COMPLIANCE COMMITTEE **CC-2008-1-1/Canada/EB**
17 April 2008

Report of the review of the initial report of Canada

Note by the secretariat

The report of the review of the initial report of Canada (FCCC/IRR/2007/CAN) was published on 11 April 2008. An advance version of the report is contained in the annex to this note. The secretariat would draw your attention, in particular, to paragraphs 6, 7, 123–126, 137, 139 and 140, as well as Table 1 (last row) and Table 5, of the report.

In accordance with section VII, paragraph 1, of the annex to decision 27/CMP.1 and rule 19, paragraph 1, of the Rules of procedure of the Compliance Committee of the Kyoto Protocol (annex to decision 4/CMP.2), the report was allocated by the bureau to the enforcement branch.

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Report of the review of the initial report of Canada

According to decision 13/CMP.1, each Annex I Party with a commitment inscribed in Annex B to the Kyoto Protocol shall submit to the secretariat, prior to 1 January 2007 or one year after the entry into force of the Kyoto Protocol for that Party, whichever is later, a report (the "initial report") to facilitate the calculation of the Party's assigned amount pursuant to Article 3, paragraphs 7 and 8, of the Kyoto Protocol, and to demonstrate its capacity to account for emissions and the assigned amount. This report reflects the results of the review of the initial report of Canada conducted by an expert review team in accordance with Article 8 of the Kyoto Protocol.

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I. Introduction and summary

A. Introduction

1. This report covers the in-country review of the initial report of Canada, coordinated by the United Nations Framework Convention on Climate Change (UNFCCC) secretariat, in accordance with Guidelines for review under Article 8 of the Kyoto Protocol (decision 22/CMP.1). The review took place from 5 to 10 November 2007 in Ottawa, Canada, and was conducted by the following team of nominated experts from the roster of experts: generalist – Mr. Audun Rosland (Norway); energy – Mr. Simon Eggleston (United Kingdom of Great Britain and Northern Ireland); industrial processes – Mr. Jochen Harnisch (Germany); agriculture – Ms. Anna Romanovskaya (Russian Federation); land use, land-use change and forestry (LULUCF) – Mr. Nijavalli Ravindranath (India); waste – Ms. Tatiana Tugui (Moldova). Ms. Tatiana Tugui (Moldova) and Mr. Audun Rosland (Norway) were the lead reviewers. In addition the expert review team (ERT) reviewed the national system, the national registry, and the calculations of the Party's assigned amount and commitment period reserve (CPR), and took note of the LULUCF parameters and the elected Article 3, paragraph 4 activities. The review was coordinated by Mr. Matthew Dudley and Ms. Astrid Olsson (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, in this final version of the report.

B. Summary

1. Timeliness

3. Decision 13/CMP.1 requests Parties to submit the initial report prior to 1 January 2007 or one year after the entry into force of the Kyoto Protocol for that Party, whichever is later. The initial report of Canada was submitted on 15 March 2007, which is not in accordance with decision 13/CMP.1. In its initial report Canada refers to its 2006 greenhouse gas (GHG) inventory submission of 11 May 2006, which was used as the basis for the review by the ERT. The Party submitted revised emission estimates on 24 December 2007 in response to questions raised by the ERT during the course of the in-country visit. Canada submitted revised estimates on 23 January 2008 in response to questions raised by the ERT on the Party's 24 December 2007 revised estimates. This report is based on the revised estimates of 23 January 2008.

2. Completeness

4. Table 1 below provides information on the mandatory elements included in the initial report and Canada's revised values of the assigned amount and the CPR provided by the Party resulting from the review process. These revised values are based on revisions of emissions from combustion of liquid fuels – carbon dioxide (CO_2) (paragraphs 58 and 59); combustion of solid fuels (coal) – CO_2 (paragraph 60); ammonia production – CO_2 (paragraph 76); production of HCFC-22 – hydrogen fluorocarbon 23 (HFC-23) (paragraph 81); electrical equipment – sulphur hexafluoride (SF_6) (paragraph 82); other (2.G) – CO_2 (paragraph 77); enteric fermentation – methane (CH_4) (paragraph 90); direct soil emissions – nitrous oxide (N_2O) (paragraph 92); indirect emissions – N_2O (paragraph 94); solid waste disposal on land – CH_4 (paragraph 111); and wastewater handling – N_2O (paragraph 114), which resulted in revision of the total GHG emissions, including base year emissions, from 598,911,219 tonnes CO_2 eq as reported originally by the Party to 593,998,462 tonnes CO_2 eq (paragraph 119).

