both factors which could increase the uncertainty.

20. The ERT welcomes the inclusion in the NIR of table 6.2 of the IPCC good practice guidance, as requested in previous review reports. The analyses for the whole inventory are based on analyses made for the 2006 annual submission. According to the NIR, updates are made annually for those categories for which changes in methods or data sources have taken place. Previous review reports have encouraged Norway to update the uncertainty analysis for the whole inventory, in particular that the uncertainty estimates for the LULUCF sector be improved. The ERT also noted that uncertainty estimates for LULUCF activities under Article 3, paragraphs 3 and 4, of the Kyoto Protocol have only been discussed qualitatively in the NIR. During the review, Norway informed the ERT that it has initiated the development of a method and data collection required for the uncertainty estimation for the LULUCF sector, and that although an uncertainty estimate may be available in 2012, the estimates are unlikely to be quality controlled and ready for reporting prior to 2013 (this is also the case for KP-LULUCF). The ERT welcomes this information and encourages Norway to provide the updated uncertainty estimates as soon as possible, at the latest in the 2013 annual submission.

21. Norway uses the results of the uncertainty analysis for prioritizing improvements in the inventory.

Recalculations and time-series consistency

22. Recalculations have been performed and generally reported in accordance with the IPCC good practice guidance. The ERT noted that recalculations reported by Norway of the time series 1990–2008 have been undertaken to take into account changes and updates in AD (e.g. in the energy and agriculture sectors), changes in methods (e.g. in the LULUCF sector) and reallocation of the estimates (in the energy sector). The major changes in 2008 include a decrease in fugitive CH_4 emissions from oil and gas of 47.7 per cent, and an increase in CO_2 removals from forest land of 19.3 per cent. The total impact of the recalculations for 2008 was a decrease of 1.2 per cent in the total GHG emissions without LULUCF and a 7.1 per cent increase with LULUCF included. The emissions reallocated from transport to energy industries were also significant but did not affect the total emissions. The recalculations for 1990 resulted in a decrease of 0.04 per cent in the total GHG emissions without LULUCF and a decrease of 24.8 per cent with LULUCF included. For 1990 the major change was an increase of 19.5 per cent in CO_2 removals from forest land in the LULUCF sector; no change in fugitive CH_4 emissions from oil and gas was made. The recalculations have resulted in improvements in the inventory data, but the rationale for the recalculations in CRF table 8(b) and the NIR has not been reported transparently in all cases (see paras. 54 and 88 below). The ERT reiterates the recommendation from the previous review reports that Norway increase the transparency in its reporting by providing the rationale for the recalculations with regard to how the recalculations improve the accuracy, transparency or time-series consistency in accordance with section 7.3.3 of the IPCC good practice guidance.

23. Norway has provided recalculations for the whole time series. In cases where the data source has changed since 1990 and it is not possible to carry out recalculations back to

1990 using exactly the same methods or data sources, Norway has used the methods given in the IPCC good practice guidance to ensure consistency. Since the inventory year 2005, the emissions data used by Norway in its inventory are based on data provided to the European Union emissions trading scheme (EU ETS) for the emissions trading companies. As Norway has also previously based its inventory on plant-specific and company-specific data, this has provided the possibility of reconciling the change in the data source in the time series. The ERT noted, however, that the documentation on how time-series consistency was ensured was not always transparently described in the NIR. Therefore the ERT recommends that Norway include on this in its next annual submission (see paras. 25, 37 and 54 below).

Verification and quality assurance/quality control approaches

24. The NIR reports that Norway has in place a QA/QC plan in accordance with decision 19/CMP.1. The plan includes category-specific procedures to be implemented annually or periodically (see para. 14 above). Verification studies reported in the NIR include a comparison with the emissions data of other countries (Canada, Sweden and New Zealand) made in 2000 and a project funded by the Nordic Council of Ministers in 2002 in which GHG emissions from the agriculture sector were compared with estimates derived using the IPCC default methodology and default EFs. According to the NIR, these studies did not reveal any large errors in the Norwegian inventory; smaller errors were identified and corrected accordingly. The ERT notes that these verification studies reported in the NIR were made approximately 10 years ago and recommends that Norway provide an update of any verification measures from more recent years in its next annual submission.

25. Norway also describes in the NIR the QA procedures for plant-specific data, but the ERT noted that the information is partly outdated as it does not include the procedures for data introduced to the inventory in recent years, including the use of the EU ETS emissions data. During the review, Norway also provided the ERT with references to monitoring and review guidelines of the EU ETS, which describe the validation procedures within this scheme. The information showed that the EU ETS data monitoring and verification system has a robust foundation, but did not address the QA procedure for ensuring consistency between the data used in the GHG inventory and the other data sources and over time. The ERT recommends that Norway include information on the QA/QC implemented for the incorporation of the EU ETS data into the GHG inventory, including how time-series consistency is ensured, in its next annual submission.

26. In the energy sector the comparison between the SA and the RA provides important information for the QA of the reported CO_2 emissions from combustion in the energy sector, as well as on non-energy use of fuels in other sectors. Norway has for some time reported significant differences between the SA and RA estimates, with RA estimates being higher for most years. In the previous review report, it was recommended that Norway implement a QA/QC project to explore the reasons for the significant differences and report on the outcomes in its NIR. During the review, Norway informed the ERT that implementation of the project had been postponed owing to a lack of resources, but in its response to the list of potential problems and further questions from the ERT, Norway informed the ERT that resources had been allocated for the project and assured the ERT that it had started in early 2011 and was planned to last until the end of 2012. The ERT recommends that Norway implement the project and report on progress made and the results of the project in its next annual submission (see para. 7 above and paras. 38 and 39 below).

Transparency

27. The NIR describes the methodologies used in the inventory preparation generally in a transparent way, but the ERT noted that quantitative data on key AD, EFs and parameters are very scarce. Furthermore, descriptions of country-specific methods (e.g. the nitrogen model in the agriculture sector) and the use of and justification for country-specific EFs and other parameters are often not provided. Also, the methods used to incorporate GHG emissions data gathered from the EU ETS into the inventory have not been explained in a fully transparent manner (see para. 37 below). Therefore, it is often not possible to reproduce the calculation of the estimates, or to assess underlying assumptions and rationale for choices of data, methods or other inventory parameters. The information on rationale for recalculations also needs improvement (see para. 22 above). The ERT reiterates the recommendations from previous review reports that Norway improve the transparency of the NIR, taking into account the issues identified above as well as the specific recommendations in the sectoral chapters of this report.

Inventory management

28. The NIR reports that Norway has an archiving system, which includes 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. According to the NIR, 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 core institutions responsible for the inventory, the Climate and Pollution Agency, Statistics Norway and the Norwegian Forest and Landscape Institute, all archive the materials within their responsibilities at their premises. During the review, the ERT was provided with the requested additional archived information.

29. Norway's NIR provides an improvement plan for the inventory. The ERT noted that the plan is mostly general and does not include reasons for the planned improvements or, in most cases, a timetable for their implementation. The ERT encourages Norway to include this information in the NIR of its next annual submission.

3. Follow-up to previous reviews

30. Norway has implemented many recommendations from previous review reports, for example reallocating emissions in the energy sector to increase comparability, increasing transparency of information on the uncertainty and key category analyses, improving the use of notation keys, enhancing the completeness of the LULUCF sector and recalculating the energy and waste sectors in order to improve the accuracy of the estimates. The ERT commends Norway for these improvements. However, the ERT noted that Norway has still to implement some of the recommendations, the most significant of which relate to the implementation of the project to explore reasons for the considerable differences in the SA and the RA estimates in the energy sector (see paras. 38 and 39 below). Other recommendations to be implemented are improving the transparency of the descriptions for country-specific methods, AD and EFs as well as providing more justification for recalculations.

31. In its NIR, Norway lists improvements recommended since 2010 and notes how the Party has implemented these in the latest submission. The NIR does not, however, specify whether the recommendations came from previous review reports or from internal QA/QC and other procedures. The ERT encourages Norway to provide information on its responses to recommendations from the previous review reports separately from other information, with a clear indication on how the Party has responded to these recommendations, or will address them in future annual submissions.

4. Areas for further improvement

Identified by the Party

32. The 2011 NIR identifies several areas for improvement, mostly relating to improvements in transparency, QA/QC and verification and improvements in the LULUCF sector. The ERT encourages Norway to implement the planned improvements (see para. 29 above).

Identified by the expert review team

33. During the review, the ERT identified cross-cutting issues for improvement. These are listed in paragraph 124 below.

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

B. Energy

1. Sector overview

35. The energy sector is the main sector in the GHG inventory of Norway. In 2009, emissions from the energy sector amounted to 38,865.26 Gg CO_2 eq, or 75.8 per cent of total GHG emissions. Since 1990, emissions have increased by 31.4 per cent. The key drivers for the rise in emissions are increased oil and gas extraction, due to new discoveries in the North Sea, and transport, due to more and greater use of cars, sports utility vehicles and light duty trucks. Within the sector, 37.2 per cent of the emissions were from energy industries, followed by 36.8 per cent from transport, 8.8 per cent from other sectors, 8.6 per cent from manufacturing industries and construction and 0.7 per cent from other. The remaining 7.9 per cent were from fugitive emissions from fuel.

