Advance Version

COMPLIANCE COMMITTEE **CC/ERT/ARR/2013/14**
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Report of the individual review of the annual submission of Canada submitted in 2012

Note by the secretariat

The report of the individual review of the annual submission of Canada submitted in 2012 was published on 24 May 2013. For purposes of rule 10, paragraph 2, of the rules of procedure of the Compliance Committee (annex to decision 4/CMP.2, as amended by decision 4/CMP.4), the report is considered received by the secretariat on the same date. This report, FCCC/ARR/2012/CAN, contained in the annex to this note, is being forwarded to the Compliance Committee in accordance with section VI, paragraph 3, of the annex to decision 27/CMP.1.

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

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

Contents

I. Introduction and summary

1. This report covers the centralized review of the 2012 annual submission of Canada, coordinated by the UNFCCC secretariat, in accordance with decision 22/CMP.1. The review took place from 10 to 15 September 2012 in Bonn, Germany, and was conducted by the following team of nominated experts from the UNFCCC roster of experts: generalist – Mr. Justin Goodwin (United Kingdom of Great Britain and Northern Ireland) and Ms. Suvi Monni (Finland); energy – Mr. Ali Can (Turkey), Ms. Rianne Dröge (Netherlands) and Mr. Peter Seizov (Bulgaria); industrial processes – Mr. Cheon-Hee Bang (Republic of Korea) and Mr. Mauro Meirelles de Oliveira Santos (Brazil); agriculture – Mr. Sorin Deaconu (Romania) and Mr. Mahmoud Medany (Egypt); land use, land-use change and forestry (LULUCF) – Mr. Kevin Black (Ireland), Mr. Erik Karltun (Sweden) and Mr. Atsushi Sato (Japan); and waste – Ms. Juliana Boateng (Ghana) and Mr. Qingxian Gao (China). Mr. Meirelles de Oliveira Santos and Mr. Goodwin were the lead reviewers. The review was coordinated by Mr. Matthew Dudley (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 Canada, which provided comments that were considered and incorporated, as appropriate, into this final version of the report.

3. In 2010, the main greenhouse gas (GHG) in Canada was carbon dioxide (CO_2), accounting for 78.8 per cent of total GHG emissions[1] expressed in carbon dioxide equivalent (CO_2 eq), followed by methane (CH_4) (13.1 per cent) and nitrous oxide (N_2O) (6.8 per cent). Hydrofluorocarbons (HFCs), perfluorocarbons (PFCs) and sulphur hexafluoride (SF_6) collectively accounted for 1.3 per cent of the overall GHG emissions in the country. The energy sector accounted for 81.2 per cent of total GHG emissions, followed by agriculture (8.0 per cent), industrial processes (7.5 per cent), waste (3.2 per cent) and solvent and other product use (0.03 per cent). Total GHG emissions amounted to 691,718.21 Gg CO_2 eq and increased by 17.4 per cent between the base year[2] and 2010.

4. Tables 1 and 2 show GHG emissions from Annex A sources, emissions and removals from the LULUCF sector under the Convention and emissions and removals from activities under Article 3, paragraph 3, and, if any, Article 3, paragraph 4, of the Kyoto Protocol (KP-LULUCF), by gas and by sector and activity, respectively. In table 1, 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. Tables 3–5 provide information on the most important emissions and removals and accounting parameters that will be included in the compilation and accounting database.

[1] 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, of the Kyoto Protocol, by gas, base year to 2010[a]

			Gg CO_2 eq								*Change*
		Greenhouse gas	*Base year*[a]	*1990*	*1995*	*2000*	*2005*	*2008*	*2009*	*2010*	*Base year –2010 (%)*
Annex A sources		CO_2	457 376.80	457 376.80	490 478.15	563 807.38	580 257.11	575 611.53	542 348.11	544 877.91	19.1
		CH_4	71 976.44	71 976.44	85 893.41	94 806.09	99 031.93	94 730.20	91 632.82	90 553.15	25.8
		N_2O	49 242.22	49 242.22	53 863.18	48 697.12	50 406.28	51 779.80	47 170.90	47 141.01	–4.3
		HFCs	767.25	767.25	479.41	2 936.12	5 296.47	5 550.65	6 306.34	7 072.55	821.8
		PFCs	6 538.83	6 538.83	5 489.59	4 311.08	3 317.26	2 252.32	2 171.97	1 607.52	–75.4
		SF_6	3 392.20	3 392.20	2 395.56	3 051.86	1 492.14	683.95	393.06	466.06	–86.3
KP-LULUCF	Article 3.3[b]	CO_2						13 432.79	13 535.70	13 596.78	
		CH_4						224.10	225.82	232.22	
		N_2O						137.87	140.45	142.85	
	Article 3.4[c]	CO_2	3 721.13					–11 712.01	–12 405.89	–13 077.10	–451.4
		CH_4	IE, NO					IE, NO	IE, NO	IE, NO	NA
		N_2O	11.10					0.70	0.37	0.38	–96.6

Abbreviations: IE = included elsewhere, KP-LULUCF = land use, land-use change and forestry emissions and removals from activities under Article 3, paragraphs 3 and 4, of the Kyoto Protocol, NA = not applicable, 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[a] to 2010

			Gg CO_2 eq							*Change*
		Sector	*Base year[a]*	*1990*	*1995*	*2000*	*2005*	*2008*	*2009*	*2010*	*Base year –2010 (%)*
Annex A		Energy	467 233.41	467 233.41	508 132.83	588 612.13	599 349.24	591 022.00	560 254.82	561 660.06	20.2
		Industrial processes	55 978.49	55 978.49	57 472.54	52 054.26	59 721.11	58 465.57	51 093.86	51 807.17	–7.5
		Solvent and other product use	178.71	178.71	212.58	449.60	378.00	341.62	260.49	241.97	35.4
		Agriculture	46 698.73	46 698.73	52 557.14	55 495.28	57 972.74	58 455.26	56 028.15	55 533.37	18.9
		Waste	19 204.39	19 204.39	20 224.21	20 998.39	22 380.09	22 324.00	22 385.88	22 475.64	17.0
		LULUCF	NA	–67 485.56	185 970.84	–62 107.82	53 535.12	–16 937.69	–12 086.88	71 963.80	NA
		Total (with LULUCF)	**NA**	**521 808.18**	**824 570.15**	**655 501.85**	**793 336.30**	**713 670.76**	**677 936.32**	**763 682.01**	**NA**
		Total (without LULUCF)	**589 293.74**	**589 293.74**	**638 599.30**	**717 609.66**	**739 801.18**	**730 608.45**	**690 023.19**	**691 718.21**	**17.4**
		Other[b]	NA	NA	NA	NA	NA	NA	NA	NA	NA
KP-LULUCF	Article 3.3[c]	Afforestation and reforestation						–737.97	–796.66	–856.13	
		Deforestation						14 532.73	14 698.64	14 827.98	
		Total (3.3)						**13 794.76**	**13 901.98**	**13 971.85**	
	Article 3.4[d]	Forest management						NA	NA	NA	
		Cropland management	3 732.22					–11 711.31	–12 405.51	–13 076.72	–450.4
		Grazing land management	NA					NA	NA	NA	NA
		Revegetation	NA					NA	NA	NA	NA
		Total (3.4)	**3 732.22**					**–11 711.31**	**–12 405.51**	**–13 076.72**	**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, LULUCF = land use, land-use change and forestry, NA = not applicable.

[a] "Base year" for Annex A sources refers to the base year under the Kyoto Protocol, which is 1990 for 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 for the year 2010, including the commitment period reserve

	As reported	*Revised estimates*	*Adjustment*[a]	*Final*[b]
Commitment period reserve	2 512 613 494			2 512 613 494
Annex A emissions for current inventory year				
CO_2	544 877 912			544 877 912
CH_4	90 550 372	90 553 152		90 553 152
N_2O	47 135 625	47 141 012		47 141 012
HFCs	7 072 550			7 072 550
PFCs	1 607 523			1 607 523
SF_6	466 062			466 062
Total Annex A sources	**691 710 043**	**691 718 210**		**691 718 210**
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	–856 132			–856 132
3.3 Afforestation and reforestation on harvested land for current year of commitment period as reported	NA			NA
3.3 Deforestation for current year of commitment period as reported	14 827 983			14 827 983
Activities under Article 3, paragraph 4, for current inventory year[c]				
3.4 Forest management for current year of commitment period				
3.4 Cropland management for current year of commitment period	–13 076 721			–13 076 721
3.4 Cropland management for base year	3 732 221			3 732 221
3.4 Grazing land management for current year of commitment period				
3.4 Grazing land management for base year				
3.4 Revegetation for current year of commitment period				
3.4 Revegetation in base year				

Abbreviation: NA = not applicable.
[a] "Adjustment" is relevant only for Parties for which the expert review team has calculated one or more adjustment(s).
[b] "Final" includes revised estimates, if any, and/or adjustments, if any.
[c] Activities under Article 3, paragraph 4, are relevant only for Parties that elected one or more such activities.

Table 4
Information to be included in the compilation and accounting database in t CO_2 eq for the year 2009

	As reported	*Revised estimates*	*Adjustment*[a]	*Final*[b]
Annex A emissions for 2009				
CO_2	542 348 107			542 348 107
CH_4	91 630 041	91 632 821		91 632 821
N_2O	47 165 513	47 170 900		47 170 900
HFCs	6 306 342			6 306 342
PFCs	2 171 966			2 171 966
SF_6	393 058			393 058
Total Annex A sources	**690 015 027**	**690 023 195**		**690 023 195**
Activities under Article 3, paragraph 3, for 2009				
3.3 Afforestation and reforestation on non-harvested land for 2009 as reported	–796 659			–796 659
3.3 Afforestation and reforestation on harvested land for 2009 as reported	NA			NA
3.3 Deforestation for 2009 as reported	14 698 636			14 698 636
Activities under Article 3, paragraph 4, for 2009[c]				
3.4 Forest management for 2009				
3.4 Cropland management for 2009	–12 405 512			–12 405 512
3.4 Cropland management for base year	3 732 221			3 732 221
3.4 Grazing land management for 2009				
3.4 Grazing land management for base year				
3.4 Revegetation for 2009				
3.4 Revegetation in base year				

Abbreviation: NA = not applicable.
[a] "Adjustment" is relevant only for Parties for which the expert review team has calculated one or more adjustment(s).
[b] "Final" includes revised estimates, if any, and/or adjustments, if any.
[c] Activities under Article 3, paragraph 4, are relevant only for Parties that elected one or more such activities.