5. The information in the initial report generally covers the elements as required by decision 13/CMP.1, section I of decision 15/CMP.1, and relevant decisions of the CMP.

6. Canada did not report information on the national registry in its initial report in accordance with decision 13/CMP.1, section I of decision 15/CMP.1, and relevant decisions of the Conference of the Parties serving as the Meeting of the Parties (CMP). Canada had not established a national registry by the time of the in-country visit, nor a registry system that had initialised with the international transaction log (ITL) by the publication date of this report. The ERT recommends that the Party expedite work toward initialising the national registry with the ITL, and also include information relating to the reporting requirements of the national registry stipulated in paragraph 32 of the annex to decision 15/CMP.1 along with the conclusion of the independent assessment report in its next inventory submission under the Kyoto Protocol.

Table 1. Summary of the reporting on mandatory elements in the initial report

Item	Provided	Value/year/comment
Complete GHG inventory from the base (1990) year to the most recent year available	Yes	1990–2004
Base year for HFCs, PFCs and SF_6	Yes	1990
Agreement under Article 4	No	Not applicable
LULUCF parameters	Yes	Minimum tree crown cover: 25% Minimum land area: 1.0 ha Minimum tree height: 5 m
Election of and accounting period for Article 3, paragraphs 3 and 4, activities	Yes	Elected Article 3, paragraph 4, activities: Cropland management The accounting period for Article 3, paragraphs 3 and 4, activities is the commitment period.
Calculation of the assigned amount in accordance with Article 3, paragraphs 7 and 8	Yes	2 814 882 729 tonnes CO_2 eq
Calculation of the assigned amount in accordance with Article 3, paragraphs 7 and 8, revised value	Yes	2 791 792 771 tonnes CO_2 eq
Calculation of the commitment period reserve	Yes	2 533 394 456 tonnes CO_2 eq
Calculation of the commitment period reserve, revised value	Yes	2 512 613 494 tonnes CO_2 eq
Description of national system in accordance with the guidelines for national systems under Article 5, paragraph 1	Yes	
Description of national registry in accordance with the requirements contained in the annex to decision 13/CMP.1, the annex to decision 5/CMP.1 and the technical standards for data exchange between registry systems adopted by the COP/MOP	No	See paragraph 6

3. Transparency

7. The initial report is transparent and provides all required information with the exception of the national registry.

4. Emission profile in the base year, trends and emission reduction target

8. In the base year (1990), the most important GHG in Canada was carbon dioxide (CO_2), contributing 76.9 per cent to total[1] national GHG emissions expressed in CO_2 eq, followed by CH_4, 13.7 per cent and N_2O, 7.5 per cent, see figure 1. Hydrofluorocarbons (HFCs), perfluorocarbons (PFCs), and SF_6 taken together contributed 1.9 per cent of the overall GHG emissions in the base year. The

[1] In this report, the term total emissions refers to the aggregated national GHG emissions expressed in terms of CO_2eq. excluding LULUCF, unless otherwise specified.

energy sector accounted for 79.4 per cent of the total GHG emissions in the base year followed by industrial processes, 9.2 per cent, solvent and other product use, 0.1 per cent, agriculture, 8.1 per cent and waste, 3.2 per cent, see figure 2. Total GHG emissions amounted to 593,998.5 Gg CO_2 eq and increased by 26.8 per cent from the base year to 2004.