36. Norway has performed recalculations for the energy sector between the 2010 and 2011 submissions following changes in AD and EFs and in order to correct the allocation of the estimates and identified errors The impact of these recalculations on the energy sector is a decrease in the emissions of 1.2 per cent for 2008. The main recalculations took place in the following categories:

(a) Energy industries (+1.14 per cent for CO_2);

(b) Transport (–1.01 per cent for CO_2);

(c) Other (+0.23 per cent for CO_2);

(d) CH_4 emissions from oil and natural gas (–1.15 per cent).

37. The ERT identified that the methods used to incorporate GHG emissions data gathered from the EU ETS into the inventory have not been explained in a fully transparent manner. The QA/QC of those data, and the way AD from the EU ETS are reconciled with other AD used in estimating the emissions, are also not transparently explained. As a result, the ERT found difficulties in identifying the causes of the category-specific variations in CO_2 implied emission factors (IEFs); for example, the ERT identified significant inter-annual variations in CO_2 IEFs for natural gas use in public electricity and heat production between 2003 and 2004 (–20.2 per cent), 2004 and 2005 (–12.2 per cent), 2005 and 2006 (+42.7 per cent), 2006 and 2007 (+3.6 per cent), 2007 and 2008 (–16.4 per cent) and 2008 and 2009 (+27.9 per cent). These significant inter-annual variations in CO_2 IEFs also occur for liquid fuels used in petroleum refining for all years of the time series except between 1991 and 1992, ranging from –6.4 per cent to +11.1 per cent. The change in CO_2 IEFs between 1990 and 2009 is 13.3 per cent for liquid fuels in this category. The ERT also

noted a lack of transparency in explaining variations in the comparison of CO_2 emissions between the RA with the SA (see paras. 7, 26 and 30 above and 38 and 39 below). The ERT recommends that Norway provide information on comparisons between the AD gathered from the EU ETS and the other data sources (statistical data, energy balance) in its next annual submission. These comparisons should also include explanations of how AD are reconciled to ensure that there is no double counting or omission of emissions data in Norway's inventory where EU ETS data have been used.

2. Reference and sectoral approaches

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

38. The difference in the CO_2 estimates between the RA and the SA was 10.3 per cent in 2009 and 15.6 per cent in 2008. These large differences are also observed for other years (e.g. –7.8 per cent for 2007, –9.4 per cent for 2002, –13.5 per cent for 1996, +10.4 per cent for 1993 and +7.9 per cent for 1991) and have often been noted in previous review reports. This issue seems to be affecting all fuels, across different years (+20.7 per cent for liquid fuels in 2009, 29.4 per cent for solid fuels in 2007, –11.3 per cent for gaseous fuels in 2002). In section 3.6.1 of the NIR, Norway explains that the source of these variations is not precisely known; however, it believes that the large statistical differences in Norway's national energy balance are a contributing factor. During the review, the ERT examined the trend in statistical differences in Norway's energy balances in comparison with the trend in differences of CO_2 estimates between the RA and the SA; however, there was no observable correlation. For this reason the ERT requested clarification from Norway during the review on the reasons for the difference of CO_2 estimates between the SA and the RA. The discussions and information provided by Norway were useful but did not explain all differences or confirm that all domestic fuel use was considered in the inventory. Norway was unable to provide sufficient explanations to all questions raised by the ERT, especially on the category manufacturing industries and construction, and in particular on the allocation of fuels for non-energy purposes between the energy and the industrial processes sectors.

39. The comparison of CO_2 estimates between the SA and the RA is an important QA measure in the inventory. In previous review reports, at least since 2007, Norway has been recommended to take actions to reconcile the SA and RA differences and/or to transparently explain the main causes of the differences. Therefore, the ERT sought further clarification from Norway in the list of potential problems and further questions from the ERT, noting that Norway had not allocated sufficient capacity and resources for facilitating the QA and QC in the energy sector and for resolving the problem of the reconciliation between the RA and the SA, including on how the facility-level data submitted under the EU ETS are compiled into the inventory and how their quality and consistency with IPCC methods are ensured. In its response to the list of potential problems and further questions from the ERT, Norway described in detail its plans to improve QA/QC and transparency for the RA/SA comparison and provided additional information to explain more transparently the differences in CO_2 estimates between the SA and the RA, in particular for natural gas in the 2011 annual submission. The ERT welcomed the plan and recommends strongly that Norway implement it as described in its response, taking into account all fuels, and provide in the NIR of its next annual submission information on progress made. The ERT also recommends that Norway provide more detail on the future improvements mentioned in order to analyse and reduce, if possible, the statistical difference in the energy balance, including working with Statistics Norway to better understand the source of the differences. The ERT notes that Norway informed the ERT that it has largely implemented the plan and described this in the NIR 2012.

International bunker fuels

40. Emissions from international bunkers are calculated in accordance with an IPCC tier 2 approach. In particular, Norway calculates its bunker fuel emissions based on the origin and destination of flights and the categorization of fuels within its energy balance. This allows for an accurate distinction between fuels used for domestic purposes from those used for international travel. No issues were identified by the ERT for this methodology.

Feedstocks and non-energy use of fuels

41. Norway reports CO_2 emissions from the non-energy use of coal and coke in ferroalloy production under the metal production category in the industrial processes sector. Norway reports in its energy balance the use of coal and coke as reduction agents (in e.g. ferroalloy production) as fuels, which is not in line with requirements from the IEA. The use of coal and coke as reduction agents in ferroalloy production was identified by the ERT as a possible categorization (i.e. energy versus non-energy use) issue with respect to the non-energy use of fuels. Previous review reports noted that a portion of the carbon emitted from ferroalloy production is recovered and used for fuel combustion purposes. According to the 1996 IPCC Guidelines, this recovered carbon should be classified as energy use within Norway's inventory. Norway gave information during the review that a portion of carbon emitted from ferroalloy production is recovered, sold and used for energy purposes and emissions from the combustion are reported in the CRF table under subcategories of public electricity and heat production under energy industry in the energy sector, and subcategories of iron and steel, chemicals and other manufacturing under the category of manufacturing industries and construction in the energy sector. However, the portion of carbon which is used for energy purposes but not sold (i.e. own use) is not reported as energy use. For this reason, the ERT recommends that Norway describe in a more transparent way in its next submission how much of the carbon emitted is recovered for energy own use purposes in order to properly categorize these emissions in the energy sector.

Country-specific issues

42. Norway identified CCS as a key category using qualitative criteria. The ERT notes that Norway has monitoring and measurement in place to determine and report (under the category fugitive emissions from oil and natural gas - CO_2) if fugitive emissions from CCS sites occur. The ERT acknowledges the additional details provided in the NIR and in an annex to the NIR regarding Norway's CCS project.

3. Key categories

Stationary combustion: liquid and gaseous – CO_2

43. The previous review report noted that CO_2 IEFs for liquid fuels from petroleum refining have had significant inter-annual variations (from –6.4 per cent to 11.1 per cent for all years except 1991–1992) and are among the lowest (e.g. 55.46 t/TJ for 2009) of all reporting Parties (ranging from 44.15 t/TJ to 83.51 t/TJ) and are lower than the IPCC default values (ranging from 63.07 t/TJ to 100.83 t/TJ). Norway explained during the review that the low and variable IEFs are due to a variable content of hydrogen in the refinery gas. However, the ERT believes that this may not be the only cause of this variability. The ERT encourages Norway to investigate this issue further with the reporting refineries under the EU-ETS. After further investigation and discussion with Norway during the review, it became clear for the ERT that a large portion of emissions (837.18 Gg) had been allocated to the fugitive emissions from refining/storage of oil under the category of oil and natural gas (fugitive emissions from fuels). These emissions result from the burn-off of petroleum coke from the catalyst in a catalytic cracker and as such should be

categorized as combustion-related emissions. However, since this is combustion, not for energy recovery purposes, the ERT agreed that these emissions could be reported under other of subcategory of oil under the category of oil and natural gas (fugitive emissions from fuels). However, the ERT also recommends that, if any of the burn-off emissions are the result of energy recovery activities, they should be categorized as combustion-related emissions. The ERT recommends that Norway provide information in the NIR of its next annual submission to improve transparency for this source category.

44. The ERT identified that CO_2 emissions from manufacturing industries and construction are lower in comparison with the International Energy Agency (IEA) data for 2009. The difference is 3,300 Gg CO_2 eq (approximately 100 per cent of the current emissions total). The CO_2 emissions allocated to metal production in 2009 under industrial processes (see para. 41 above) only account for approximately 1,500 Gg CO_2 eq of this difference, and Norway was unable to explain the remaining difference during the review. During the review Norway explained that plant-specific emissions data from the EU ETS were used to compile the emission estimates for all categories under manufacturing industries and construction and that fuel use reported by the facilities was subtracted from Norway's energy balance to estimate the emissions from any remaining fuel use. While plant-specific emission estimates may be more accurate than IPCC methods, the size of the identified discrepancy requires that an explanation be provided and that the discrepancies in the emission estimates be minimized, if necessary. Therefore, the ERT recommends that Norway provide in its next annual submission a transparent explanation of the emission estimates in the manufacturing industries and construction category, including the reason why the plant-specific estimates may be different from the estimates using the IPCC methods and different from the IEA data. This explanation could include a table of comparisons between the estimation methods used under the EU ETS Monitoring and Reporting Guidelines and the corresponding methods in the Revised 1996 IPCC Guidelines. This is to ensure that plant-specific emissions data are being estimated consistent with the Revised 1996 IPCC Guidelines. The explanation should also provide a full carbon balance for the bituminous coal, coke oven coke and petroleum coke used, as well as for any other carbon inputs and outputs in the emission estimates for iron and steel and ferroalloy production, including any recovered gases that might be used for energy purposes. This is to ensure that all energy-related emissions and process emissions are correctly allocated either under the energy or industrial processes sectors.