Table 5
Information to be included in the compilation and accounting database in t CO_2 eq for the year 2008

	As reported	*Revised estimates*	*Adjustment*[a]	*Final*[b]
Annex A emissions for 2008				
CO_2	575 611 529			575 611 529
CH_4	94 726 864	94 730 204		94 730 204
N_2O	51 773 330	51 779 801		51 779 801
HFCs	5 550 652			5 550 652
PFCs	2 252 319			2 252 319
SF_6	683 946			683 946
Total Annex A sources	**730 598 641**	**730 608 451**		**730 608 451**
Activities under Article 3, paragraph 3, for 2008				
3.3 Afforestation and reforestation on non-harvested land for 2008 as reported	–737 966			–737 966
3.3 Afforestation and reforestation on harvested land for 2008 as reported	NA			NA
3.3 Deforestation for 2008 as reported	14 532 728			14 532 728
Activities under Article 3, paragraph 4, for 2008[c]				
3.4 Forest management for 2008				
3.4 Cropland management for 2008	–11 711 313			–11 711 313
3.4 Cropland management for base year	3 732 221			3 732 221
3.4 Grazing land management for 2008				
3.4 Grazing land management for base year				
3.4 Revegetation for 2008				
3.4 Revegetation in base year				

Abbreviation: NA = not applicable.
[a] "Adjustment" is relevant only for Parties for which the expert review team has calculated one or more adjustment(s).
[b] "Final" includes revised estimates, if any, and/or adjustments, if any.
[c] Activities under Article 3, paragraph 4, are relevant only for Parties that elected one or more such activities.

II. Technical assessment of the annual submission

A. Overview

1. Annual submission and other sources of information

6. The 2012 annual inventory submission was submitted on 11 April 2012; it contains a complete set of common reporting format (CRF) tables for the period 1990–2010 and a national inventory report (NIR). Canada also submitted information required under Article 7, paragraph 1, of the Kyoto Protocol, including information on: activities under Article 3, paragraphs 3 and 4, of the Kyoto Protocol, accounting of Kyoto Protocol units, changes in the national system and in the national registry, and the minimization of adverse impacts in accordance with Article 3, paragraph 14, of the Kyoto Protocol. The standard electronic format (SEF) tables were submitted on 11 April 2012. The annual submission was submitted in accordance with decision 15/CMP.1.

7. Canada officially submitted revised emission estimates on 19 October 2012 in response to the list of potential problems and further questions raised by the expert review team (ERT) during the review week, including information on KP-LULUCF. It submitted revised estimates for CH_4 and N_2O emissions for the category other (manufacturing industries and construction) – cement other fuels. The figures contained in this report are those submitted by the Party on 19 October 2012.

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

Completeness of inventory

10. The inventory covers all mandatory[4] source and sink categories for the period 1990–2010 and is complete in terms of geographical coverage. In response to the list of potential problems and further questions raised by the ERT during the review week, Canada submitted revised estimates of CH_4 and N_2O emissions for the category other (manufacturing industries and construction) – cement other fuels which was previously reported as not estimated ("NE").

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

[4] Mandatory source and sink categories under the Kyoto Protocol are all source and sink categories for which the Intergovernmental Panel on Climate Change (IPCC) *Revised 1996 IPCC Guidelines for National Greenhouse Gas Inventories*, the IPCC *Good Practice Guidance and Uncertainty Management in National Greenhouse Gas Inventories* and the IPCC *Good Practice Guidance for Land Use, Land-Use Change and Forestry* provide methodologies and/or emission factors to estimate GHG emissions.

11. CH_4 emissions from industrial, domestic and commercial wastewater sludge are reported by the Party as "NE"; however, in response to a question from the ERT during the review, Canada provided information indicating that such emissions should be reported as not occurring ("NO"), which the ERT agreed with. Further, information on land area and all carbon pools for wetlands and settlements converted to cropland, grassland remaining grassland, grassland and cropland converted to wetlands, and land converted to grassland are reported by Canada as "NE". The ERT recommends that Canada improve on its reporting of carbon pools for these subcategories.

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

Overview

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

13. The Party reported in the NIR that there had been no changes to the national system since its previous annual submission.

Inventory planning

14. The NIR described the national system for the preparation of the inventory. The Pollutant Inventories and Reporting Division of Environment Canada has overall responsibility for the national inventory, on the basis of the Canadian Environmental Protection Act. The responsibilities of the Division are: inventory planning and prioritization; GHG emission estimation and analysis; NIR preparation; quality assurance/quality control (QA/QC) and verification; and archiving. Environment Canada also collaborates with provincial and territorial governments.

15. Other organizations are also involved in the preparation of the inventory as data providers. Statistics Canada provides activity data (AD) for the inventory, such as the energy balance, information on mining and electricity, data on urea and ammonia production and data on crop production and agricultural management practices.

16. Agriculture and Agri-Food Canada and the Canadian Forest Service of Natural Resources Canada are responsible for the development of key components of the LULUCF inventory, on the basis of a formal governance mechanism. In addition, Natural Resources Canada provides AD on mineral production, ethanol consumption and wood residues, as well as energy-related expertise and analysis. Transport Canada and Natural Resources Canada provide data on road vehicle fuel efficiency.

17. In accordance with a bilateral agreement with the Aluminum Association of Canada, estimates of CO_2, PFC and SF_6 emissions are provided annually to Environment Canada.

18. Canada has a QA/QC plan (see para. 31 below) and procedures for the official consideration and approval of the inventory in place.

19. The ERT considers that Canada's legal, procedural and institutional arrangements are in line with the general and specific functions of national systems defined in the annex to decision 19/CMP.1.

Inventory preparation

Key categories

20. Canada has reported a tier 1 key category analysis, both level and trend assessment, as part of its 2012 annual submission. The ERT noted that, in the NIR, Canada reported the results of the 2009 key category analysis instead of the results for 2010. In response to a question from the ERT, Canada provided the key category analysis tables for 2010. The ERT recommends that Canada enhance its QC procedures in order to avoid such errors in the future.

21. The key category analysis performed by the Party and that performed by the secretariat[5] produced similar results. However, Canada's analysis did not identify N_2O emissions from adipic acid production, reported as not applicable ("NA") for 2010, as a key category according to the trend analysis. Canada has included the LULUCF sector in its key category analysis, which was performed in accordance with the Intergovernmental Panel on Climate Change (IPCC) *Good Practice Guidance and Uncertainty Management in National Greenhouse Gas Inventories* (hereinafter referred to as the IPCC good practice guidance) and the IPCC *Good Practice Guidance for Land Use, Land-Use Change and Forestry* (hereinafter referred to as the IPCC good practice guidance for LULUCF). The ERT encourages Canada to progress to a tier 2 key category analysis, in line with the longer-term vision for improvements explained by Canada in annex 7 to its NIR.

22. In CRF table 7 Canada lists both the key and non-key categories and indicates which categories are identified as key. The ERT encourages Canada to include only the key categories in that table.

23. Canada has identified key categories for activities under Article 3, paragraphs 3 and 4, of the Kyoto Protocol, for both 1990 and 2010, and has reported them in the KP-LULUCF CRF tables but not in the NIR. The ERT recommends that Canada report the KP-LULUCF key categories in the NIR of its next annual submission.

Uncertainties

24. Canada has estimated uncertainties using the tier 1 level and trend assessment for the entire inventory and using a tier 2 method for specific categories. Canada has included the LULUCF sector in the uncertainty analysis but has not reported trend uncertainties including LULUCF. In response to a question raised by the ERT during the review, Canada explained that trend uncertainties including LULUCF are not reported due to the high annual variability in the emissions and removals from the LULUCF sector, which is primarily driven by natural factors. The Party explained that it will consider reporting trend uncertainties including LULUCF in the future. The ERT reiterates the recommendation contained in the previous review report that Canada report the results of its trend uncertainty analysis including LULUCF in its next annual submission.

25. The uncertainty of the emission level in 2010 is 3.9 per cent excluding LULUCF (the same as for 2009, as reported in the 2011 annual submission) and 6.1 per cent including LULUCF (compared with 7.1 per cent for 2009). The trend uncertainty excluding LULUCF is 0.7 per cent for 2010 compared with 0.7 per cent for 2009.

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

26. The ERT noted that not all rows were shown in NIR table A7–1, "Uncertainty Assessment Level and Trend without LULUCF". In response to a question from the ERT, Canada sent the complete table. The ERT noted that Canada had reported some of the uncertainties for AD as zero. In response to a further question from the ERT, Canada explained that for categories for which Monte Carlo uncertainty analysis was applied (e.g. road transportation) the combined uncertainty was presented in the emission factor (EF) uncertainty column and the AD uncertainty was reported as zero. In addition, some transcription errors were identified by the Party. The ERT recommends that Canada correct the identified errors in its next annual submission and improve QC procedures in order to avoid such errors in the future.

27. According to the NIR, the tier 2 uncertainty analysis developed by Canada is no longer representative as it is based on superseded methodologies used to develop the 2001 GHG inventory. Canada explains in the NIR that in the longer term it plans to improve the uncertainty analysis and use the earlier Monte Carlo simulation data and methods as the basis for the analysis. In addition, Canada reports in the NIR on its plans to improve uncertainty estimates incrementally over several years, for example by reviewing and updating the assumptions used. Canada also reports in the NIR on its plans to carry out additional expert elicitation, for example in relation to the energy sector, to improve uncertainty estimates. The ERT welcomes these plans and encourages Canada to report in its next NIR on the progress in the implementation of these specific planned improvements to its uncertainty analysis.

Recalculations and time-series consistency

28. Recalculations have been performed and reported in accordance with the IPCC good practice guidance. Canada reported in the NIR that recalculations were undertaken in response to recommendations contained in the previous review report, the findings of an internal review and quality measures as well as to take into account new AD and EFs.

29. The ERT noted that recalculations reported by the Party of the time series 1990 to 2009 have been undertaken to: correct errors (in the categories fuel combustion, petroleum refining and mining; manufacture of solid fuels and other energy industries; enteric fermentation; manure management; and agricultural soils); use new AD (for road transportation and wetlands); take into account improvements in methodologies, EFs and parameters (concerning civil aviation; fugitive emissions from fuels; coal mining and handling; ammonia production; aluminium production; waste incineration; and other (industrial processes)); and improve the completeness of the GHG inventory (with regard to petroleum refining; limestone and dolomite use; soda ash use; solid waste disposal on land; and waste incineration). The major changes, and the magnitude of the impact, include a 0.3, 0.4 and 0.3 per cent decrease in the estimated total GHG emissions in the base year, 2008 and 2009, respectively. With regard to the emission estimates for 2009, the impact of the significant recalculations includes:

(a) A 0.4 per cent decrease in the estimate of CO_2 emissions from road transportation;

(b) A 0.3 per cent decrease in the estimate of CO_2 emissions from other sectors;

(c) A 0.3 per cent decrease in the estimate of CO_2 emissions from oil and natural gas;

(d) A 0.2 per cent decrease in the estimate of CO_2 emissions from chemical industry;

(e) A 0.8 per cent decrease in the estimate of CO_2 emissions from the category other (industrial processes).