Figure 1. Shares of gases in total GHG emissions, base year

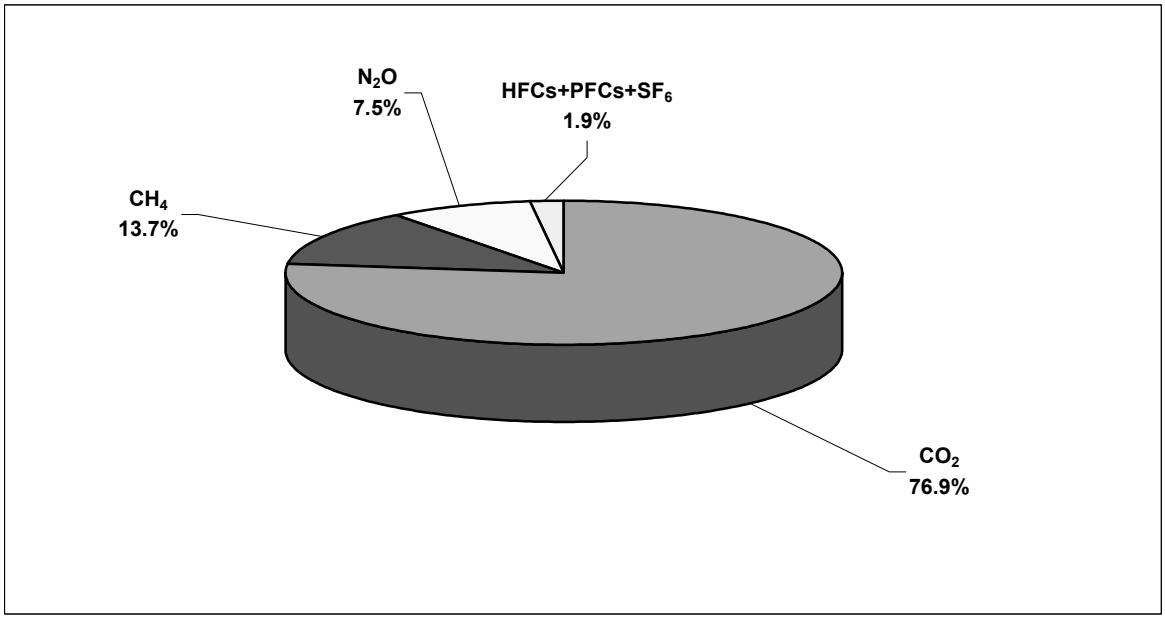
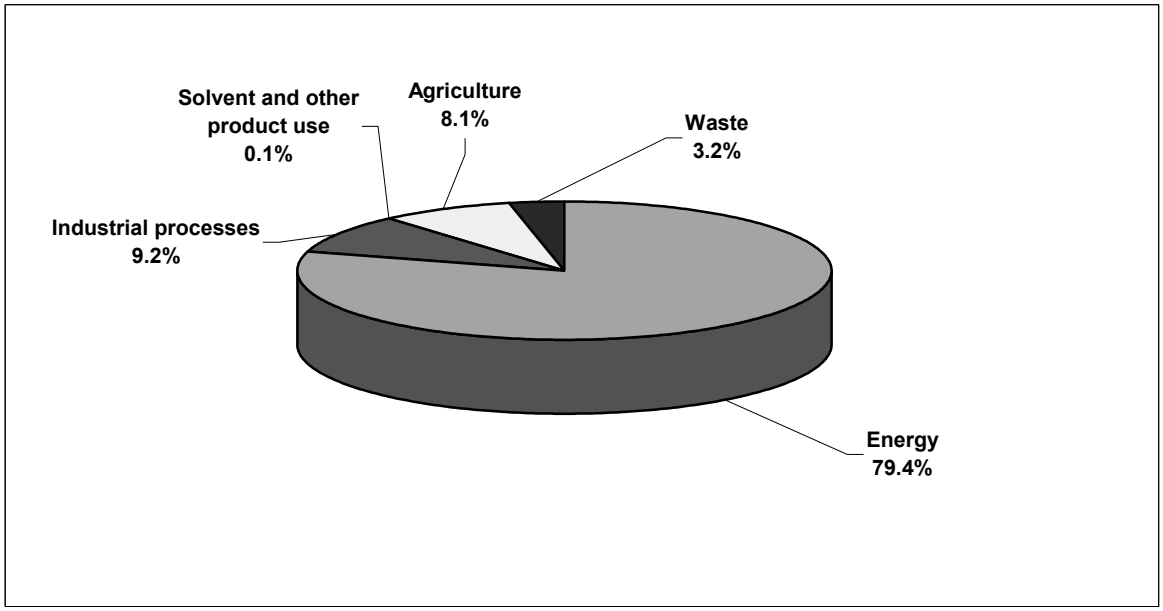