45. The ERT noted significant inter-annual variations of the CO_2 IEFs for other fuels for public electricity and heat production (e.g. the 1996 value (51.50 t/TJ) is 115.8 per cent higher than the 1995 value (23.90 t/TJ)). During the review, Norway confirmed that this is due to a change in the EF for other fuels in 1996, which has led to an inconsistent time series. The ERT recommends that Norway revise the CO_2 EFs for other fuels used in the estimates for this category in accordance with the IPCC good practice guidance to ensure time-series consistency in its next annual submission and explain any significant differences between Norway's IEFs and the default factors in the Revised 1996 IPCC Guidelines.

46. The ERT noted significant differences between the CO_2 IEFs for gaseous fuels for chemicals in the NIR and the defaults from the Revised 1996 IPCC Guidelines (56.1 t/TJ). For the years of 1997–1999 (67.95, 67.19, and 66.99 t/TJ), 2002 (85.35 t/TJ), and 2007–2008 (94.89 and 102.97 t/TJ), the CO_2 IEFs of Norway are the highest among the reporting Parties. Likewise, for 2009 the CO_2 IEF of the Party (91.88 t/TJ) is the highest among the reporting Parties (54.76–91.88 t/TJ). For the period between 1990 and 1993, the emissions are reported as "not occurring". During the review, Norway explained that this is due to the use of derived gases (fuel gas) from various types of equipment (e.g. ethylene crackers, methanol production) in the chemical industry. The ERT recommends that Norway provide

in the NIR of its next annual submission the derivation of the calorific values and EFs for these derived gases, including a carbon balance for these gases, in order to improve the transparency and explain the differences from the default EFs in the Revised 1996 IPCC Guidelines. This is to ensure that all emissions from non-energy and energy uses are appropriately accounted for.

Navigation: liquid fuels – CO_2

47. The ERT noted significant inter-annual variations in the CO_2 IEFs for gas/diesel oil used in navigation (e.g. 12.7 per cent increase between 2004 and 2005 and 11.3 per cent decrease between 2005 and 2006). During the review, Norway acknowledged that this may be an error, whereby reallocations of data on fuel consumption and CO_2 emissions for offshore oil drilling were not coordinated. The ERT recommends that Norway correct this error in its next annual submission. In its response to the draft annual review report Norway informed the ERT that the error has been corrected in the 2012 submission.

Fugitive emissions: liquid fuels – CO_2

48. The ERT identified significant inter-annual variations in the CO_2 emissions from oil transportation (e.g. between 2008 (141.72 Gg) and 2009 (124.02Gg) the change in emissions were identified as significant). The 2009 value is 12.5 per cent lower than the 2008 value. The following inter-annual changes in emissions have also been identified as significant: 1990–1991 (+10.1 per cent), 1991–1992 (+23.7 per cent), 1992–1993 (+12.1 per cent), 2001–2002 (–17.5 per cent), 2002–2003 (–21.2 per cent), 2003–2004 (–17.5 per cent), 2004–2005 (–29.4 per cent), 2005–2006 (–24.1 per cent) and 2007–2008 (–34.2 per cent). The change in emissions between 2009 and 1990 (–66.2 per cent) has also been identified as significant. During the review, Norway stated that the variation up to 2001 is due to the increased amount of crude oil produced and loaded. The reduced emissions thereafter are due to decreased oil production but mainly due to measures implemented that have reduced NMVOC emissions. To increase transparency of the estimates for this category, the ERT recommends that Norway, in order to explain this issue to future ERTs, clarify in detail inter-annual variations in emissions in the NIR of its next annual submission.

Fugitive emissions: natural gas – CH_4

49. The inter-annual variations in emissions of CH_4 from natural gas production have been identified as significant (e.g. between 2008 (1.9 Gg) and 2009 (2.2 Gg)). The 2009 value is 15.7 per cent higher than the 2008 value. The following inter-annual changes also have also been identified as significant: 1990–1991 (159.7 per cent), 1991–1992 (61.5 per cent), 1992–1993 (24.5 per cent), 1993–1994 (13.7 per cent), 1995–1996 (31.0 per cent), 1996–1997 (12.6 per cent), 1999–2000 (26.9 per cent) and 2001–2002 (26.5 per cent). During the review Norway indicated that this is likely due to changes in production quantities. To increase transparency of the estimates for this category, the ERT recommends that Norway, in order to explain this issue to future ERTs, clarify in detail in the NIR of its next annual submission whether these inter-annual variations are due to variations in AD or due to variations in some other parameters used in the emissions estimation.

4. Non-key categories

Road transportation: liquid fuels – N_2O

50. The ERT noted an important inter-annual variation of the IEF for N_2O for gasoline in road transportation (in 2005 the IEF (1.88 kg/TJ) was 43.2 per cent lower than the value

for 2004 (3.31 kg/TJ)). Norway has stated that the Handbook Emission Factors for Road Transport (HBEFA) model is now used for Norway's transport sector emissions inventory (section 3.2.5 of the NIR) and during the review it acknowledged that the jump in the N_2O IEF between 2004 and 2005 does seem unrealistic. So far, Norway has not found any errors in data or in the model, but has stated that the case will be further investigated. The ERT noted that the HBEFA model for calculating emissions from road transportation has been implemented for the Norwegian emissions inventory unaltered, and that the documentation of EFs in HBEFA is generally complete and that the EFs are appropriate for Norwegian conditions. Published documentation related to EFs in HBEFA is available online.[5] N_2O EFs in HBEFA are based on EFs in the COPERT IV model. The ERT recommends that the issue be further investigated and any errors be corrected in Norway's next annual submission.

C. Industrial processes and solvent and other product use

1. Sector overview

51. In 2009, emissions from the industrial processes sector amounted to 6,830.61 Gg CO_2 eq, or 13.3 per cent of total GHG emissions, and emissions from the solvent and other product use sector amounted to 159.33 Gg CO_2 eq, or 0.3 per cent of total GHG emissions. Since the base year, emissions have decreased by 50.1 per cent in the industrial processes sector, and decreased by 16.7 per cent in the solvent and other product use sector. The key drivers for the fall in emissions in the industrial processes sector are a reduction in emissions of PFCs from aluminium production (–88.8 per cent) due to a shift to technologies and practices with lower emissions, a reduction in CO_2 emissions from carbide production (–87.3 per cent) from reduced production, particularly when one plant closed in 2006, a reduction in SF_6 emissions from magnesium production (–94.4 per cent) due to improvements in technology and process management and a reduction in N_2O emissions from nitric acid production (–77.8 per cent) as a result of the use of an abatement technology based on N_2O decomposition by the extension of a reactor chamber in all Norwegian production lines. Within the sector, 57.4 per cent of the emissions were from metal production, followed by 14.8 per cent from mineral production, 13.9 per cent from chemical production and 11.3 per cent from consumption of halocarbons and SF_6. The remaining 2.6 per cent was from the category other production.

52. Norway has made recalculations for the industrial processes sector between the 2010 and 2011 submissions following revisions in AD for iron and steel production, ferroalloys production and consumption of halocarbons and SF_6 (SF_6 use in electrical equipment), reallocation of CO_2, CH_4 and N_2O emissions from fuel gas for the production of plastics from the category chemicals in the energy sector to other (chemical industry) in the industrial processes sector and in order to rectify identified errors in aluminium production (CO_2 emissions). The impact of these recalculations on the industrial processes sector is an increase in emissions of 1.0 per cent for 2008 and 0 per cent in 1990. The impact on the metal production category in 2008 was 0.4 per cent, –0.8 per cent for the consumption of halocarbons and SF_6 category and 5.4 per cent for the chemical industry category.

53. Norway has made recalculations for the solvent and other product use sector between the 2010 and 2011 submissions following changes in AD for the years 2005–2008 (revised data for the number of in-patient stays in hospitals for the use of N_2O from anaesthesia). The impact of these recalculations on the solvent and other product use sector is a decrease in emissions of 5.0 per cent for 2008.

[5] <http://www.hbefa.net/e/index.html>.

54. These recalculations are reported in the CRF tables and the NIR, but adequate justification for them is not always provided (e.g. why the revision of iron and steel data was for not for all years in the time series). During the review, satisfactory answers regarding the revision of AD from one plant (reallocation of emissions from energy to the industrial processes sector) were provided by Norway to the ERT. However, the ERT believes that these explanations should have been presented in the NIR, and recommends that, in order to enhance the transparency of the inventory, Norway document clearly the reasons for all recalculations in the NIR of its next annual submissions in accordance with the IPCC good practice guidance and the UNFCCC reporting guidelines.

55. The NIR states that nearly all of the reported GHG emissions from industrial processes are from annual reports sent by each plant to the Climate and Pollution Agency. During the review, Norway explained that data from plants in the EU ETS are used in the inventory and are checked against data from the annual company emission reports. The ERT noted that this is not easily deduced from what is written in the NIR. The ERT recommends that Norway clearly explain in the NIR of its next annual submission which data from the annual reports of the EU ETS are used in the industrial processes sector, which QA/QC processes are used to ensure the data quality and how the data are incorporated to ensure time-series consistency.