30. The rationale for the recalculations is provided in the NIR and in CRF table 8(b), except for explanations for recalculations performed in relation to relevant KP-LULUCF activities

Verification and quality assurance/quality control approaches

31. Canada provides information on the QA/QC plan and procedures in annex 6 to the NIR. QA/QC procedures are implemented throughout the inventory process, from initial data collection through development of emission and removal estimates to inventory publication.

32. The QC procedures follow the IPCC good practice guidance and include systematic tier 1 checks, which are performed annually, at least for the key categories. The tier 2 QC procedures involve a variety of approaches, such as tracing inputs to their root sources and assessing the applicability of methods, EFs and AD. In the NIR Canada provides examples of the issues identified during the QC process, such as the need to revise the historical AD for fuel combustion and the CO_2 EFs for coal, which resulted in a recalculation of the relevant estimates.

33. QA procedures are carried out annually in relation to selected data and methods and consist of review activities undertaken by independent experts. The experts involved represent industry, academia and government.

34. Verification of emissions data is carried out, for example, by comparing the inventory estimates with data obtained from Canada's facility-level Greenhouse Gas Emissions Reporting Program.

35. The ERT noted that there are some inconsistencies in the information reported in different CRF tables, such as the explanations for notation keys used provided in CRF table 9 and the actual notation keys used in the other CRF tables, as well as in the information provided in CRF table summary 3 on methods and EFs and the respective information provided in the NIR. For example, according to the NIR the method used to estimate emissions from HCFC-22 production is tier 1, whereas in CRF table summary 3 the method is reported as "NA". In addition, the ERT identified QC problems with regard to the reporting of uncertainties and key categories (see paras. 20 and 26 above). The ERT recommends that Canada further improve its QC procedures, in order to avoid such errors in its next annual submission.

36. The ERT noted that Canada does not have specific QC procedures in place for the KP-LULUCF inventory. It therefore recommends that Canada carry out QC procedures also in relation to the data that are specific to KP-LULUCF.

Transparency

37. In the previous review report it was recommended that Canada improve the transparency of its reporting for the energy, industrial processes, waste and KP-LULUCF sectors. The ERT reiterates the recommendation made in the previous review report that Canada improve the transparency of the information provided in the NIR and the CRF tables with regard to the energy sector (see para. 50 below), iron and steel plants (see para. 75 below), the methods used to estimate emissions of HFCs and PFCs (see para. 77 below), the breakdown of limestone and dolomite use (see para. 79 below) and the composition of incinerated waste (see para. 101 below) in its next annual submission.

38. The ERT notes that the structure and content of the NIR does not follow the annotated outline of the NIR. In particular, Canada has not included part II of the NIR (supplementary information required under Article 7, paragraph 1) but has included the required information in annex 11 to the NIR suggested by the secretariat. The ERT

encourages Canada to structure its NIR in line with the above-mentioned annotated outline, in order to improve the transparency of its next annual submission.

39. The ERT noted that the erroneous use of notation keys hinders transparency in a number of cases (see paras. 52 and 78 below). For example, CO_2 emissions from adipic acid production are reported as "NE" for 2010, whereas N_2O emissions are reported as "NA". In the NIR Canada explains that adipic acid production ceased in 2009. Therefore, the correct notation key would be "NO" for both CO_2 and N_2O emissions. The ERT recommends that Canada improve the transparency of its next annual submission by ensuring that the notation keys are used correctly.

Inventory management

40. Canada has a centralized archiving system, which includes the archiving of disaggregated EFs and AD and documentation on how these factors and data have been generated and aggregated for the preparation of the inventory. The archived information also includes internal documentation on QA/QC procedures, external and internal reviews, and documentation on annual key categories and key category identification and planned inventory improvements. The Pollutant Inventories and Reporting Division of Environment Canada keeps the archive. During the review, the ERT was provided with the requested additional archived information.

3. Follow-up to previous reviews

41. The ERT noted a number of improvements made by Canada following recommendations made in the previous review report, including:

(a) Submitting its inventory by 15 April 2012;

(b) Improving the transparency of its annual submission (e.g. by enhancing information contained in Annex 4 to the NIR in relation to the energy sector and providing information explaining the different methods used to estimate N_2O emissions from nitric acid production in the industrial processes sector);

(c) Improving the quality of the GHG inventory by addressing errors (e.g. correcting the mistakes in AD and EFs used to estimate fugitive emissions from oil refining, and using the same CO_2 EF for natural gas to estimate emissions in the energy and in the industrial processes (ammonia production) sectors) and implementing planned improvements (e.g. using information on the calcium oxide content of clinker to develop a country-specific EF to estimate CO_2 emissions from cement production (industrial processes), and acquiring the necessary AD for a tier 1a approach to estimate CO_2 emissions from ammonia production (industrial processes);

(d) Providing revised estimates in response to the adjustment recommended in the previous review report regarding the emission estimates for wastewater handling (waste sector).

42. The ERT noted that the publication date of the 2011 annual review report (ARR) for Canada was 26 April 2012 and therefore after the official submission of the Party's 2012 annual submission. The ERT noted the following outstanding recommendations contained in the 2011 ARR, accepting that Canada has not had sufficient time to react to them but recommending that they be implemented for the Party's 2013 annual submission:

(a) To include the LULUCF sector in the trend uncertainty analysis;

(b) With regard to the energy sector GHG inventory, to improve the transparency of the inventory (see para. 50 below), its accuracy (see paras. 51 and 58 below) and reporting in relation to waste incineration with energy recovery (see para. 53 below), non-energy use of fuels in regards to apparent fuel consumption (see para. 55 below) and

emission estimates for fuel categories in line with the *Revised 1996 IPCC Guidelines for National Greenhouse Gas Inventories* (hereinafter referred to as the Revised 1996 IPCC Guidelines) (see para. 49 below);

(c) With regard to the industrial processes sector, to improve the transparency of the inventory (see paras. 72, 73, 75, 78 and 79 below) and its accuracy (see para. 76 below);

(d) To include information in the NIR on its choice not to revert managed grassland to unmanaged land because of scientific uncertainty as to what determines the reversion of managed land to unmanaged (LULUCF sector);

(e) To provide an estimate of emissions and removals from grassland remaining grassland (LULUCF sector);

(f) Regarding cropland remaining cropland (LULUCF sector), to use reconstruction methods for the AD prior to 1970 that are not more demanding than the current assumption of "no changes in management practices", an assumption that leads to an ever increasing amount of "residual emissions", as acknowledged by Canada in its NIR;

(g) To provide evidence that the estimation method used for the LULUCF category land converted to wetlands provides unbiased estimates regarding the decay of submerged biomass, or to revert to a tier 1 approach for the category land converted to wetlands, or to use a longer conversion period than 10 years for the category land converted to wetlands; and

(h) To provide a clear explanation in the NIR of the separation of non-CO_2 emissions from harvest residue burning after deforestation from emissions from crop residue burning, and to include "emissions/removals from Article 3.4 activities that are not accounted for under activities under Article 3.3" in table A11–1 of the NIR, which is related to reporting requirements under decision 15/CMP.1.

43. The ERT noted that, in accordance with decision 15/CMP.1, annex, paragraph 4, each Party included in Annex I to the Convention shall describe in its annual inventory any steps taken to improve estimates in areas that were previously adjusted. In the previous review report an adjustment was applied in the category wastewater handling. However, in its 2012 annual submission Canada did not provide information in its NIR on steps undertaken to improve the estimate of N_2O emissions from human sewage in line with the above-mentioned requirement. In response to a question raised by the ERT with regard to that requirement, Canada explained that the estimation methodology was modified as a result of the adjustment and that this information will be included in its next annual submission (see para. 100 below).

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

44. During the review, the ERT identified several issues for improvement. These are listed in table 6 below.

45. Recommended improvements relating to specific categories are presented in the relevant sector chapters of this report and in table 6 below.

B. Energy

1. Sector overview

46. The energy sector is the main sector in the GHG inventory of Canada. In 2010, emissions from the energy sector amounted to 561,660.06 Gg CO_2 eq, or 81.2 per cent of total GHG emissions. Since 1990, emissions have increased by 20.2 per cent. The key drivers for the rise in emissions are road transportation and the fossil fuel industry. Within the sector, 34.7 per cent of the emissions were from transport, followed by 27.5 per cent

from energy industries, 14.4 per cent from manufacturing industries and construction, 12.9 per cent from other sectors, 10.3 per cent from oil and natural gas and 0.2 per cent from solid fuels. The remaining 0.01 per cent were emissions from the category other (fuel combustion).

47. The Party has reported recalculations for the energy sector, which have resulted from changes in AD and EFs and the need to rectify identified errors. The impact of these recalculations on the energy sector is decreases in the estimated emissions of 0.3 per cent for 1990, 1.1 per cent for 2008 and 1.1 per cent for 2009. Canada has recalculated the AD and emissions for all combustion categories on the basis of an improved allocation of the energy statistics for the years 2003–2009. The reallocation had no effect on the estimate of the total fuel consumed but had a large effect on the estimated fuel consumption of some of the categories (e.g. a decrease of 136.45 PJ (37.7 per cent)) in gaseous fuel use in the category other (manufacturing industries and construction). The other main recalculations took place in the following categories:

(a) CO_2 emissions from oil and natural gas;

(b) CO_2, CH_4 and N_2O emissions from road transportation;

(c) CO_2, CH_4 and N_2O emissions from petroleum refining.

48. The ERT observed that CH_4 and N_2O emissions from the combustion of waste tyres in cement kilns were not reported in the 2012 annual submission. In response to the list of potential problems and further questions raised by the ERT during the review week, Canada submitted estimates of these emissions for all years of the time series (see para. 67 below). For 2010, this has resulted in a 4.1 and 0.6 per cent increase in the estimated CH_4 and N_2O emissions, respectively, or a combined increase in the estimated emissions of 8.17 Gg CO_2 eq in this category.

49. Canada's categorization of fuels is based on the physical state of the fuel, as identified in the previous review report. Such a categorization is not in line with the Revised 1996 IPCC Guidelines. In response to a question raised by the ERT during the review, Canada indicated that it plans to implement the recommendation made in the previous review report and allocate fuel types in accordance with the Revised 1996 IPCC Guidelines. The ERT commends the Party for addressing this long-standing issue and recommends that it implement the planned improvement for its 2013 annual submission.

50. The ERT noted that most of the transparency issues raised in the previous review report have not been addressed in the Party's 2012 annual submission (e.g. the issues set out in paras. 32 (general), 44 (energy statistics), 45 (imported natural gas), 48 (flaring AD), 51 (coal production data), 55 (oil production data), 59 (biomass AD), 61 (iron and steel industry and coke production) and 62 (carbon content of coke) of the 2011 ARR). The Party informed the ERT that a number of the recommendations have not yet been able to be implemented and, for some of the recommendations, implementation times are difficult to predict (as a result of prioritization and the time needed for research). The ERT reiterates the above-listed recommendations made in the 2011 ARR, with a view to the improvement of the transparency of the NIR in relation to these issues.