Figure 2. Shares of sectors in total GHG emissions, base year



9. Tables 2 and 3 show the GHG emissions by gas and by sector, respectively.

10. Canada's quantified emission limitation is 94 per cent, as included in Annex B to the Kyoto Protocol.

Table 2. Greenhouse gas emissions by gas, 1990–2004[a]

GHG emissions (without LULUCF)	Gg CO_2 eq								Change
	Base year	1990	1995	2000	2001	2002	2003	2004	BY–2004 (%)
CO_2	457 534.0	457 534.0	490 535.4	563 145.5	556 506.9	564 303.7	590 246.8	589 596.6	28.9
CH_4	75 561.8	75 561.8	90 197.4	99 569.3	101 127.2	100 963.2	101 890.7	103 498.1	37.0
N_2O	48 873.2	48 873.2	53 956.7	46 885.5	45 255.4	44 823.1	46 578.7	49 425.5	1.1
HFCs	767.3	767.3	479.4	2 993.8	3 545.7	3 923.0	4 367.7	4 678.0	509.7
PFCs	6 538.8	6 538.8	5 489.5	4 308.2	3 492.4	2 991.9	3 034.5	3 056.7	–53.3
SF_6	4 723.3	4 723.3	3 726.7	4 346.5	4 389.8	4 064.2	4 179.2	3 024.4	–36.0

Note: BY = Base year; LULUCF = Land use, land-use change and forestry.

[a] Canada submitted revised estimates for all years after the initial review on 23 January 2007. These estimates differ from Canada's GHG inventory submitted in 2006.

Table 3. Greenhouse gas emissions by sector, 1990–2004[a]

Sectors	Gg CO_2 eq								Change
	Base year	1990	1995	2000	2001	2002	2003	2004	BY–2004 (%)
Energy	471 652.5	471 652.5	512 959.3	590 964.4	585 866.8	592 733.2	618 116.9	614 728.5	30.3
Industrial processes	54 872.7	54 872.7	56 706.8	51 256.4	49 794.3	49 724.9	51 202.6	55 648.4	1.4
Solvent and other product use	417.3	417.3	441.5	462.4	467.4	472.7	477.0	481.3	15.3
Agriculture	48 076.0	48 076.0	54 325.0	58 193.4	57 899.7	57 618.9	59 716.3	61 364.5	27.6
LULUCF	NA	–81 765.1	194 293.7	–130 932.7	–121 089.4	6 123.0	–11 326.8	80 839.9	NA
Waste	18 980.0	18 980.0	19 952.5	20 372.2	20 289.2	20 519.6	20 784.9	21 056.5	10.9
Other	NA	NA	NA	NA	NA	NA	NA	NA	NA
Total (with LULUCF)	NA	512 233.4	838 678.7	590 316.0	593 228.0	727 192.2	738 970.9	834 119.1	NA
Total (without LULUCF)	593 998.5	593 998.5	644 385.1	721 248.8	714 317.3	721 069.2	750 297.7	753 279.2	26.8

Note: BY = Base year; LULUCF = Land use, land-use change and forestry; NA = Not applicable.

[a] Canada submitted revised estimates for all years after the initial review on 23 January 2007. These estimates differ from Canada's GHG inventory submitted in 2006.

II. Technical assessment of the elements reviewed

A. National system for the estimation of anthropogenic GHG emissions by sources and sinks

11. Canada's national system is in accordance with the guidelines for national systems under Article 5, paragraph 1, of the Kyoto Protocol (decision 19/CMP.1). Hence, the national system can perform the general and specific functions required by these guidelines. The national system is supported by institutional arrangements for the preparation of the inventory; includes procedures for official approval; a quality assurance/quality control (QA/QC) plan; a working archive system; a description of the process for collecting data and developing estimates; can identify key categories and generate quantitative uncertainty analysis; and includes a process for performing recalculations to improve the inventory.