2. Key categories

Iron and steel production – CO_2

56. In its NIR and during subsequent communication with the ERT during the review, Norway explained that reported CO_2 emissions from pig iron production come from the chemical reaction of ilmenite and coal, which produces titanium dioxide slag as the main product and pig iron as a by-product. In the previous review report, the ERT recommended that Norway include CO_2 emissions from this process (reported under pig iron) under other (chemical production). Norway explained that, because of delays with the publication of the previous review report, it was unable to implement this recommendation in the 2011 annual submission. During the review, Norway reiterated its intention to report these emissions under other (chemical production) in its next annual submission. The ERT welcomes this initiative and notes that Norway informed the ERT that this has been completed in the 2012 annual submission.

57. The reported CO_2 IEF for steel production varies more widely after 2005 than it did before that year (e.g. decrease of 14.6 per cent between 2006 and 2007, and increase of 17.4 per cent between 2007 and 2008). The NIR explains that the carbon content of the scrap iron varies (between 0.15 and 4 per cent), as does the carbonate input into the steel-making process. During the review, Norway explained that the annual emissions vary according to the type of scrap iron used and the other inputs. However, this does not entirely explain why this variation is more pronounced after 2005. The ERT encourages Norway to investigate whether there are additional reasons for the increasing variation in the CO_2 IEF for steel since 2005 and to report on them in the NIR of its next annual submission.

Aluminium production – PFCs

58. One of the largest decreases in the industrial processes sector since 1990 is reported for PFC emissions from aluminium production. There are large inter-annual PFC IEF variations (more than 10 per cent for the years 1990–1991, 1991–1992, 1996–1997, 1997–1998, 2002–2003, 2003–2004, 2005–2006, 2006–2007 and 2008–2009) for this category. An example is between 2008 and 2009, where the IEF for perfluromethane (CF_4) dropped by 41.6 per cent and for perfluoroethane (C_2F_6) by 27.9 per cent. The reason for this decrease was due to the implementation of technologies and practices with lower emissions.

During the review, Norway provided additional information on the share of older technology (known as the Soderberg technology) still in use in aluminium production in Norway (8 per cent in 2009 compared with 15 per cent in 2008). In order to improve transparency, the ERT encourages Norway to include a table in the NIR of its next annual submission showing the shares of the Soderberg technology and the newer technology type (prebaked) in use in Norway and the PFC IEFs for each year of the time series.

Consumption of halocarbons and SF_6 – HFCs

59. For imported refrigeration equipment (commercial and industrial), Norway uses a product life factor (PLF) of 3.5 per cent, which is at the lower end of the range of the default EFs for stand-alone commercial refrigeration from the IPCC good practice guidance (1–10 per cent). During the review, Norway explained that it imports equipment from many European countries and some Asian countries, especially China; however, documentation and reasoning for this factor have not been provided to the ERT. The ERT recommends that Norway provide justification for the 3.5 per cent factor for imported refrigeration equipment in its next annual submission.

60. For commercial and industrial refrigeration, the PLF for HFC-152a increased from 9.5 to between 12.8 and 13.3 per cent for the period 2006–2008, then dropped to 9.8 per cent in 2009. During the review, Norway explained that the observed higher PLF in 2006–2008 is the effect of emissions from disposal being included in emissions from stocks. This means that some emissions are incorrectly allocated to emissions from stocks instead of disposal, but this does not affect the overall emissions from this activity. The ERT recommends that Norway correct this misallocation of emissions within this activity before its next annual submission. The ERT also recommends that Norway include in the NIR of its next annual submission the information provided during the review on the relative share of imported products for the refrigeration subcategories, which explains the difference between some low PLF values reported in the NIR (table 4.11) and the higher values reported in CRF table 2(II).F.

61. In the CRF tables Norway reported PLFs for HFC-134 and C_3F_8 of 1.0 per cent for commercial refrigeration. During the review, Norway confirmed that this was an error and that the EF should be 10.0 per cent (or higher if used in transport refrigeration). Norway confirmed this will be corrected before the next annual submission. The ERT strongly recommends that Norway correct these errors in time for the next annual submission.

62. Norway reported in its NIR that data for imported and exported chemicals in bulk, collected annually by the Climate and Pollution Agency until 2009, are being replaced by the direct use of customs statistics on import data. This will result in a complete review of the emission methodology and is planned to be incorporated into the 2012 annual submission. The ERT welcomes this planned improvement to the accuracy of the activity and emissions data.

3. Non-key categories

Lime production – CO_2

63. Norway uses a country-specific method based on the volume of carbonates consumed in lime production, with plant-specific EFs for both limestone and dolomite inputs, which results in more accurate emission estimates than those produced using the IPCC default method. The AD reported in the CRF are therefore for the consumption of limestone and dolomite rather than the amount of lime produced. This means that the CO_2 IEFs for lime production over the time series are very low (e.g. 0.42 for 2009 compared with the default IPCC EF of 0.785 t/t for quicklime). To assist with comparability across Parties, the ERT encourages Norway to report final lime production values in CRF sectoral

background table 2(I).A-G and include the necessary explanations in the NIR of its next annual submission.

64. The ERT notes that it is good practice for this category to provide shares of different types of lime produced in a country (e.g. high-calcium lime, dolomitic lime, hydrated lime). Norway stated during the review that data on the shares of different lime types produced will be included in the NIR of its next annual submission. The ERT welcomes this planned improvement and notes that Norway informed the ERT that this has been completed in the 2012 annual submission.

65. The ERT observed large inter-annual changes in the CO_2 IEFs in 1990–1991 (7.5 per cent), 1998–1999 (20.8 per cent), 1999–2000 (–16.9 per cent) and 2000–2001 (7.2 per cent). The NIR does not provide any discussion on these variations in the time series. During the review, Norway stated that there is a discrepancy between data used for emissions and AD for one of the plants producing lime and that it will further investigate the issue. The ERT encourages Norway to complete this work and recalculate the CO_2 emission estimates where necessary to obtain a consistent and accurate time series in its next annual submission.

Soda ash – CO_2

66. Norway reports in its NIR that soda ash use is not occurring in the country. Given that there are many uses for soda ash and that this activity is reported for many Parties, this seemed unusual. During the review Norway provided information indicating there is some use of soda ash. The ERT strongly recommends that Norway obtain data on soda ash use and include corresponding estimates in its 2012 annual submission.

D. Agriculture

1. Sector overview

67. In 2009, emissions from the agriculture sector amounted to 4,202.67 Gg CO_2 eq, or 8.2 per cent of total GHG emissions. Since 1990, emissions have decreased by 6.4 per cent. The key driver for the fall in emissions is the decline in animal population, especially cattle, whose population has declined by 10.9 per cent since 1990. Within the sector, 45.1 per cent of the emissions were from enteric fermentation, followed by 44.3 per cent from agricultural soils and 10.5 per cent from manure management. The remaining 0.1 per cent were from field burning of agricultural residues.

68. Norway performed recalculations for the agriculture sector between the 2010 and 2011 submissions following revisions in AD and EFs. The impact of these recalculations on the agriculture sector is a decrease of 2.1 per cent for 2008 and an increase of 0.0008 per cent for 1990. The main recalculations took place for agricultural soils and field burning of agricultural residues. The recalculations for agricultural soils resulted in a 4.7 per cent decrease in emissions for 2008, while recalculations for field burning of agricultural residues resulted in a 4.8 per cent increase in emissions. For 1990, the recalculations resulted in an increase of 2.37 per cent in emissions.

69. The NIR provides information on methods, EFs and relevant parameters, uncertainty analysis, QA/QC procedures, recalculations and sources of AD for each category. However, the ERT noted that transparency could be improved by including AD (actual figures) and background information on the development of country-specific parameters in the NIR. The ERT reiterates the recommendation from the previous review report that Norway improve the transparency of the information on methods and AD by including in the NIR of its next annual submission the AD (actual figures by category and year) and background

information on the development of country-specific methods and parameters (see paras. 71 and 73 below).

2. Key categories

Enteric fermentation – CH_4

70. Norway used a tier 2 methodology to estimate emissions from cattle and sheep and a tier 1 methodology with IPCC default EFs to estimate emissions from other animals, except reindeer, for which the EF used by Sweden and Finland was applied. The ERT commends Norway for keeping in line its reported estimates with the IPCC good practice guidance.

71. In applying the tier 2 approach, Norway takes into consideration the lifetime of the animals, including those which live less than a year, which is consistent with the IPCC good practice guidance. However, this approach has not been clearly explained in the NIR. The ERT therefore reiterates the recommendation made in the previous two review reports that Norway provide in its next annual submission detailed AD and values for the parameters used for the determination of the EFs.

Manure management – CH_4 and N_2O

72. Norway used country-specific equations and parameters to estimate CH_4 and N_2O emissions for this category. As indicated in the previous review report, the ERT noted an inconsistency in the reporting of volatile solids (VS) between the NIR and CRF tables. In the NIR the VS fraction is reported as a percentage, while relevant CRF tables refer to it using a unit of kg/animal/year. The ERT recommends that Norway use the same units in both the NIR and the CRF tables in order to ensure consistency with the values and to improve transparency of the reporting.

Agricultural soils – N_2O

73. Norway used country-specific equations and parameters to estimate N_2O emissions for subcategories under direct soil emissions, pasture, range and paddock manure, and indirect emissions. To determine ammonia volatilization values from nitrogen excretion by animals, Norway uses a country-specific ammonia (NH_3) model. The ERT commends Norway for its effort to keep in line with the IPCC good practice guidance, which encourages the use of country-specific factors. However, the ERT reiterates the recommendation made in the previous two review reports that Norway provide in its next annual submission more detailed information on the NH_3 model, such as the principle, basic equations and assumptions, in order to improve transparency.