51. Canada provided the ERT with the same response with regard to the observation that the accuracy issues raised in the previous review report have not been addressed in the 2012 annual submission (e.g. the issues set out in paras. 40 (coke in CRF table 1.A(d)), 46 (EF of imported natural gas) and 54 (units used in CRF tables) of the 2011 ARR). The ERT also reiterates the recommendations made in the 2011 ARR with regard to improving the accuracy of the annual submission.

52. Where a specific fuel is not used in a category, Canada uses the notation key "NA" to report this. The ERT recommends that the Party use "NO" instead.

53. Canada informed the ERT during the previous review that it planned to correct the allocation of waste incineration with energy recovery to the energy industries category. Such an improvement has not yet been implemented. The Party informed the present ERT that a waste incineration survey is currently under way for the years 2010 and 2011. The incorporation of the resultant data, as well as data from previous surveys, and the subsequent reallocation of the relevant estimated emissions to the energy sector will be reviewed by the Party for completeness and accuracy before incorporation in its future annual submissions. The ERT appreciates this planned improvement, which is in line with the IPCC good practice guidance, and recommends that the Party implement the improvement as soon as possible in a future annual submission.

2. Reference and sectoral approaches

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

54. Canada has reported a comparison of the emission estimates calculated using the sectoral and reference approaches. The comparison is presented in CRF table 1.A(c) and in annex 4 to the NIR and shows a difference in the estimated fuel consumption, with the estimate calculated using the reference approach being higher than that calculated using the sectoral approach by 2.5 per cent for 1990 and 0.2 per cent for 2010. Furthermore, the comparison shows a difference in the estimated CO_2 emissions, with the estimate calculated using the reference approach being lower than that calculated using the sectoral approach by 0.1 per cent for 1990 and 0.5 per cent for 2010.

55. The ERT identified that "apparent fuel consumption" and "apparent fuel consumption (excluding non-energy use and feedstocks)" reported in CRF table 1.A(c) were equal for solid fuels and gaseous fuels. The Party indicated that the non-energy use of gaseous and solid fuels is already excluded from the apparent fuel consumption in the column "apparent fuel consumption" and is therefore also excluded from the "apparent fuel consumption (excluding non-energy use and feedstocks)". The comparison of the reference and sectoral approaches is not changed by this. However, excluding the non-energy use of fuels from the apparent fuel consumption is not in line with the Revised 1996 IPCC Guidelines. The ERT recommends that the Party, in its next annual submission, include the non-energy use of fuels in the apparent fuel consumption and exclude it from the "apparent fuel consumption (excluding non-energy use and feedstocks)".

56. The reported apparent fuel consumption is lower than that reported to the International Energy Agency (IEA) for all years of the inventory time series by 13–22 per cent. The growth rate over the period 1990–2010 of the total apparent fuel consumption is 19.6 per cent according to the CRF tables but 20 per cent according to IEA data. During the review, the Party explained that the National Inventory Group (at Environment Canada) is engaged in discussions with the agencies reporting to IEA, with a view to trying to reconcile any differences in data. The ERT encourages Canada to continue its efforts to reconcile the differences between the data reported to IEA and those reported in the CRF tables and to report thereon in its next annual submission.

International bunker fuels

57. The calculation of the amount of fuel used for international aviation bunkers is based on the location of the origin and destination airports. This is in line with the IPCC good practice guidance. The difference in total jet kerosene and aviation gasoline use between the data reported to IEA and those reported in the CRF tables is –1.1 per cent. The difference in jet kerosene use for civil aviation is +97.8 per cent and the difference in jet kerosene use for aviation bunkers is –66.2 per cent. Canada attributed these differences to different methodologies being used: in the CRF tables the split between domestic and

international use of jet kerosene is based on the location of the origin and destination airports, while the IEA data are based on the amount of fuel sold to domestic and international carriers. The ERT recommends that Canada clarify this issue in its next NIR in order to improve transparency.

58. The calculation of the amount of fuel used for international marine bunkers is based on data on fuel sold to foreign marine vessels, which may result in an underestimate of the fuel used for international marine bunkers because it may not fully include foreign trips made by Canadian vessels, in accordance with the criteria for defining international and domestic marine transport presented in chapter 2, table 2.8, of the IPCC good practice guidance. In response to a question raised by the ERT during the review, Canada indicated that the Marine Emission Inventory Tool (MEIT) has been built to estimate emissions from shipping. It informed the ERT that the model's primary purpose is to estimate point source emissions from ships in use within the boundaries of Canadian waters and that it may offer a little additional capacity to help split the fuel sold in Canada into that used for domestic or international shipping purposes; thus, MEIT has not been used for the inventory. Canada indicated that the current method will need to be used for now since other improvements have priority. The ERT reiterates the recommendation made in the previous review reports that Canada make further efforts to allocate fuel to domestic and international navigation separately in accordance with the IPCC good practice guidance.

Feedstocks and non-energy use of fuels

59. In the sectoral approach, the non-energy use of fuels is accounted for under the industrial processes sector, which is in line with the Revised 1996 IPCC Guidelines. The ERT noted that the amount of associated CO_2 emissions allocated to the category other (industrial processes) in CRF table 1.A(d) is not equal to the emissions reported in the category other (industrial processes) in CRF table 2(I). In response to a question raised by the ERT during the review, Canada clarified that emissions from the non-energy use of petroleum coke are allocated to the category aluminium production (instead of to the category other (industrial processes) as CRF table 1.A(d) states). Canada also provided an explanation for the remaining differences of 925 Gg between the values in CRF table 1.A(d) and table 2(I).A-G, which are due to anode consumption in the electric arc furnaces in the iron and steel production and to some peripheral non-energy fuel types (e.g., diesel oil and heavy fuel oil). The ERT recommends that the Party change the emission allocation reported in CRF table 1.A(d) for petroleum coke to aluminium production and that it provide an explanation for the differences between the values in CRF table 1.A(d) and table 2(I).A-G in the NIR.

60. During the review, Canada informed the ERT that the carbon stored in non-energy use of fuels for naphtha was incorrectly entered in CRF table 1.A(d). The ERT recommends that the Party correct this error in its next annual submission and implement additional QA/QC procedures to prevent this type of error from occurring in the future.

3. Key categories

Stationary combustion: gaseous, liquid and solid fuels – CO_2, CH_4 and N_2O[6]

61. The ERT noted that the energy conversion factors reported in NIR table A4–2 and in the Canadian energy statistics differ by a factor of 1,000 for the fuels still gas and coke oven gas. The Party informed the ERT that the units in table A4–2 should be TJ/GL

[6] Not all emissions related to all gases under this category are key categories, particularly CH_4 and N_2O emissions. However, since the calculation procedures for issues related to this category are discussed as whole, the individual gases are not assessed in separate sections.

(instead of TJ/ML) for those fuels. This does not affect the emission calculations since the Party uses AD in natural units for calculating the emissions. The ERT recommends that the Party correct the aforementioned units in the NIR and ensure the proper conversion of the AD by implementing additional QA/QC procedures.

62. In NIR table A2–1 the Party provides a link between the CRF categories and the Canadian energy balance[7]. The ERT identified that the energy use reported in the CRF tables is different from the corresponding data in the Canadian energy balance (when the guidance on AD in table A2–1 of the NIR is followed). For liquid fuels the Canadian energy balance reports about 6 per cent greater energy consumption than the data provided in the CRF tables. Canada clarified during the review that the difference is caused by the categories international bunkers and ethanol from road transportation, which are both reported in the energy statistics but not reported under fuel combustion – liquid fuels in the CRF tables. Also, Canada indicated that the preliminary version of the Canadian energy balance used for the emission calculations is subject to slight variations compared with the final version. The ERT recommends that Canada provide an explanation for the differences between the data in the energy balance and in the CRF tables in its next NIR, in order to improve transparency.

Road transportation: liquid fuels and biomass – CO_2, CH_4 and N_2O[8]

63. The Party indicated in the NIR that recalculations have been performed for road transportation due to the incorporation of updated ethanol fuel consumption data from a new biofuels study. The amounts of bioethanol are included in the energy statistics under gasoline and thus need to be extracted from those statistics. The amounts of biodiesel are not included in the energy statistics under diesel and thus need to be added to those statistics. At the request of the ERT the Party provided additional information on the AD for biofuels. The ERT recommends that the detailed information provided by Canada in response to the questions raised on the above issue also be included in the Party's next NIR.

64. Canada calculates the GHG emissions from road transportation following a tier 3 approach. The fuel consumption is calculated using both top-down and bottom-up approaches and the difference between the resulting estimates is used to allocate the fuel to road transportation and off-road transportation. Canada indicated that all fuel sold (as provided in the energy statistics) is allocated to on-road and off-road transportation. The ERT recommends that the Party show the results of the bottom-up and top-down approaches to calculating fuel consumption in the NIR and explain in the NIR that all fuel is accounted for in accordance with the IPCC good practice guidance.

Oil and natural gas: CO_2, CH_4 and N_2O[9]

65. The ERT noted that the energy consumption of refineries, which is used as AD in the category refining/storage, has been recalculated in the 2012 annual submission for the entire time series. During the review, the Party clarified, in response to a question raised by the ERT, that the AD for this category consist of the fuel consumption reported under petroleum refining plus the fuel consumption reported for flaring. In addition, the Party indicated that an error has been made in the AD for the category refining/storage, causing an overestimation of emissions for the entire time series. The Party intends to correct this in

[7] Report on Energy Supply and Demand in Canada 2010, version 3, February 2012.

[8] Not all emissions related to all gases under this category are key categories, particularly CH_4 and N_2O emissions. However, since the calculation procedures for issues related to this category are discussed as whole, the individual gases are not assessed in separate sections.

[9] Not all emissions related to all gases under this category are key categories, particularly N_2O emissions. However, since the calculation procedures for issues related to this category are discussed as whole, the individual gases are not assessed in separate sections.

its next annual submission. The ERT recommends that the Party report on the recalculation in its next annual submission.

66. Canada indicated in the NIR that it performed a recalculation of the estimated emissions from flaring (oil). For one new company the Party previously used an EF from another company (because no other data were available). Since data on the specific company are now available, the Party has recalculated the estimated emissions, resulting in a decrease in the estimate of CO_2 emissions from flaring of 1,959.83 Gg (–31.1 per cent of emissions from flaring) for 2009. The Party informed the ERT that there are on-going studies that may provide improved AD and EFs the conventional upstream oil and gas industry and also coal mining EFs. The ERT commends the Party for using facility-specific EFs for flaring (oil) and recommends incorporating in subsequent annual submissions the updated EFs and AD resulting from the conclusion of these studies.