12. Table 4 shows which of the specific functions of the national system are included and described in the initial report.

Table 4. Summary of reporting on the specific functions of the national system

Reporting element	Provided	Comments
Inventory planning		
Designated single national entity*	Yes	See section II.A.1
Defined/allocated specific responsibilities for inventory development process*	Yes	See section II.A.1
Established process for approving the inventory*	Yes	See section II.A.1
Quality assurance/quality control plan*	Yes	See section II.A.2
Ways to improve inventory quality	Yes	See section II.B.3
Inventory preparation		
Key category analysis*	Yes	See section II.B.1
Estimates prepared in line with IPCC guidelines and IPCC good practice guidance*	Yes	See section II.B.2
Sufficient activity data and emission factors collected to support methodology*	Yes	See section II.B
Quantitative uncertainty analysis*	Yes	See section II.B.2
Recalculations*	Yes	See section II.B.2
General QC (tier 1) procedures implemented*	Yes	See section II.A.2
Source/sink category-specific QC (tier 2) procedures implemented	Partly	See section II.A.2
Basic review by experts not involved in inventory	Yes	See section II.A.2
Extensive review for key categories	Partly	See section II.A.2
Periodic internal review of inventory preparation	Partly	See section II.A.2
Inventory management		
Archive inventory information*	Yes	See section II.A.3
Archive at single location	Yes	See section II.A.3
Provide ERT with access to archived information*	Yes	See section II.A.3
Respond to requests for clarifying inventory information during review process*	Yes	See section II.A.1

* Mandatory elements of the national system.

1. Institutional, legal and procedural arrangements

13. During the in-country visit, Canada explained the institutional arrangements as part of the national system for preparation of the inventory. The Greenhouse Gas Division of Environment Canada is the designated single national entity. Other institutions, both governmental agencies, industry partners and provincial and territorial governments contribute in the preparation of the inventory. Some have defined and allocated specific responsibilities in the inventory development process: formal arrangements have been set up between Environment Canada, Statistics Canada, Agriculture and

Agri-food Canada and the Canadian Forest Service of Natural Resources Canada (NRCan) for the annual delivery of activity data (AD) (Statistics Canada − Manufacturing, Construction and Energy Division) and emission/removal estimates in the Cropland and Forestry land categories (Agriculture and Agri-food Canada and the Canadian Forest Service of NRCan). Other governmental agencies, including other Divisions of Statistics Canada, the Canada Space Agency, Transport Canada and other groups in Environment Canada provide AD through their own data collection activities, and/or technical expertise. Industry partners, such as the Aluminium Association of Canada, the Canadian Electrical Association and individual companies are providers of AD, process-related emissions and expert review. Provincial and territorial governments contribute information on natural resources management and technical expertise for the review of emissions data. The Greenhouse Gas Division of Environment Canada has the following main responsibilities: (a) overall responsibility for the national system; (b) inventory planning, preparation and management; (c) GHG estimation, analysis and reporting; (d) QA/QC and verification, and (e) the archiving system.

14. The ERT considers that institutional arrangements are clearly defined and ensure a good basis for inventory preparation. It commends Canada for its effective implementation of the national system. The ERT highlights the establishment of the land use, land-use change and forestry monitoring accounting and reporting system (LULUCF MARS) as important for the successful development of the LULUCF inventory over the last three years.

15. The ERT was informed during the in-country visit that the majority of funding for the Greenhouse Gas Division of Environment Canada (the single national entity) was historically derived from supplementary funding sources. In response to the draft review report, Canada provided additional explanations noting the inventory program has been identified within the department as a priority for funding. In implementation of the national system, the ERT commends Canada for recognizing the need to provide sufficient resources to its inventory preparation.

16. In Canada's national system exchange of data between different governmental institutions and data input from industry partners are critical for producing accurate emission estimates. The ERT recommends that this data exchange be improved. In this regard the ERT notes that confidentiality is often a critical barrier for Environment Canada with regard to collecting real and accurate AD, emission factors (EFs) and emission estimates, as well as verification of such data, both from single facilities and from other governmental institutions. The ERT recommends Canada to consider how this confidentiality barrier could be overcome.