3. Non-key categories

Field burning of agricultural residues – CH_4 and N_2O

74. Norway recalculated the emissions from field burning of agricultural residues by using EFs from the *2006 IPCC Guidelines for National Greenhouse Gas Inventories* (hereinafter referred to as the 2006 IPCC Guidelines). However, in responding to the questions from the ERT during the review, Norway indicated that it had no justification for the change of EFs. The ERT recommends that Norway change the EFs to those in the Revised 1996 IPCC Guidelines and recalculate the emission time series in its next annual submission or provide solid justification for the use of EFs from the 2006 IPCC Guidelines.

E. Land use, land-use change and forestry

1. Sector overview

75. In 2009, net removals from the LULUCF sector amounted to 25,328.50 Gg CO_2 eq. Since 1990, net removals have increased by 196.0 per cent. Net removals from the LULUCF sector offset 49.4 per cent of the total GHG emissions of Norway. The key driver for the rise in removals is the increase of living biomass on forest land remaining forest land due to significant forest tree planting in new areas from 1955 to 1992. Within the sector, 27,892.76 Gg CO_2 eq net removals were from forest land, and emissions of 1,870.00 Gg CO_2 eq were from grassland, followed by emissions of 558.92 Gg CO_2 eq from settlements and 119.46 Gg CO_2 eq from cropland. Emissions of 16.65 Gg CO_2 eq were from other (emissions from liming) and 3.43 Gg CO_2 eq from wetlands. The remaining removals of 4.19 Gg CO_2 eq were from other land.

76. AD are based on the latest results of the national forest inventory (NFI) carried out from 2005 to 2009 and covering for the first time the entire country. Norway plans to reassess the permanent plots of the NFI every five years and to use it as the database for land use and land-use changes. Land-use data are provided in the NIR in a graph for 1990 and 2009. In 2009, forest land covered 37.6 per cent, cropland 3.0 per cent, grassland 0.6 per cent, wetlands 11.1 per cent and settlements 2.0 per cent of Norway's total area. Other land covers the largest area (45.7 per cent) of Norway. Compared with the previously land-use data, provided in the previous submission, the area of forest land has become considerably larger (from 30.0 to 37.6 per cent) and the area of other land considerably smaller (from 58.0 to 45.7 per cent). Responding to the question raised by the ERT during the review, the Party explained that the changes and to document the land-use changes, Norway provided a detailed land-use change matrix for every year of the period during the review and explained that it would be included in its next annual submission. The ERT welcomes the planned improvement in reporting land-use changes, and recommends that Norway provide a consistent time series and a land-use change matrix in the next annual submission in order to increase transparency. In its response to the draft annual review report, Norway informed the ERT that this has partly been completed in the 2012 submission.

77. Norway made recalculations for all categories of the LULUCF sector between the 2010 and 2011 submissions following the application of revised methods to calculate carbon stock changes in living biomass (see para. 79 below), updated AD from the NFI and the application of the Yasso model for the estimation of carbon stock change in mineral soils related to land-use changes. The new database from the NFI was applied. The impact of these recalculations on the LULUCF sector is a decrease of removals in the early 1990s and in 2006 and a highly variable increase in the other years. Net removals increased by 20.1 per cent in 2008 and decreased by 24.2 per cent in 1990. The main impacts of the recalculations took place in the following categories:

(a) Forest land (increase of net removals by 19.3 per cent in 2008);

(b) Settlements (increase of emissions by 47.1 per cent in 2008);

(c) Other land (from not estimated to net removals of 4.2 Gg CO_2 eq in 2008).

78. Norway has reported in the NIR an uncertainty analysis, based on the previous submission, applying a tier 2 analysis. In annex II to the NIR uncertainty estimates are provided for all IPCC categories, including LULUCF. The uncertainty of the LULUCF sector is much higher than the total of all other sectors. The uncertainty of the total inventory without LULUCF is 4 per cent, and 17 per cent including LULUCF, in 2009. Norway informed the ERT that it has started a project to update the uncertainty estimate for the LULUCF sector based on revised methods and updated AD that were used for the

recalculations and that preliminary estimates are expected to be included in the 2013 annual submission. In addition, Norway informed the ERT about planned improvements. Inter alia, work is in progress to adjust the national land-use classification to be better aligned with the LULUCF classification. This will help to establish more reliable AD for 1990 and to improve estimates of living biomass for the entire country and the whole time series. Further, it is planned to improve estimates of change in soil organic carbon using the Yasso07 model and to improve estimates of dead wood based on a survey started in 2010 by the NFI. The ERT welcomes these efforts and encourages Norway to report on any progress in its next annual submission.

2. Key categories

Forest land remaining forest land – CO_2

79. Forest land remaining forest land was a net sink of 27,598.93 Gg CO_2 eq in 2009, resulting mainly from the increase of carbon stocks in living biomass and in mineral soils. Norway used a tier 3 method to produce estimates for this category. The stock change method is applied to estimate the change in carbon stocks in living biomass, using a combination of NFI data and models. Estimates of carbon stock changes in living biomass have been updated by bridging the two NFI data sets, one for the period 1986–1993 and the other from 1994 to the present. A correction factor has been introduced for the period 1989–1998. The dynamic soil model Yasso is applied to estimate carbon stock changes in dead organic matter (DOM) and soils, taking into account estimated litter and dead wood from standing biomass, annually recorded natural mortality, 10 per cent residues, and stumps and roots from harvested volumes. The model estimates cover all the forested land area, but does not distinguish between mineral and organic soils. No explanation is provided on how the carbon stock changes of organic soils are estimated. For drained organic soils, the tier 1 default factor for boreal forests of 0.16 Mg C ha^{-1} $year^{-1}$ from the IPCC good practice guidance for LULUCF is applied. Norway plans to improve these estimates using Yasso07 and by updating input variables. The ERT welcomes the planned improvement and recommends that Norway provide transparent information on how carbon stock changes of organic soils are estimated and report on any new estimates obtained from the implementation of the planned improvements in its next annual submission.

Land converted to forest land – CO_2

80. Land converted to forest land was a net sink of 294.20 Gg CO_2 eq in 2009, resulting from the increase of carbon stocks in living biomass and in soils (including litter and DOM). The Yasso07 model was applied to estimate carbon stock changes in dead wood, litter and soil carbon. Emissions and removals are estimated for all land-use changes except for wetlands converted to forest land because Norway considers the change from wetlands to forests as not human-induced, as this is a result of tree growth on wetland, were the definition of forest was not previously met. Net carbon stock change in organic soils is reported as “NE” (not estimated) because Yasso07 represents processes for mineral soils only. No information is provided regarding whether organic soils are drained. Norway plans to separate mineral and organic soils in its next annual submission. The ERT welcomes the planned improvement and recommends that Norway provide the results in the next annual submission and report information on drainage of organic soils under this category. In its response to the draft annual review report, Norway informed the ERT that emissions for drained organic soils are reported under forest remaining forest, since the official statistics do not distinguish between new area drained for afforestation activities and drainage taking place on areas for forest remaining forest. Norway plans to clarify this in the 2013 submission.

Cropland remaining cropland – CO_2

81. CO_2 emissions from soils in Norway occur mainly as a result of the cultivation of histosols (organic soils) and the application of lime (including liming of lakes). Norway assumed the total area of organic soils to be 85,000 ha, on the basis of a sampling and an estimation of its representativeness, of which 10.0 per cent is part of cropland. As mentioned in the previous annual review report, Norway reports the area of organic soils under this land category (in CRF table 5.B) as 8,500 ha for the entire time series. However, as reported under the agriculture sector (CRF table 4.D), this area has decreased over time from 8,500 ha to 7,000 ha. Norway explained during the review that the reporting of the two sectors is made by different institutes, which will coordinate their estimates for the next annual submission. The ERT welcomes this improvement and recommends that Norway provide coordinated estimates in the next annual submission and improve its QC procedures. The ERT noted that Norway informed that the same areas are used for agricultural soils and cropland for whole time series in the 2012 submission.

82. As no new data were available, Norway has assumed the same amount of lime applied as in 2007. In response to a suggestion in the 2009 review report, Norway explained in the NIR that still no data are available on the application of different types of lime and relevant EFs; therefore "NO" (not occurring) is reported for dolomite application. As cropland remaining cropland is a key category and as lime application contributes more than 25 per cent to the emissions from this category, the ERT recommends Norway to progress to a tier 2 approach, to investigate the application of different forms of lime and to estimate emissions from the application of the different types of lime. It further recommends Norway to check whether "NO" or "NE" or "IE" (included elsewhere) is correct for the reporting of dolomite.