4. Non-key categories

Stationary combustion: other fuels – CH_4 and N_2O

67. In its original submission of 11 April 2012, in the category other (manufacturing industries and construction (cement)) the Party reports "NE" for CH_4 and N_2O emissions from other fuels. The Party provided the explanation that no CH_4 or N_2O emission estimates have been developed yet because there are no known EFs or studies available and they are likely to amount to less than 1 per cent of the CO_2 emissions. The Party indicated that the fuel used is "waste tyres", for which the ERT identified corresponding EFs in the Revised 1996 IPCC Guidelines (volume 3, tables 1–7 and 1–8, for the combustion of other biomass and waste in manufacturing industries and construction). The ERT listed this potential underestimate in the list of potential problems and further questions raised by the ERT during the review week and, in response, Canada submitted revised estimates that incorporated this previously missing emissions. The revised estimates were calculated using non-CO_2 EFs (for waste tyres) from the United States Environmental Protection Agency instead of the EFs set out in tables 1–7 and 1–8 of the Revised 1996 IPCC Guidelines, since the former specifically apply to the primary component of waste burned at cement facilities. The revised estimate led to an increase of emissions from this category by 3.05 Gg CO_2 eq for 1990 and 8.17 Gg CO_2 eq for 2010. The ERT concluded that the revised emission estimates were prepared in line with the Revised 1996 IPCC Guidelines. The ERT noted that the revised estimate of CH_4 emissions for 1991 is a copy of the estimate of CH_4 emissions for 1990 and recommends that Canada rectify this minor error in its next annual submission.

C. Industrial processes and solvent and other product use

1. Sector overview

68. In 2010, emissions from the industrial processes sector amounted to 51,807.17 Gg CO_2 eq, or 7.5 per cent of total GHG emissions, and emissions from the solvent and other product use sector amounted to 241.97 Gg CO_2 eq, or 0.03 per cent of total GHG emissions. Since 1990, emissions have decreased by 7.5 per cent in the industrial processes sector and increased by 35.4 per cent in the solvent and other product use sector. The key driver for the fall in emissions in the industrial processes sector is the decrease in N_2O emissions from chemical industry. However, the emission trend includes an increase in other emissions (e.g. from consumption of halocarbons and SF_6) as well as decreasing trends in particular categories. The emission trend in the solvent and other product use sector can be explained by the increase in domestic demand for N_2O for anaesthetic or propellant purposes. Within the industrial processes sector, 29.9 per cent of the emissions

were from metal production, followed by 28.2 per cent from the category other, 15.4 per cent from mineral products and 12.5 per cent from chemical industry. The remaining 14.1 per cent were from consumption of halocarbons and SF_6.

69. The Party has reported recalculations performed for the industrial processes sector between its 2011 and 2012 annual submissions, which were undertaken to address recommendations made in the previous review report and following changes in EFs. The impact of these recalculations on the industrial processes sector is an increase in the estimated emissions of 9.5 per cent for 2009. The main recalculations took place in the following categories:

(a) CO_2 emissions from limestone and dolomite use;

(b) CO_2 emissions from soda ash use;

(c) CO_2 emissions from ammonia production.

70. The inventories for the industrial processes and solvent and other product use sectors are generally complete. However, Canada states in the NIR that CO_2 emissions from asphalt roofing, road paving with asphalt and adipic acid production, CH_4 emissions from ammonia production and metal production, and N_2O emissions from ammonia production, PFC aerosols/metered dose inhalers and electrical equipment are not estimated, and are likely not to be occurring, but are all reported as "NE" in the CRF tables. The ERT encourages Canada to explore means of estimating emissions for which there are no methodologies available in the Revised 1996 IPCC Guidelines and the IPCC good practice guidance using country-specific or alternative methodologies.

2. Key categories

Cement production – CO_2

71. Canada has estimated CO_2 emissions from cement production using a tier 2 approach in accordance with the IPCC good practice guidance, using the default EF from the Revised 1996 IPCC Guidelines (0.5071 kt CO_2/kt clinker produced) and a default cement kiln dust correction factor of 1.02. In the previous review report it was noted that Canada planned to develop a country-specific EF based on the calcium oxide content of clinker; however, the development of that EF has yet to be realized. During the review, Canada explained that the country's cement industry is currently engaged in regulatory consultations with the Government and that priorities for improvements will be established accordingly. Nevertheless, the ERT reiterates the recommendation made in the previous review report that Canada pursue this improvement and report thereon in its next annual submission.

Lime production – CO_2

72. The ERT found that Canada corrected the estimate of total national lime production by using the proportion of hydrated lime production to total lime production and the water content in the hydrated lime, but it is not clear whether the AD presented in the CRF tables are the corrected or the original values. Canada clarified that the correction was taken into account when calculating the emission estimates but not when reporting the AD in the CRF tables. The previous review report states that Canada provided time-series AD for the production of high-calcium and dolomitic lime during the review week, and it was subsequently recommended that Canada include this information in its 2012 NIR, as well as information explaining the large decline in the share of dolomitic lime during the periods 1999–2000 and 2008–2009. In response to a question raised by the ERT during the review, Canada indicated that it would consider incorporating in its next NIR the above-mentioned

information. The present ERT reiterates the recommendation that the information be provided in its next annual submission.

Iron and steel production – CO_2

73. Canada states in the NIR that the reductant used to produce crude iron from iron ore is 100 per cent metallurgical coke. From this statement the ERT assumes that no other reductant is used. The ERT noted that the NIR states that GHG emissions associated with the use of reductants other than metallurgical coke are reported under other (industrial processes) and in the appropriate industrial category under the energy sector. In response to a question raised by the ERT during the review, it was found that Canada has, at times and using much lower quantities than the metallurgical coke, used reductants other than coal. Further, and in response to a question raised by the ERT during the review, Canada explained that CO_2 emissions associated with the use of other reductants have been allocated to the other and undifferentiated production category and to the iron and steel category under the energy sector. The ERT recommends that the Party increase transparency with regard to the use of metallurgical coke and other reductants for iron and steel production in the industrial processes and energy sectors in its next annual submission.

74. In response to a question raised by the ERT during the review, it was found that data on total pig iron production are confidential for the years 2008–2010; however, in the CRF tables only the data for 2009 are marked confidential. Canada explained that data on pig iron production are confidential only for the year 2009. The ERT recommends that the Party revise this misinformation when reporting in its next annual submission and that Canada enhance its QC procedures to prevent this type of error from occurring in the future.

75. In response to a question raised by the ERT during the review, Canada stated that it would implement a recommendation made in the previous review report and will improve the transparency of its reporting relating to the technologies used by its four major integrated iron and steel plants in the country, as reflected in the IPCC tier 2 method. The ERT reiterates the above-mentioned recommendation.

Consumption of halocarbons and SF_6 – HFCs

76. In the previous review report the previous ERT recommended that Canada increase the accuracy of its reporting of HFC emissions from consumption of halocarbons and SF_6 by developing country-specific EFs. In response to a question from the current ERT, Canada stated that, in 2012, it would undertake a study to determine country-specific HFC EFs. Further, Canada indicated that the results of that study would be likely to be incorporated in its 2014 annual submission. The ERT recommends that Canada report in its next annual submission on the progress made on the study.

77. The NIR provides explanations of EFs and underlying assumptions used to develop emission estimates for HFCs (1996–2009) and PFCs (1995–2009). The ERT found that it was not clear whether the same method had been used to estimate HFC and PFC emissions for 2010 as for the other years. Canada clarified during the review that the same method had been used to estimate emissions for 2010 and that the information in the NIR will be updated in its next annual submission. The ERT recommends that Canada address this transparency issue in its next annual submission.

Other (industrial processes) – CO_2

78. Emissions reported in the category other (industrial processes) are from the non-energy use of fossil fuels (e.g. the use of natural gas liquids, feedstocks in the chemical industry and lubricants) that are not accounted for elsewhere under the industrial processes

sector. Canada reports numerous activities under the category (other (non–specified)) in CRF table 2(I).A-G, but AD are reported as "NA". CO_2 emissions in this category are reported as aggregate amounts; however, the ERT noted that activities such as carbide production can be reported separately. In response to a question from the ERT on this matter, Canada indicated that it plans to introduce the CO_2 estimation methodology for carbide and other feedstock uses of hydrocarbons in production processes in its 2015 annual submission. The ERT recommends that Canada follow up on this planned improvement and report on the progress made in its next annual submission.

3. Non-key categories

Limestone and dolomite use – CO_2

79. Canada has not reported in its NIR a breakdown of limestone and dolomite use. The NIR states that for iron and steel production a 70/30 split is assumed between limestone and dolomite. However, information on the split when limestone and dolomite are used for other activities is not provided. The ERT reiterates the recommendation made in the previous review report that Canada include such information in its next annual submission.

D. Agriculture

1. Sector overview

80. In 2010, emissions from the agriculture sector amounted to 55,533.37 Gg CO_2 eq, or 8.0 per cent of total GHG emissions. Since 1990, emissions have increased by 18.9 per cent. The key drivers for the rise in emissions are the increases in the beef cattle and swine populations and in the amount of nitrogen-synthetic fertilizer applied to agricultural soils. Within the sector, 54.6 per cent of the emissions were from agricultural soils, followed by 33.6 per cent from enteric fermentation. Manure management accounted for 11.7 per cent. The remaining 0.1 per cent was from field burning of agricultural residues.

81. The Party has made recalculations for the agriculture sector between its 2011 and 2012 annual submissions in order to rectify identified errors. The impact of these recalculations on the agriculture sector is an increase in the estimated emissions of 0.3 per cent for 2009. The main recalculations took place in the following categories:

(a) CH_4 emissions from enteric fermentation;

(b) CH_4 and N_2O emissions from manure management;

(c) N_2O emissions from agricultural soils, both direct and indirect emissions.

82. The inventory for the agriculture sector is complete with respect to the coverage of activities, gases and years, is transparent and accurate, and emissions have been estimated in line with the IPCC good practice guidance. Uncertainties, recalculations, QA/QC procedures and planned improvements have been described in the NIR at the subsectoral level. The emission estimates are consistent across the time series. The sources of AD and EFs, the methodological issues and the emissions trends have been clearly explained in the NIR. The ERT commends Canada for the high-quality inventory.

83. During the review week and in response to the list of potential problems and further questions raised by the ERT, Canada confirmed that mules and asses are not raised for commercial purposes in the country and reported the associated livestock and emissions data as "NO". Canada provided confirmation from the Food and Agriculture Organization of the United Nations (FAO) that the data on mules and asses in the FAO database were erroneous, and that data on mules and asses have not been compiled in Canada due to the

insignificance of population numbers in the context of the Canadian agricultural livestock industry.