17. The ERT was informed that Environment Canada in March 2004 established a mandatory reporting programme for single facilities. According to this reporting programme facilities with more than 100 kilo-tonnes of GHG emissions have been required to report their emissions annually to Environment Canada since 2005. These data cannot yet be used directly in the inventory preparation, as no specific estimation methodology is prescribed, and only aggregated data are reported by facilities. The facility data can, however, be used to verify national inventory estimates for certain sectors or categories. In order to reduce the uncertainty of important subcategories in the GHG inventory, the ERT encourages Canada to further develop the mandatory facility reporting programme so that facility-level data can be directly used in its GHG inventory. Additional information meeting a required standard of quality would then be required, such as methodology details, AD, EFs and measurements from the facilities. Consideration to ensure consistent entity and fuel definition must be established between the mandatory facility reporting program and those of the national energy balances, as compiled by Statistics Canada, for the national inventory to estimate emissions from facilities that are not covered or that do not meet Statistics Canada's reporting threshold.

18. In order to improve energy data, data delivery timeliness and to reconcile the energy data presented in the common reporting format (CRF) with data from the International Energy Agency (IEA) Canada has established a formal working group to address and improve the quality of the underlying

energy statistics, and the Industrial Consumption of Energy Survey used for the emissions inventory. The ERT considers that this is an important task for the energy sector and encourages Canada to conclude this work rapidly, as it should lead to improvements in the accuracy and transparency of both the sectoral and reference approaches.

19. Canada has a formal national system established for reporting forestry activities under Article 3, paragraph 3, and for the elected activity under Article 3, paragraph 4, cropland management. Canada has implemented a LULUCF MARS system which will form the basis for Canada's LULUCF accounting and reporting. The ERT concludes that this system can perform the functions required for reporting activities under Article 3, paragraphs 3 and 4.

20. In Canada there is an established process for the official consideration and approval of the inventory, including recalculations, prior to its submission to the UNFCCC secretariat, and for responding to any issues raised by the ERT. The responsible organization is Environment Canada. The national system proved that it was operational during the in-country visit and Canada responded to all requests for further information from the ERT. The national system also provides effective responses to requests for clarifying inventory information resulting from the different stages of the review process, and information on the national system.

2. Quality assurance/quality control

21. Canada has elaborated and implemented a QA/QC plan 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). This includes general QC procedures (tier 1) as well as some source/sink category-specific procedures (tier 2) for key categories and for those individual categories in which significant methodological and/or data revisions have occurred. Canada has established transparent processes and procedures for its QA/QC work, including definition of responsibilities, identification of a QA/QC coordinator in the Greenhouse Gas Division of Environment Canada, and a perspicuous documentation of the QA/QC procedures. The ERT has also noted that review procedures are carried out by staff who have not been involved in the inventory preparation process, which is in line with the IPCC good practice guidance. However, not all elements of the QA/QC plan have yet been implemented by the Party due to resource limitations. Hence, the ERT concludes that it is important that sufficient resources be allocated in order to maintain and improve the quality of Canada's GHG inventory.

22. The ERT encourages Canada to finalize the implementation of tier 2 category-specific and peer review procedures as soon as possible. In this regard, Canada should consider conducting category-specific QA/QC activities more frequently than over a seven-year cycle. The ERT also recommends Canada to further develop its short- and long-term improvement plans and improve the linkage between the QA/QC plan, uncertainty analysis and key category analysis.

3. Inventory management

23. Canada has a well-organized centralized archiving system, which includes the archiving of disaggregated EFs, 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, documentation on annual key categories and key category identification, and planned inventory improvements. Most of the data and information are archived electronically in the Greenhouse Gas Division of Environment Canada, while references, user manuals and reports, which are not available electronically, are kept in hard copy at a library archive in the same agency. All material referenced will in the future be included in the electronic archive, where practicable. Relevant data from external providers are archived in institutions other than Environment Canada. During the in-country visit, the ERT was provided with the requested additional archived information, including confidential data, according to national procedures.