Grassland remaining grassland – CO_2

83. As no relevant changes have taken place in the management of grassland, in accordance with the IPCC good practice guidance no change in the carbon stocks of living biomass, DOM and soil organic carbon is assumed. Norway reported net carbon stock change in organic soils as a constant value for the period 1990–2009 (–510 Gg C). This change is estimated by applying country-specific EFs of 10 Mg C ha^{-1} $year^{-1}$ for high organic matter soils and 5 Mg C ha^{-1} $year^{-1}$ for mixed organic soils. The ERT noted that around 90 per cent of the organic soils used in agricultural production in Norway (76,500 ha) is assumed to be grassland and that CO_2 emissions from organic soils were considered as a key category on the basis of the level and trend assessments. Norway states in the NIR that it is reconsidering EFs for organic soils in cooperation with Sweden and Finland and expects to apply them in the reporting in 2014. The ERT welcomes the planned improvements and reiterates the recommendation made in the previous annual review report that Norway, in its next annual submission, provide an estimate of annual emissions or explain why the net carbon stock change in organic soils (i.e. the loss of carbon) was constant from 1990 to 2009. The ERT notes that Norway informed that the time series are recalculated due to updating of AD in the 2012 submission.

Land converted to settlements – CO_2

84. Norway used a tier 3 method (modelling) to estimate the carbon stock changes in living biomass and in the soils for forest land converted to settlements. No carbon stock change was estimated when other land-use categories are converted to settlements. The ERT noted that Norway stated in table 7.8 of the NIR that it assumes carbon pools of 152 t per ha in DOM and in soils under cropland and grassland. It is mentioned in the NIR that most carbon is stored in the topsoil, which is removed if land is converted to settlements. However, Norway reports "NA" (not applicable) in the CRF tables for the corresponding

carbon stock changes in cropland and grassland converted to settlements. Norway argued during the review week that there are no default data available for carbon stocks in soils in settlements and no default values are provided by the IPCC good practice guidance for LULUCF. The ERT, considering the information on high-carbon stocks in soils of cropland and grassland, recommends that Norway further investigate the change of carbon stocks in soils from the conversion of different land-use categories to settlements, as it does report emissions from the forest land converted to settlements, or use the correct notations keys, which might be "NE" or "NO".

3. Non-key categories

Wetlands – N_2O, CH_4

85. Norway has considerable areas of reservoirs for hydroelectric power generation and has noted their potential relevance for emissions of N_2O and CH_4. Norway mentioned that ongoing national projects (SINTEF and StatKraft) are expected to provide estimates of emissions, but it is not known whether and when the findings of these projects will be available. The ERT reiterates the encouragement in the previous review report for Norway to report any information concerning emissions from flooded lands (wetlands) as soon as data become available.

Other land – CO_2

86. Norway includes under this category land that is not managed, such as bare rocks, wasteland, land with shallow soils or unfavourable climatic conditions, unmanaged heath or land with sparse tree cover. While the area of other land has considerably decreased as a result of the recalculations between the 2010 and 2011 submissions, it still represents 45.7 per cent of the total land area of Norway. Bearing this in mind, the previous review report recommended that Norway make an effort to disaggregate the category and reclassify areas that have the potential to become forests. Norway stated in the NIR of its 2011 submission that a project has been started aiming to adjust its land-use classification to be better aligned with the IPCC LULUCF classification. The ERT welcomes this effort and encourages Norway to report any progress and/or optimized classification in the next annual submissions. In the previous review report, Norway was further recommended to estimate carbon stock changes for land converted from managed land to unmanaged land. In response to this recommendation, Norway has provided estimates of carbon stock changes in living biomass for cropland, wetlands and settlements converted to other land. Estimates of changes in the carbon stock in soils for forest land converted to other land are included under forest land converted to settlements in the 2011 annual submission, and Norway assumes the same starting point as for the forest land converted to settlements. The ERT welcomes the efforts made to improve AD of other land and recommends that Norway make further progress in utilizing the new NFI data to provide estimates for all land-use conversions from and to other land.

F. Waste

1. Sector overview

87. In 2009, emissions from the waste sector amounted to 1,234.56 Gg CO_2 eq, or 2.4 per cent of total GHG emissions. Since 1990, emissions have decreased by 32.1 per cent. The key driver for the fall in emissions is the decrease in CH_4 emissions from solid waste disposal on land, mainly due to policies and measures to reduce the amount of organic wastes landfilled (prohibition of disposal of biodegradable wastes, etc.) and to increase the collection and treatment of landfill gas (CH_4). Within the sector, 86.3 per cent of the

emissions were from solid waste disposal on land, followed by 13.7 per cent from wastewater handling and 0.01 per cent from waste incineration.

88. Norway has performed recalculations for the waste sector between the 2010 and 2011 submissions. The impact of these recalculations on the waste sector was a decrease in emissions of 0.06 and 0.7 per cent for 1990 and 2008, respectively. The decrease was almost entirely attributable to the recalculation in the category solid waste disposal on land as a result of applying revised AD, representing a more than 99 per cent impact on the recalculation for this category. The recalculation in the waste incineration category had an insignificant impact on the total GHG emissions of the sector (less than 0.01 per cent). The recalculation in the waste incineration category is not addressed in the NIR, nor is a rationale for it provided in CRF table 8(b). The ERT encourages that Norway provide reasoning for the recalculations made in all categories in the NIR and CRF table 8(b) of its next annual submissions, even if the impact of the recalculations on the total emissions is small.

89. The ERT noted that some key data, such as half-life values for the estimation of CH_4 emissions from solid waste disposal (see para. 90 below), were adopted without references and a full explanation. During the review, Norway provided references for and information on the questioned issues, but not in a complete manner. The ERT recommends that Norway provide the references and detailed explanations for all country-specific data in its next annual submission.

2. Key categories

Solid waste disposal on land – CH_4

90. Emissions from this category amounted to 1,065.34 Gg CO_2 eq. Norway applied a country-specific methodology in line with the Revised 1996 IPCC Guidelines and the IPCC good practice guidance. Norway has continued its efforts to improve the accuracy of the emission estimates from this category by applying AD collected by Statistics Norway. Norway has elaborated this by determining the historical AD back to 1950. Key variables used to estimate CH_4 from landfills, such as the half-life value and the degradable organic carbons shown in table 8.1 in the NIR, are, however, introduced without a full explanation. The ERT recommends that Norway elaborate and provide information and explanations to support the key parameter values in its next annual submission.

Wastewater handling – N_2O

91. Emissions from this category amounted to 159.25 Gg CO_2 eq. Norway estimated the N_2O emissions from domestic and commercial wastewater handling using a country-specific methodology. The AD were received from Statistics Norway. The IPCC default EFs are used, except for N_2O emissions from wastewater handling with biological nitrogen removal, where a country-specific EF (2.0 per cent of the removed nitrogen is assumed to be converted to N_2O) has been used. For the part of human sewage that is not covered by the domestic wastewater handling facilities, the IPCC default methodology is used. The methodologies and their implementation are transparently described in the NIR.

3. Non-key categories

Wastewater handling – CH_4

92. The IPCC default methodology was used to estimate CH_4 emissions from this category, which amounted to 9.82 Gg CO_2 eq. The ERT noted that information in the NIR is limited and could be improved by providing a time series for the AD and methane conversion factor values used. The ERT recommends that Norway provide this information

in its next annual submission in order to improve transparency of the NIR. Norway has reported CH_4 emissions from industrial wastewater handling only for food processing industries. The ERT encourages Norway to explore whether CH_4 emissions from other industrial wastewater facilities occur and could be reported in the inventory of the next annual submission.

Waste incineration – CO_2, CH_4 and N_2O

93. Emissions from this category amounted to 0.16 Gg CO_2 eq. The CH_4 and N_2O emissions from this category come from flaring at solid waste disposal sites, cremation and combustion of hospital waste. Hospital waste has not been combusted separately since 2006; no CO_2 emissions are reported as these are considered to be of biogenic origin. Other waste incineration in Norway is associated with energy recovery and is reported in the energy sector in line with the Revised 1996 IPCC Guidelines. Norway used country-specific EFs to estimate the emissions in this category. The ERT encourages that Norway provide justification for the use of country-specific EFs by, for example, comparing the EFs with those used by other European countries in its next annual submission.

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. Norway submitted estimates for afforestation, reforestation and deforestation activities under Article 3, paragraph 3, of the Kyoto Protocol and for forest management, as Norway elected this activity under Article 3, paragraph 4, of the Kyoto Protocol. Norway chose to account for activities under Article 3, paragraphs 3 and 4, at the end of the commitment period. It provided all supplementary information required under Article 3, paragraphs 3 and 4, of the Kyoto Protocol in the NIR and in the CRF tables for KP-LULUCF in accordance with the annex to decision 15/CMP.1. Norway reported that no factoring out of effects caused by increased CO_2 concentration or nitrogen deposition was applied to the estimates. Norway uses the same definitions, approaches and methodologies for the KP-LULUCF reporting as for the LULUCF sector under the Convention.

95. The land information system used by Norway is based on the NFI. The latest assessment was carried out from 2005 to 2009 and covered the entire country for the first time. The NFI is performed in five-year re-sampling cycles. It is the basis for the land-use change identification for reporting purposes under the Kyoto Protocol and permits a detailed spatial assessment and identification of afforestation and deforestation activities. This system is in line with approach 1 of the IPCC good practice guidance for LULUCF, but Norway did not stratify the country area. Reporting the boundaries of the whole country as the boundaries of areas that encompass units of land subject to activities under Article 3, paragraph 3, and land subject to activities under Article 3, paragraph 4, may not be good practice with regard to ensuring that units of land and areas of land are identifiable as requested by decisions 15/CMP.1 and 16/CMP.1. The ERT recommends that Norway provide a transparent description of the methods used to confirm that its application to the available land-related information ensures that units of land and areas comply with the requested information as set out in decision 15/CMP.1. Furthermore, Norway did not provide a time series of areas of land under afforestation/reforestation and deforestation activities since 1990. In response to questions raised by the ERT during the review, Norway provided a detailed matrix showing annual land-use changes that can be used to provide data of areas of afforestation/reforestation and deforestation. Norway explained in the NIR

that areas above the coniferous tree line and in the county of Finnmark are not yet included in the estimates under afforestation/reforestation and deforestation because there is no time series of land-use change in these regions. Norway plans to include these areas and the corresponding changes of carbon stocks in its 2014 annual submission for KP-LULUCF. The ERT recommends that Norway provide in its next annual submission a time series of areas of land under afforestation/reforestation and deforestation activities in order to increase transparency and to report on afforestation/reforestation and deforestation in the areas above the coniferous tree line and in the county of Finnmark as earlier as possible. In its response to the draft annual review report Norway informed that it plans to include further description of the method applied and a time-series back to 1990 in its 2013 submission.