2. Key categories

Enteric fermentation – CH_4

84. Canada uses both tier 1 and tier 2 methods to estimate emissions from enteric fermentation: a tier 2 method with country-specific EFs is used to estimate emissions from dairy and non-dairy cattle, while a tier 1 method with default EFs is used for estimating emissions from the remaining livestock types. AD are provided by Statistics Canada (Canadian official statistics). The approach implemented is in line with the IPCC good practice guidance.

85. The ERT commends the Party for implementing a recommendation made in the previous review report in relation to developing a time series for digestible energy that accounts for changes in the digestibility of feed rations associated with cattle.

E. Land use, land-use change and forestry

1. Sector overview

86. In 2010, net emissions from the LULUCF sector amounted to 71,963.80 Gg CO_2 eq. Since 1990, net removals have decreased by 206.6 per cent (from –67,485.56 Gg CO_2 eq). Forest land, the largest subcategory, changed from a net sink of –93,097.51 Gg CO_2 eq in 1990 to a net source of 68,120.34 Gg CO_2 eq in 2010. This is due to the combined effect of large emissions from forest fires in 2010 and the cumulative impact of severe insect infestations over the last decade. Cropland, the next largest subcategory, changed from a net source of emissions in 1990 (11,333.95 Gg CO_2 eq) to a net sink in 2010 (–7,400.77 Gg CO_2 eq). The key drivers for these changes are an increase in the areas converted from forest land to cropland and a change in land management practices, particularly increased summer fallow and no-tillage cropping systems. Within the sector, 68,120.3 Gg CO_2 eq were from forest land, followed by 8,844.4 Gg CO_2 eq from settlements and 2,399.2 Gg CO_2 eq from wetlands, while cropland accounted for removals of 7,400.2 Gg CO_2 eq.

87. There are significant fluctuations in the LULUCF emission/removal profile due to the occurrence and severity of fires and insect infestations on forest land. As a result, the LULUCF sector is a net sink for only 12 years of the 21-year time series.

88. The Party has made recalculations for the LULUCF sector between its 2011 and 2012 annual submissions following changes in AD related to peat harvesting statistics for the entire time series in an effort to improve the accuracy of the inventory estimates. There were also small changes to the harvest and insect damage activity data for forest land, based on most recent statistics. The combined impact of these recalculations on the LULUCF sector is an increase in the estimated removals of less than 0.1 per cent for the base year, 2008 and 2009. The most significant recalculation took place in the wetlands category, where information on peat harvesting and areas of peatland used for peat extraction changed, resulting in a 0.5 per cent increase in the estimated emissions from wetlands in 2009.

89. Canada uses tier 2 and tier 3 approaches to estimate emission removals from the LULUCF sector. For the spatial representation of land areas, Canada uses the Monitoring Accounting and Reporting System (MARS) to ensure a consistent representation of areas over the time series, on the basis of approach 2 from the IPCC good practice guidance for LULUCF. MARS uses remote sensing and some additional non-geospatial agricultural census data for cropland. When comparing the Party's 2011 and 2012 annual submissions,

the ERT noted some very small changes in the areas reported for cropland and forest land over the time series. Canada indicated that these small differences are due to rounding errors when AD are aggregated from the soil polygon and reporting zone to the national level, and recognized that additional QA/QC is required to ensure consistent area representations across the time series and different annual submissions. The ERT noted that tier 1 and tier 2 QC procedures are in place for all LULUCF subcategories and that QA is carried out by different state agencies. The ERT welcomes the Party's acknowledgement of the need for the further improvement of the QA/QC system and recommends that such improvements be documented in the next annual submission.

90. The reporting of all pools across different subcategories is generally complete; however, the ERT reiterates the recommendation made in the previous review report for the mandatory reporting of pools and areas reported as "NE" in some LULUCF subcategories for which default estimation methods are available in the IPCC good practice guidance for LULUCF, including land converted to grassland and grassland remaining grassland. The ERT noted that Canada has indicated that AD are not available for the estimation of carbon stock changes in some categories, including grassland remaining grassland, grassland converted to wetlands, and land converted to grassland, and that methods are being developed to address the lack of complete reporting across all LULUCF subcategories. In cases where no country-specific data are available, tier 1 default approaches should be used, where possible, in accordance with the IPCC good practice guidance for LULUCF. The ERT recommends that Canada improve its reporting of the pools in the above-mentioned subcategories currently reported as "NE".

2. Key categories

Land converted to cropland – CO_2

91. In the previous review report the issue of "residual soil emissions" associated with land-use change prior to 1970 was raised. Based on examples from the CENTURY model provided in the NIR, it is evident that the time required for soil carbon stocks to reach a steady state after land-use transitions could be significantly longer than 50 years in some cases. The ERT recognizes that Canada bases its estimates on AD covering a 40-year period from 1970 to 2010 for estimates of "residual soil emissions". Canada is encouraged to continue using higher-tier methodologies when possible and to ensure that every effort is made to estimate all potential changes in carbon pools, particularly for historical emissions from deforested soils, which should be reported under cropland remaining cropland.

92. Biomass carbon stock changes for grassland converted to cropland are reported as "NO". The land-use definition used classifies grassland as including only unimproved grassland, while cropland includes improved pastures and arable crops. Canada assumes that this classification framework – the method for estimating carbon stock changes in these categories – results in biomass carbon stock changes being negligible following land-use transition from grassland to cropland. However, the Party neither provided empirical data nor cited publications supporting the assumption that the steady state biomass carbon stock in unimproved grassland is different from that in improved pastures or arable crops. Based on the literature,[10] it is evident that unimproved grassland could include tall grasses and woody biomass, which may be likely to represent a larger biomass pool at a steady state when compared with improved pastures and cropland. The IPCC good practice guidance for LULUCF outlines requirements for the estimation of biomass carbon stock changes following land-use transitions to cropland. The ERT recommends that Canada either

[10] Shorthouse JD. 2010. Ecoregions with Grasslands in British Columbia, the Yukon, and Southern Ontario. *In*: JD Shorthouse and KD Floote (eds.). *Athropods of Canadian Grasslands (Volume 1): Ecology and Interactions in Grassland Habitats*. Biological Survey of Canada. pp.83–103.

include an assessment of biomass carbon stock changes associated with grassland conversion to cropland using default biomass values, or provide some data supporting the assumption that these stock changes are negligible.

3. Non-key categories

Land converted to forest land – CO_2, CH_4 and N_2O

93. Canada provides detailed uncertainty analysis for most LULUCF subcategories, except land converted to forest land. Canada indicated in the NIR and to the ERT that it is due to resource limitations that uncertainty analysis for this category has not been undertaken and that there are plans to complete such uncertainty analysis in the future, although no formal target has been set. The ERT encourages Canada to perform an uncertainty analysis for all LULUCF subcategories and to provide details of this analysis in future annual submissions. The ERT also recommends that Canada indicate in its next annual submission its plan and time frame for estimating and reporting uncertainties for all LULUCF subcategories.

Biomass burning – CO_2, CH_4 and N_2O

94. In the previous review report the development of methods and the collection of AD for reporting biomass burning on grassland was encouraged, on the basis of indications in the NIR that this biomass burning on grassland does occur in Canada, albeit rarely. During the review, Canada indicated that a study to provide the AD required for reporting biomass burning on grassland has recently been carried out, but implementation of a new methodology is ongoing and can only be implemented after the next annual submission. The ERT welcomes this improvement and recommends that corresponding estimates be included in the Party's next annual submission.

F. Waste

1. Sector overview

95. In 2010, emissions from the waste sector amounted to 22,475.64 Gg CO_2 eq, or 3.2 per cent of total GHG emissions. Since 1990, emissions have increased by 17.0 per cent. The key drivers for the rise in emissions are the increases in emissions from solid waste disposal on land and wastewater handling. Within the sector, 91.0 per cent of the emissions were from solid waste disposal on land, followed by 6.0 per cent from wastewater handling and 3.1 per cent from waste incineration.

96. Canada has made recalculations for the waste sector between its 2011 and 2012 annual submissions in response to the 2011 annual review report and following changes in AD and calculation parameters. The impact of these recalculations on the waste sector is a decrease in the estimated emission of 1.0 per cent for 2009, a negligible increase in the estimated emissions for 2008 and an increase in the estimated emissions of 2.1 per cent for the base year (1990). The main recalculations took place in the following categories:

(a) CH_4 emissions from solid waste disposal on land;

(b) CO_2, CH_4 and N_2O emissions from waste incineration.

2. Key categories

Solid waste disposal on land – CH_4

97. The ERT noted the use of a constant waste composition for each province in the period 1990–2009. The ERT reiterates a recommendation made in the previous review

report that Canada update its waste composition data and associated degradable organic carbon values, with a view to improving the accuracy of the relevant emission estimates.

3. Non-key categories

Wastewater handling – CH_4 and N_2O

98. Emissions from domestic and commercial wastewater were calculated using a country-specific method and country-specific EFs, but transparent information on the treatment techniques and estimation methodologies is not provided in the NIR. The ERT recommends that Canada provide further description of the country-specific method and explain how it is in line with the Revised 1996 IPCC Guidelines in its next annual submission.

99. CH_4 emissions from industrial wastewater sludge and domestic and commercial wastewater sludge were reported as "NE" in CRF table 6.B due to the lack of AD. During the review, in response to a question raised by the ERT regarding this apparent underestimation, Canada said that its industrial facilities with wastewater treatment systems treat the sludge anaerobically and flare and/or utilize the CH_4 (combustion efficiency near 100 per cent); therefore, the emissions were reported as "NE". The ERT concluded that "NO" should be used instead of "NE" and recommends that Canada update the relevant information accordingly in the CRF tables of its next annual submission.

100. Canada has calculated N_2O emissions from human sewage using an IPCC default method. In response to adjustments applied by the previous ERT in relation to wastewater handling, Canada has used country-specific protein consumption values to calculate emissions, with the protein consumption factor based on annual food statistics data. The values for 2008 and 2009 were almost equal to those used in the adjustment applied in 2011 (37.73 and 37.51 kg/person, respectively, while in the adjustment these figures were 37.70 and 37.50 kg/person). Recalculations were made for 1990 to 2009 and the result of the recalculation for 2009 shows an increase in the estimated emissions of 47.2 per cent (316.08 kt CO_2 eq). The recalculation was performed in line with the adjustment applied by the previous ERT. The ERT encourages Canada to revise the description of this subcategory in its next annual submission.

Waste incineration – CO_2, CH_4 and N_2O

101. Canada reported emissions from municipal solid waste, hazardous waste and sewage sludge incineration. The ERT recommends that Canada provide greater detail on the composition of incinerated municipal solid waste and include such information 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

102. Canada has provided estimates of emissions and removals from activities under Article 3, paragraph 3, of the Kyoto Protocol (afforestation/reforestation and deforestation) and from cropland management under Article 3, paragraph 4, of the Kyoto Protocol. The Party has elected to account for activities under the Kyoto Protocol at the end of the first commitment period. Canada uses the same methodologies, definitions and AD as used for its reporting under the Convention, but does not transparently explain inconsistencies

between its reporting under the Convention and that under the Kyoto Protocol (see para. 103 below). The representation of land areas is generally in accordance with the requirements set out in the related paragraphs of the annex to decision 15/CMP.1 and the annex to decision 16/CMP.1, but some issues have been identified in relation to cropland management (see para. 108 below) and afforestation/reforestation (see para. 106 below). Provided that those two issues are addressed, the ERT considers that Canada has provided in the NIR all of the required supplementary information in relation to activities under Article 3, paragraphs 3 and 4, of the Kyoto Protocol.

103. In annex 11 to the NIR, Canada provides a brief description of why there are inconsistencies when comparing the areas reported in table NIR-2 (Kyoto Protocol reporting) and CRF table 5 (Convention reporting). In 2010, for example, the total area for land converted to forest land according to the reporting under the Convention was 88.31 kha, compared with 98.02 kha reported for land subject to afforestation/reforestation since 1990 under the Kyoto Protocol. There are similar inconsistencies in the area reported for cropland in CRF table 5.B when compared with the areas reported for cropland management in table NIR-2 under the Kyoto Protocol. These differences are due largely to the different temporal time scales used for the reporting under the Convention (20-year transition) compared with that used for the reporting under the Kyoto Protocol (afforestation/reforestation after 1989). However, the supplementary information provided in annex 11 to the NIR does not transparently show how areas under afforestation/reforestation and deforestation and cropland management are calculated and how these relate to the categories reported under the Convention. During the review, the Party provided detailed information outlining how the areas reported under the Kyoto Protocol relate to the reporting under the Convention, thereby addressing the transparency issue raised by the ERT. The ERT recommends that Canada include this information for the entire time series in the annex to the NIR in its next annual submission, in order to improve transparency.

104. There were no recalculations made for any KP-LULUCF categories, but there was a very small difference in the estimate of removals from cropland management for 1990 when the 2011 and 2012 annual submissions were compared (see para. 109 below).

105. Canada has not documented any information on uncertainty analysis specifically for KP-LULUCF. Although the methodologies and uncertainty estimates for forest lands are described in the LULUCF section of the NIR, estimates for KP-LULUCF are derived from separate analysis, given the difference in the time frame of the two reporting formats. The ERT recommends that Canada include information on uncertainty analysis for all KP-LULUCF activities in its next annual submission.

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

Afforestation and reforestation – CO_2, CH_4 and N_2O

106. The remote sensing methods used as part of MARS are documented in the NIR, which provides clear information on how land subject to harvest or disturbance followed by reestablishment is distinguished from land under deforestation, as required by decision 15/CMP.1, annex, paragraph 8. However, more information was requested from Canada during the review to show that activities under Article 3, paragraph 3, of the Kyoto Protocol were directly human-induced and not a result of natural forest encroachment. The information provided during the review clearly demonstrated that the currently documented legislation and policies clearly verify that afforestation/reforestation activities in particular are a direct influence of forest management or establishment intervention and are in fact directly human-induced, in accordance with decision 15/CMP.1, annex, paragraph 8(a). The ERT recommends that the provided information on policy and legislation be included or referred to in the NIR of the Party's next annual submission.

Deforestation – N_2O and CH_4

107. The ERT reiterates the recommendation made in the previous review report that Canada provide a transparent explanation of how the reported non-CO_2 emissions from harvest and crop residue burning on deforested land are clearly separated from those from crop residue burning reported under the agriculture sector and cropland management under Article 3, paragraph 4, of the Kyoto Protocol. The ERT recommends that Canada provide this information in the NIR of its next annual submission and include "emissions/removals from Article 3.4 activities that are not accounted for under activities under Article 3.3" in table A11–1 of the NIR, which is related to reporting requirements under decision 15/CMP.1.

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

Cropland management – CO_2, CH_4 and N_2O

108. The ERT noted that the estimated total area under cropland management decreased by 216.33 kha between 2008 and 2010. Since there is no reported afforestation in these years and there are no other elected activities under Article 3, paragraph 4, of the Kyoto Protocol, Canada has not accounted for 216.33 kha under cropland management. The Party indicated that this error is due to the use of agricultural census data which only track net area change, but also indicated that there are plans to use remote sensing for wall-to-wall mapping for future annual submissions. The ERT recommends that Canada ensure that once land is accounted for under activities under Article 3, paragraphs 3 and 4, of the Kyoto Protocol, the reporting of such areas continues throughout the commitment period, as outlined in related supplementary methodological guidance provided in the IPCC good practice guidance for LULUCF and in accordance with decision 15/CMP.1, annex, paragraphs 5 and 6(d).

109. Canada has reported activities under cropland management for the base year (1990) in accordance with decision 15/CMP.1, annex, paragraph 9(b). However, the ERT noted a difference in the areas reported for the base year when the 2011 and 2012 annual submissions were compared (i.e. 48,757.51 kha reported in the 2012 annual submission compared with 48,757.42 kha in the 2011 annual submission). The Party acknowledged that the agriculture census inventory system has introduced these differences due to rounding errors. The ERT recommends that Canada correct these errors and ensure that the implemented land tracking system provides a consistent representation of areas under cropland management, in order to meet the requirements set out in decision 15/CMP.1, annex, paragraph 6(b), and decision 16/CMP.1, annex, paragraph 20.

2. Information on Kyoto Protocol units

Standard electronic format and reports from the national registry

110. Canada has reported information on its accounting of Kyoto Protocol units in the required SEF tables, as required by decisions 15/CMP.1 and 14/CMP.1. The ERT took note of the findings and recommendations included in the SIAR on the SEF tables and the SEF comparison report.[11] The SIAR was forwarded to the ERT prior to the review pursuant to decision 16/CP.10.

111. Information on the accounting of Kyoto units has been prepared and reported in accordance with decision 15/CMP.1, annex, chapter I.E, and reported in accordance with

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

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 ITL and the clean development mechanism registry and meets the requirements referred to in decision 22/CMP.1, annex, paragraph 88(a–j). The Party provided information in line with the requirements included in decision 15/CMP.1, annex, paragraphs 12–17. 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.

National registry

112. The ERT took note of the SIAR and its finding that the reported information on the national registry is complete and has been submitted in accordance with the annex to decision 15/CMP.1. The ERT further noted from the SIAR and its finding that the national registry continues to perform the functions set out in the annex to decision 13/CMP.1 and the annex to decision 5/CMP.1, and continues to adhere to the technical standards for data exchange between registry systems in accordance with decisions 16/CP.10 and 12/CMP.1. The national registry also has adequate security, data safeguard and disaster recovery measures in place and its operational performance is adequate.

113. However, the SIAR identified the following problems: (a) that the Party needs to clarify the public information available on the website regarding Article 6 project information in accordance with decision 13/CMP.1, annex, paragraph 46(a–d); and (b) reiterating the recommendation made in the previous review report, that if the national registry is opened to private entity accounts Canada needs to update the security plan by including additional authentication measures. During the review, Canada informed the ERT that: (a) it will change the information publically available on the website from "No emission reduction units have been issued in 2011 on the basis of Article 6 projects" to "Canada has never issued any emission reduction units on the basis of Article 6 projects"; and (b) plans to open Canada's Kyoto Protocol national registry to private accounts have been suspended and therefore the security plan has not been updated. The ERT considers that Canada has followed the recommendations.

Calculation of the commitment period reserve

114. Canada has reported its commitment period reserve in its 2012 annual submission. The Party reported its commitment period reserve to be 2,512,613,494 t CO_2 eq, based on the assigned amount and not on the most recently reviewed inventory. The ERT agrees with this figure.

3. Changes to the national system

115. Canada reported that there have been no changes to its national system since the previous annual submission. The ERT concluded that the Party's national system continues to be in accordance with the requirements of national systems outlined in decision 19/CMP.1.

4. Changes to the national registry

116. Canada reported that there have been no changes to its national registry since the previous annual submission. The ERT concluded that the Party's national registry continues to perform the functions set out in the annex to decision 13/CMP.1 and the annex to decision 5/CMP.1 and continues to adhere to the technical standards for data exchange between registry systems in accordance with relevant decisions of the Conference of the Parties serving as the meeting of the Parties to the Kyoto Protocol (CMP).

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

117. Canada has reported information on the minimization of adverse impacts in accordance with Article 3, paragraph 14, of the Kyoto Protocol, as requested in decision 15/CMP.1, annex, chapter I.H, paragraphs 23 and 24.

118. Canada did not report information on any changes in its reporting of the minimization of adverse impacts that have occurred since its previous annual submission in accordance with the provisions of decision 15/CMP.1, annex, chapter I.H, paragraph 25. The ERT reiterates the recommendation made in the previous review report that Canada include, in its next annual submission, information on any such changes.

119. The reported information is considered generally complete and transparent. The process to establish and implement climate change response measures in Canada includes comprehensive consultation among involved stakeholders at the international and national levels as well as an extensive public consultation with provinces on planned activities.

III. Conclusions and recommendations

A. Conclusions

120. Canada made its annual submission on 11 April 2012. The annual submission contains the GHG inventory (comprising CRF tables and an NIR) and supplementary information under Article 7, paragraph 1, of the Kyoto Protocol (information on: activities under Article 3, paragraphs 3 and 4, of the Kyoto Protocol, Kyoto Protocol units, changes to the national system and the national registry, and minimization of adverse impacts in accordance with Article 3, paragraph 14, of the Kyoto Protocol). This is in line with decision 15/CMP.1.

121. The ERT concludes that the inventory submission of Canada has been prepared and reported in accordance with the "Guidelines for the preparation of national communications by Parties included in Annex I to the Convention Part I: UNFCCC reporting guidelines on annual inventories". The inventory submission is complete and the Party has submitted a complete set of CRF tables for the years 1990–2010 and an NIR; these are generally complete in terms of geographical coverage, years, sectors, categories and gases. Some of the categories in the LULUCF sector, particularly all carbon pools for wetlands and settlements converted to cropland, grassland remaining grassland, grassland and cropland converted to wetlands, and land converted to grassland, were reported as "NE". The ERT recommends that the Party provide estimates for these categories in its next annual submission, in order to improve completeness.

122. 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.