96. Norway applied the new database from the NFI for the recalculations of all KP-LULUCF activities between the 2010 and 2011 submissions. It implemented a correction factor for NFI data of the period 1989–1998 to estimate carbon stock change in living biomass because NFI methods were different in the period before 1994. Furthermore, the Yasso07 model has been applied for the estimation of carbon stock changes in mineral soils in land-use changes. The impact of the recalculation on each KP-LULUCF activity for 2008 is as follows:

(a) Afforestation/reforestation: increase of area by 57.17 kha and slight reduction of removals by 3.47 Gg CO_2;

(b) Deforestation: increase of area by 2.63 kha and emissions by 971.81 Gg CO_2;

(c) Forest management: increase of area by 2,656.03 kha and removals by 6,786.62 Gg CO_2.

97. Norway considers all land-use changes to forest as afforestation, even those land conversions (e.g. from unmanaged other land) that do not necessarily satisfy the definition set out in decision 16/CMP.1. Norway argues in the NIR that all new forest land is considered managed because it is used for different human activities, such as harvesting, hunting or hiking. The ERT recommends that Norway provide in its next annual submission additional justification for the classification of the types of land conversion to forest which can be considered to be directly human-induced, and classify as afforestation only those land-use changes to forest for which this can be demonstrated. Land-use changes to forest that cannot be classified as AR but become managed should be reported under forest management.

98. Norway has not reported carbon stock changes individually for each of the five carbon pools for afforestation and reforestation, and deforestation, as required for all activities under Article 3, paragraphs 3 and 4, of the Kyoto Protocol, and organic soils are reported as "NE" for afforestation and reforestation. The reason for this is that the Yasso07 model, which is applied to calculate these carbon stock changes, cannot distinguish between the pools dead wood, litter and soil organic carbon and between mineral and organic soils. The ERT recognizes the difficulty of providing separate estimates for SOM (soil organic matter) and DOM. To improve transparency, the ERT recommends that Norway provide information on how the Yasso model and the Yasso07 model estimate emissions/removals for the aggregate of SOM and DOM. The ERT further encourages Norway to make efforts to report all pools separately.

99. Norway reported in table NIR-1 CO_2, CH_4 and N_2O emissions from biomass burning as "IE" for afforestation/reforestation and "NA" for deforestation. In CRF table 5(KP-II)5, it reported these emissions as "IE" and for forest management, where they should be included, "NO". In CRF table 5(KP-II)4, "IE" (explanation: reported under cropland remaining cropland) is reported for lime application on deforestation areas and "NA" for areas of forest management. In tables 5(KP-II)1-3, "NO" is reported for N_2O emissions. In

table 5(KP-II)3, Norway further reports "NA" for deforested land converted to cropland, whereas under the Convention reporting an area of forest land converted to cropland is reported. The ERT recommends that Norway make sure that it uses "NA" strictly according to the definition in the reporting guidelines; that means only in the event that an activity does not affect emissions or removals of the respective gases. Furthermore, it recommends that Norway provide additional information in all CRF tables in which emissions and removals are included if "IE" is reported and provide estimates of N_2O emissions in tables 5(KP-II)1-3 or to explain why they do not occur.

100. Norway identified forest management as a key category in the CRF table NIR-3, whereas land converted to settlements – living biomass is identified as a key category in the NIR, however deforestation is not identified as key in CRF table NIR-3. Norway has not reported quantitative uncertainty estimates for KP-LULUCF activities. However, during the review, Norway informed the ERT that these are in preparation and that preliminary results are expected to be reported in the annual submission in 2013. The ERT recommends that Norway include the results of the corresponding quantitative uncertainty analysis as early as possible in its annual submissions and complete table NIR-3 with information on all activities.

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

Afforestation and reforestation – CO_2

101. Norway used the same tier 3 methodology to estimate the carbon stock changes in living biomass for afforestation and reforestation as for land converted to forest land under the Convention. However, as noted in paragraph 79 above, estimates for the carbon pools litter and dead wood are included in the estimates of carbon stock changes in mineral soils. Organic soils are reported as "NE". The ERT refers to the recommendation in paragraph 98 above and strongly recommends that Norway provide these estimates for carbon stock changes in organic soils in its next annual submission, as omitting them might result in a potential underestimation of emissions.

Deforestation – CO_2

102. Carbon stock changes of the pools litter and dead wood are reported as "IE" and are included in the estimates of the carbon stock change in mineral soils, as they are for afforestation and reforestation activities. The Yasso07 model is applied to estimate emissions/removals from forest land converted to settlements and other land and country specific EFs are used for the conversion to cropland and grassland. The area of organic soils is reported as "NO" and the carbon stock change in organic soils as "IE", with the argument that the area is so small that it cannot be separated from mineral soils. The ERT refers to the recommendation in paragraph 98 above and strongly recommends that Norway provide information on the area of organic soils and its emissions and removals, as omitting them might result in a potential underestimation of emissions.

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

Forest management – CO_2, N_2O

103. Norway notes in the NIR that all forests are subject to forest management. The same tier 3 method is applied as for forest land remaining forest land under the Convention. Norway reports all five carbon pools for this activity. The ERT commends Norway for improving the methodology and disaggregating the estimates for carbon stock changes of litter and dead wood and carbon stock change in soils in response to the recommendation in the previous review report. Norway reported N_2O emissions from fertilization and from

drainage of soils as "NO". The ERT recommends Norway to provide of those N_2O emissions or to explain why they do not occur. The ERT notes that Norway informed that the time series of CO_2 and N_2O emission from drainage of soil and fertilization are provided in the 2012 submission.

2. Information on Kyoto Protocol units

Standard electronic format and reports from the national registry

104. Norway has reported information on its accounting of Kyoto Protocol units in the required SEF tables, as required by decisions 15/CMP.1 and 14/CMP.1. The ERT took note of the findings included in the SIAR on the SEF tables and the SEF comparison report.[6] The SIAR was forwarded to the ERT prior to the review, pursuant to decision 16/CP.10. The ERT reiterated the main findings contained in the SIAR.

105. Information on the accounting of Kyoto Protocol units has been prepared and reported in accordance with chapter I.E of the annex to decision 15/CMP.1, and reported in accordance with decision 14/CMP.1 using the SEF tables. This information is consistent with that contained in the national registry and with the records of the international transaction log (ITL) and the clean development mechanism registry and meets the requirements set out in paragraph 88(a–j) of the annex to decision 22/CMP.1. The transactions of Kyoto Protocol units initiated by the national registry are in accordance with the requirements of the annex to decision 5/CMP.1 and the annex to decision 13/CMP.1. 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.

106. Norway provided access to information from its national registry that substantiated or clarified the information reported in its annual submission.

National registry

107. 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 safeguards and disaster recovery measures in place and its operational performance is adequate. The national registry has fulfilled all requirements regarding the public availability of information in accordance with section II.E of the annex to decision 13/CMP.1.

Calculation of the commitment period reserve

108. Norway has reported its commitment period reserve in its 2011 annual submission. The Party reported that its commitment period reserve has not changed since the initial report review (225,519,117 t CO_2 eq), as it is based on the assigned amount and not the most recently reviewed inventory. The ERT agrees with this figure.

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

3. Changes to the national system

109. Norway reported that there is no change in its national system since the previous annual submission. The ERT concluded that Norway's national system continues to be in accordance with the requirements of national systems set out in decision 19/CMP.1.

4. Changes to the national registry

110. Norway provided information on changes to its national registry in its annual submission. Norway reported that new public versions of the Greta software had been released during 2010 and these had been deployed by Norway to increase the capacity of the registry. In addition, Norway reported in the NIR that a two-man rule mechanism (all transactions need approval from two authorized users in order to be proposed to the ITL and CITL) has been fully implemented in its national registry between the end of 2010 and the beginning of 2011 and that no technical changes were made to the registry software in order to implement this security requirement, which in 2011 became mandatory for all accounts; and it was implemented through an administrative process. The ERT concluded that, taking into account the confirmed changes in the national registry, Norway's national registry 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

111. Norway did not report information on changes in its reporting of the minimization of adverse impacts in accordance with Article 3, paragraph 14, in its annual submission. However, the ERT concluded that, taking into account the information provided in the NIR, the information provided continues to be complete and transparent. The ERT recommends that Norway, in its next annual submission, report any changes in its information provided under Article 3, paragraph 14, in accordance with chapter I.H of the annex to decision 15/CMP.1.