123. The Party'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.

124. The Party has made recalculations for the inventory between its 2011 and 2012 annual submissions in response to recommendations made in the 2011 ARR. The impact of these recalculations on the national totals is a decrease in the estimate of emissions of 0.3 per cent for 2009. For 2009, the impact of the significant recalculations includes:

(a) A 0.4 per cent decrease in the estimate of CO_2 emissions from road transportation;

(b) A 0.3 per cent decrease in the estimate of CO_2 emissions from other sectors;

(c) A 0.3 per cent decrease in the estimate of CO_2 emissions from oil and natural gas;

(d) A 0.2 per cent decrease in the estimate of CO_2 emissions from chemical industry;

(e) A 0.8 per cent decrease in the estimate of CO_2 emissions from the category other (industrial processes).

125. The ERT considers that Canada has provided in the NIR most of the required supplementary information on activities under Article 3, paragraphs 3 and 4, of the Kyoto Protocol. The information supplied to the ERT during the review (e.g. explanation of the calculation of land areas, the relationship of the reporting under the Kyoto Protocol to the Convention categories, and information on policy and legislation) should be incorporated into the NIR for the next annual submission, in addition to the inclusion of information on uncertainty analysis for KP-LULUCF activities and a clear explanation of how emissions from biomass burning are separated between KP-LULUCF activities and the agriculture sector, and the assurance that the land size accounted for under Article 3, paragraphs 3 and 4, of the Kyoto Protocol continues throughout the commitment period.

126. The Party has made no recalculations for KP-LULUCF activities between its 2011 and 2012 annual submissions.

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

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

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

130. Canada has reported information under decision 15/CMP.1, annex, chapter I.H, "Minimization of adverse impacts in accordance with Article 3, paragraph 14", as part of its 2012 annual submission. The information is considered generally complete and transparent.

B. Recommendations

131. The ERT identifies issues for improvement as listed in table 6 below.

Table 6
Recommendations identified by the expert review team

Sector	*Category*	*Recommendation*	*Paragraph reference*
Overview	Key categories	Include in CRF table 7 only the categories identified as key categories	22
		Report the KP-LULUCF key categories in the NIR of the next annual submission	23
	Uncertainties	Report the results of the trend uncertainty analysis including LULUCF in the next annual submission	24
		Correct the identified errors in NIR table A7–1 in the next annual submission	26
	Verification and quality assurance/quality control approaches	Further improve QC procedures to avoid inconsistencies in the information reported in different CRF tables and between the NIR and the CRF tables in the next annual submission	35
		Apply QC procedures also to the data that are specific to KP-LULUCF	36
	Transparency	Improve the transparency of the reporting on the energy, industrial processes, waste and KP-LULUCF sectors	37
		Improve the transparency of the next annual submission by ensuring that notation keys are used correctly	39
Energy	Overview	Implement the planned improvement on the categorization of fuels in line with the Revised 1996 IPCC Guidelines for the next submission	49
		Improve transparency in the NIR, as recommended in the 2011 ARR	50
		Improve accuracy in the NIR, as recommended in the 2011 ARR	51
		Use the notation key for not occurring (“NO”) to report where fuel was not used instead of that for not applicable (“NA”)	52
		Correct the allocation of waste incineration with energy recovery to energy industries	53
	Reference and sectoral approaches	Include the non-energy use of fuels in the apparent fuel consumption and exclude it from the “apparent fuel consumption (excluding non-energy use and feedstocks)	55
	International bunker fuels	Clarify the difference in the allocation of jet kerosene and aviation gasoline for civil aviation and international bunkers according to IEA data and the data in the CRF tables in the next NIR, in order to improve transparency	57
		Make further efforts to allocate the fuels consumed in navigation between domestic and international utilization, in accordance with the IPCC good practice guidance	58
		Move the allocation reported in CRF table 1.A(d) for petroleum coke to the correct category (2.C.3) and provide an explanation of the other differences in the NIR	59
		Correct the error in filling CRF table 1.A(d) with carbon stored in the non-energy use of fuels for naphtha and implement additional QA/QC procedures to prevent this type of error from occurring in	60

Sector	*Category*	*Recommendation*	*Paragraph reference*
		the future	
	Stationary combustion: gaseous, liquid and solid fuels – CO_2, CH_4 and N_2O	Correct the units in table A4–2 of the NIR and ensure the proper conversion of the AD by implementing additional QA/QC procedures	61
		Provide an explanation for the differences between the energy balance data and the data in the CRF tables in the next NIR, in order to improve transparency	62
	Road transportation: liquid fuels and biomass – CO_2, CH_4 and N_2O	Detailed information provided by Canada in response to the questions raised on the above issue also be included in the Party's next NIR.	63
		Show the results of the bottom-up and top-down approaches in the NIR and explain in the NIR that all fuel is accounted for	64
	Oil and natural gas: CO_2, CH_4 and N_2O	Report on the recalculation of the energy consumption of refineries in the next annual submission	65
		Incorporate in subsequent annual submissions the updated emission factors and activity data resulting from the conclusion of the studies on the conventional upstream oil and gas industry and a coal mining	66
		Rectify the minor error of CH_4 emissions for 1991 being a copy of those for 1990 in its next annual submission	67
Industrial processes	Cement production – CO_2	Report on the progress of the previous plan to develop a country-specific EF based on the calcium oxide content of clinker	71
	Lime production – CO_2	Include information in the NIR on the AD for hydrated lime production, as well as on high-calcium and dolomitic lime, and provide an analysis of the trends	72
	Iron and steel production – CO_2	Increase transparency on the use of metallurgical coke and other reductants for iron and steel production	73
		Correct the error regarding the confidentiality of data on pig iron production for the years 2008 to 2010 in the NIR	74
		Increase the transparency of the reporting regarding the four major integrated iron and steel plants in the country	75
	Consumption of halocarbons and SF_6 – HFCs	Include information on the study to determine country-specific HFC EFs	76
	Consumption of halocarbons and SF_6 – HFCs and PFCs	Correct the information on the EFs and methods used in 2010 in the next annual submission	77
	Other (non-specified) – CO_2	Provide information in the next annual submission on the planned improvement and report on the progress made on the disaggregation of this category regarding carbide and other feedstock uses of hydrocarbons in production processes and related methodologies	78
	Limestone and dolomite use – CO_2	Include information in the next annual submission on the breakdown of limestone and dolomite for all activities using them	79

Sector	*Category*	*Recommendation*	*Paragraph reference*
Land use, land-use change and forestry	Overview	Improve the reporting of carbon pools in subcategories currently reported as not estimated ("NE")	90
	Land converted to cropland – CO_2	Either include an assessment of biomass carbon stock changes associated with grassland conversion to cropland using default biomass values, or provide some data supporting the assumption that these stock changes are negligible.	92
	Land converted to forest land – CO_2, CH_4 and N_2O	The ERT also recommends that Canada indicate in its next annual submission its plan and time frame for estimating and reporting uncertainties for all LULUCF subcategories.	93
	Biomass burning – CO_2, CH_4 and N_2O	Include in the next annual submission estimates of emissions from biomass burning on grassland, following the recently completed study	94
Waste	Solid waste disposal on land – CH_4	Update the waste composition data and associated DOC values, with a view to improving the accuracy of the relevant emission estimates	97
	Wastewater handling – CH_4	Provide further description of the country-specific estimation method and compare with the IPCC methodology in order to check if it is in line with the Revised 1996 IPCC Guidelines	98
		Use the notation key "NO" to report CH_4 emissions from wastewater instead of reporting them as "NE" in the CRF tables in the next annual submission	99
	Waste incineration – CO_2, CH_4 and N_2O	Provide greater detail on the composition of incinerated municipal solid waste and include such information in its next annual submission	101
Information on activities under Article 3, paragraphs 3 and 4, of the Kyoto Protocol	Activities under Article 3, paragraph 3, of the Kyoto Protocol	Include the detailed information outlining how areas reported under the Kyoto Protocol are related to the reporting under the Convention for the entire time series in the annex to the NIR in the next annual submission, in order to improve transparency	103
		Include uncertainty analysis for all KP-LULUCF activities in the next annual submission	105
		Include information on policy and legislation in the NIR	106
	Deforestation – CO_2	Provide a clear explanation in the NIR of the separation of non-CO_2 emissions from harvest residue burning after deforestation from emissions from crop residue burning, and include "emissions/removals from Article 3.4 activities that are not accounted for under activities under Article 3.3" in table A11–1 of the NIR, which is related to reporting requirements under decision 15/CMP.1	107
	Cropland management – CO_2, CH_4 and N_2O	Ensure that once land is accounted for under Article 3, paragraphs 3 and 4, of the Kyoto Protocol, the reporting on these areas continues throughout the commitment period	108
		Correct rounding errors in the areas reported for the base year and ensure that the implemented land tracking system for a consistent representation of areas under cropland management meets the necessary requirements	109

Sector	*Category*	*Recommendation*	*Paragraph reference*
Supplementary information required under Article 7, paragraph 1, of the Kyoto Protocol	Minimization of adverse impacts in accordance with Article 3, paragraph 14, of the Kyoto Protocol	Include in the next annual submission information on any changes that have occurred compared with the information reported in the previous annual submission	118

IV. Questions of implementation

132. 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/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 Canada 2012. Available at <http://unfccc.int/resource/docs/2012/asr/can.pdf>.

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

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

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

B. Additional information provided by the Party

Responses to questions during the review were received from Mr. David Moore (Environment Canada), including additional material on the methodologies and assumptions used. The following document[1] was also provided by Canada:

Canadian Energy Balance 2012. *Report on Energy Supply and Demand – Canada 2010* version 3 February 2012. Provided by the Party during the review.

[1] Reproduced as received from the Party.

Annex II

Acronyms and abbreviations

AD	activity data
ARR	annual review report
CH_4	methane
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
EF	emission factor
ERT	expert review team
FAO	Food and Agriculture Organization of the United Nations
F-gas	fluorinated gas
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
GWP	global warming potential
HFCs	hydrofluorocarbons
IE	included elsewhere
IEA	International Energy Agency
IPCC	Intergovernmental Panel on Climate Change
ITL	international transaction log
kg	kilogram (1 kg = 1,000 grams)
kgoe	kilograms of oil equivalent
lCER	long–term certified emission reduction unit
KP-LULUCF	land use, land-use change and forestry emissions and removals from activities under Article 3, paragraphs 3 and 4, of the Kyoto Protocol
LULUCF	land use, land-use change and forestry
m^3	cubic metre
MARS	Monitoring Accounting and Reporting System
Mg	megagram (1 Mg = 1 tonne)
Mt	million tonnes
Mtoe	million tonnes of oil equivalent
N_2O	nitrous oxide
NA	not applicable
NE	not estimated
NIR	national inventory report
NO	not occurring
PFCs	perfluorocarbons
PJ	petajoule (1 PJ = 10^{15} joule)
QA/QC	quality assurance/quality control
SEF	standard electronic format
SF_6	sulphur hexafluoride
SIAR	standard independent assessment report
TJ	terajoule (1 TJ = 10^{12} joule)
UNFCCC	United Nations Framework Convention on Climate Change