112. Norway's NIR included, inter alia, information on cooperation in the technological development of fossil fuel technologies that emit less GHGs, including dissemination of lessons learned and other information related to carbon capture and storage. Norway's Oil for Development initiative, aimed at assisting developing countries in their efforts to manage petroleum resources in a way that enhances economic growth and generates welfare for the whole population in an environmentally sustainable way, was also presented.

III. Conclusions and recommendations

113. Norway made its annual submission on 15 April 2011. The annual submission contains the GHG inventory (comprising CRF tables and an NIR) and supplementary information under Article 7, paragraph 1, of the Kyoto Protocol (information on activities under Article 3, paragraphs 3 and 4, of the Kyoto Protocol, Kyoto Protocol units, changes to the national system, and the national registry and minimization of adverse impacts in accordance with Article 3, paragraph 14, of the Kyoto Protocol). This is in line with decision 15/CMP.1.

114. The ERT concludes that the inventory submission of Norway has been prepared and reported in accordance with the UNFCCC reporting guidelines. The inventory submission is complete and Norway has submitted a complete set of CRF tables for the years 1990–2009 and an NIR; these are complete in terms of geographical coverage, years and sectors,

as well as complete in terms of categories and gases, with the exception of soda ash use in industrial processes. The ERT recommends that Norway obtain data on soda ash use and include corresponding estimates in its 2012 annual submission (see para. 66 above).

115. 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.

116. Norway's inventory is generally in line with the Revised 1996 IPCC Guidelines, the IPCC good practice guidance and the IPCC good practice guidance for LULUCF. The ERT noted the need for improved QA/QC procedures and transparency in the energy, industrial processes and agriculture sectors, for example how the data from the EU ETS are used in the energy and industrial processes sectors and how times-series consistency is ensured when these data are incorporated into the inventory.

117. Norway has made recalculations for the inventory between the 2010 and 2011 submissions in response to the 2010 annual review report and following changes in methods, 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 1.2 per cent for 2008 and an increase of 0.04 per cent in 1990. The main recalculations took place in the following sectors/categories:

(a) Energy sector: CH_4 emissions from oil and natural gas;

(b) Industrial processes sector: CO_2 emissions from metal production, emissions from the consumption of halocarbons and SF_6, and CO_2, CH_4, and N_2O emissions from chemical industry;

(c) LULUCF sector: carbon stock change in forest land.

118. Norway provided information on activities under Article 3, paragraphs 3 and 4, of the Kyoto Protocol generally in accordance with paragraphs 5–9 of the annex to decision 15/CMP.1. The ERT identified areas for improvement in relation to the identification of land areas, emission and removal estimation, uncertainty estimation and transparency of the reporting.

119. Norway has made recalculations for the KP-LULUCF activities between the 2010 and 2011 submissions in response to the 2010 annual review report following changes in AD, parameters and methodologies. The impact of these recalculations on each KP-LULUCF activity for 2008 is as follows.

(a) Removals from afforestation/reforestation increased by 3.6 per cent;

(b) Deforestation lands turned from a sink (–92.56 Gg CO_2 eq) into a source (879.25 Gg CO_2 eq);

(c) Removals under forest management increased by 22.1 per cent.

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

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

122. 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.

123. Norway has reported information under chapter I.H of the annex to decision 15/CMP.1, "Minimization of adverse impacts in accordance with Article 3, paragraph 14",

as part of its 2011 annual submission, and this information is considered to be complete and transparent.

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

(a) Improvement of the QA/QC procedures and verification, especially in the energy sector, to explain and/or reduce the differences between the SA and RA CO_2 estimates;

(b) Strengthening of procedures to monitor that measures (e.g. updates of uncertainty estimates, verification measures) which are planned to be implemented periodically are implemented within the planned time frames;

(c) Provision of more precise descriptions and justifications for country-specific methodologies and recalculations to increase the transparency of the reasoning for the changes implemented as well as their impact on the time-series consistency;

(d) Development of uncertainty estimates and identification of key categories for activities under Article 3, paragraphs 3 and 4, of the Kyoto Protocol.

125. In the course of the review, the ERT formulated a number of specific recommendations relating to the completeness and transparency of the information presented in Norway's annual submission. The key recommendations are that Norway:

(a) Include in the NIR an explanation of the low uncertainty estimates for AD used to estimate CO_2 emissions from the energy sector (see para. 19 above);

(b) Provide additional information on the QA/QC procedures and time-series consistency for the use of plant-specific data that have been introduced to the inventory in the recent years, such as the EU ETS emissions (see paras. 25, 37,39 and 55 above);

(c) Provide, in the energy sector, updated information on the QA/QC project exploring the reasons for the significant difference in the SA and RA estimates of CO_2 emissions from combustion sources and its implementation, consistent with the recommendations in paragraphs 7, 26, 30 and 37–39 above;

(d) Improve and revise the allocation of emissions in the energy and industrial processes sectors (see paras. 41, 43, and 44 above);

(e) Include CO_2 emissions from soda ash production in the industrial processes sector;

(f) Improve the transparency of reporting in the energy, industrial processes (e.g. provide justification for the 3.5 per cent factor for imported refrigeration equipment and consumption of halocarbons and information on the relative share of imported products for refrigeration subcategories to explain differences in the PLF values reported in the NIR and the CRF), agriculture (e.g. describe the nitrogen model used in the estimation of the emissions) and waste sectors (e.g. provide more details, including references to justify country-specific parameters), as specified in paragraphs 49, 59, 69, 71, 73, 89 90 and 93 above;

(g) Provide a consistent time series of land-use change matrices in the LULUCF sector (see para. 74 above);

(h) Improve, in the LULUCF sector, the transparency of reporting of carbon stock changes in mineral and organic soils and include estimates of CO_2 emissions from organic soils (see paras. 79 and 84 above);

(i) Improve the consistent use of AD in the agriculture and LULUCF sectors (see para. 81 above);

(j) Provide a time series of the land areas afforested/reforested and deforested since 1990 in order to increase transparency (see para. 95 above);

(k) Provide clear and detailed justifications for the types of land converted to forest that can be considered to be directly human-induced, and classify under afforestation/reforestation only those lands for which this can be demonstrated (see para. 97 above);

(l) Include estimates of CO_2 emissions from organic soils for afforestation/reforestation and deforestation lands (see paras. 101 and 102 above);

(m) Report any changes in information on the minimization of adverse impacts under Article 3, paragraph14 (see para. 111 above).

IV. Questions of implementation

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

Annex I

Documents and information used during the review

A. Reference documents

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

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

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

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

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

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

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

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

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

Status report for Norway 2011. Available at <http://unfccc.int/resource/docs/2011/asr/ nor.pdf>.

Synthesis and assessment report on the greenhouse gas inventories submitted in 2011. Available at <http://unfccc.int/resource/webdocs/sai/2011.pdf>.

FCCC/ARR/2010/NOR. Report of the individual review of the greenhouse gas inventory of Norway submitted in 2010. Available at <http://unfccc.int/resource/docs/2011/arr/nor.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 Ms. Alice Gaustad (Climate and Pollution Agency), including additional material on the methodology and assumptions used. The following documents[1] were also provided by the Party:

SSB. 2010. Referat fra møte om prosjekter i 2010 (Minutes of the meeting on the projects in 2010).

Utslipp til luft 2010 (The project plan includes activities related to the work of statistics on air emissions of greenhouse gases and long-haul gas emissions (acidifying gases, heavy metals, organic pollutants m.m.).

Gro Hylen. 2008. *Project Plan 2008-2014, LULUCF, UNFCCC and the Kyoto Protocol*, Norwegian Institute for Forest and Landscape, Section: National Forest Inventory.

Statistics Norway. 2011. *QA/QC - Report for Statistics Norway*.

[1] Reproduced as received from the Party.

Annex II

Acronyms and abbreviations

AD	activity data
CH_4	methane
CCS	carbon dioxide capture and storage
CMP	Conference of the Parties serving as the meeting of the Parties to the Kyoto Protocol
CO_2	carbon dioxide
CO_2 eq	carbon dioxide equivalent
CRF	common reporting format
DOM	dead organic matter
EF	emission factor
ERT	expert review team
EU	European Union
EU ETS	European Union emission trading system
Gg	gigagram
GHG	greenhouse gas; unless indicated otherwise, GHG emissions are the sum of CO_2, CH_4, N_2O, HFCs, PFCs and SF_6 without GHG emissions and removals from LULUCF
ha	hectare
HBEFA	Handbook Emission Factors for Road Transport
HFCs	hydrofluorocarbons
IE	included elsewhere
IEF	implied emission factor
IPCC	Intergovernmental Panel on Climate Change
ITL	international transaction log
KP-LULUCF	land use, land-use change and forestry emissions and removals from activities under Article 3, paragraphs 3 and 4, of the Kyoto Protocol
kg	kilogram (1 kg = 1,000 grams)
LULUCF	land use, land-use change and forestry
NA	not applicable
NE	not estimated
N_2O	nitrous oxide
NFI	national forest inventory
NH_3	ammonia
NIR	national inventory report
NO	not occuring
PFCs	perfluorocarbons
PLF	product life factor
QA/QC	quality assurance/quality control
RA	reference approach
SA	sectoral approach
SEF	standard electronic format
SF_6	sulphur hexafluoride
SIAR	standard independent assessment report
SO_2	sulphur dioxide
SOM	soil organic matter
t/t	tonne per tonne
TJ	terajoule (1 TJ = 10^{12} joule)
UNFCCC	United Nations Framework Convention on Climate Change
VS	volatile solid