B. Greenhouse gas inventory

24. In conjunction with its initial report, Canada has submitted a complete set of CRF tables for the years 1990–2004 and a national inventory report (NIR). The Party submitted revised emission estimates on 24 December 2007 in response to questions raised by the ERT during the course of the in-country visit. Canada submitted revised estimates on 23 January 2008 in response to questions raised by the ERT on the 24 December 2007 revised estimates by the Party. This report is based on the revised estimates of 23 January 2008.

25. During the in-country visit Canada provided the ERT with additional information. These documents are in many cases referenced in the NIR. The full list of materials used during the review is provided in the annex to this report.

1. Key categories

26. Canada has reported a tier 1 level and trend key category analysis for 2004, and also applied a qualitative approach in determining its key categories as part of its initial report submission. Canada has also included the LULUCF sector in its key category analysis for 2004. However, the initial report submission did not include a key category analysis for 1990. The Party provided a 1990 key category analysis (excluding LULUCF) to the ERT during the in-country visit. The structure of this review report will be based on the secretariat's key category analysis with the exception of a number of categories in the energy sector which are more aggregated than the level of the secretariat's analysis.

27. The key category analysis performed by Canada and the secretariat[2] produced generally similar results. However, Canada has chosen more disaggregated categories for some sectors and has not separated categories by fuel type in the energy sector, as in the analysis produced by the secretariat. The ERT recommends Canada to include a key category analysis for 1990 which includes LULUCF in its next inventory submission. The ERT also recommends Canada to develop a tier 2 key category analysis which includes quantitative inclusion of uncertainty.

28. The results of the key category analysis are one of the driving factors for the preparation of the inventory. Canada uses the key category analysis in the prioritization of resources and choice of methodological tier. In line with the IPCC good practice guidance most of the key categories are estimated using higher-tier methods.

2. Cross-cutting topics

29. The inventory is in line with the *Revised 1996 IPCC Guidelines for National Greenhouse Gas Inventories* (hereinafter referred to as the Revised 1996 IPCC Guidelines), the IPCC good practice guidance and the *IPCC good practice guidance for Land Use, Land-Use Change and Forestry* (hereinafter referred to as the IPCC good practice guidance for LULUCF).

30. The inventory is compiled in accordance with Article 7, paragraph 1, of the Kyoto Protocol and decision 15/CMP.1.

[2] The secretariat identified, for each Party, those 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* (hereinafter referred to as the IPCC good practice guidance for LULUCF) for the base year or base year period, as well as the latest inventory year. Key categories according to the tier 1 trend assessment were also identified. 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.

Completeness

31. The inventory submitted in conjunction with the initial report is in general complete in terms of coverage of years, sectors and gases. Some minor categories are missing in the 2006 submission, such as emissions from waste incinerators with energy recovery; use of recovered landfill gas as fuel; waste tyres and other waste used as fuel in cement kilns; bio-diesel in road transportation; abandoned mines; HCFC-22 production; and from grassland remaining grassland. The sector chapters of the NIR provide a full description of categories not covered in the inventory. The ERT recommends Canada to include these categories in its next inventory submission, especially where data and methods are available or easily collected, in order to improve the completeness of the inventory.

32. With regard to GHGs the CRF tables are completely filled in and the notation keys reported where appropriate. However, Canada did not report the following tables: 2(II).F; and long range transboundary air pollution (LRTAP) emissions of indirect GHGs are not reported in CRF table 9 (completeness) and are only provided in an annex to the 2006 NIR. The ERT encourages Canada to consider reporting indirect GHGs (precursors) and sulphur dioxide (SO_2) in the CRF table in its next inventory submission.

Transparency

33. Canada's inventory is generally transparent and the NIR provides a good basis for the review of the inventory. The NIR provides most of the information necessary to assess the inventory; however, some additional information could improve the transparency to the extent where confidential information is not compromised. Furthermore, the ERT has identified the following issues for improvement in the NIR and recommends that Canada consider separation of data on oil sand production from data on fuel combustion in the mining industry (see paragraph 49); aggregate some of the textual information included in the industrial processes sub-categories (see paragraph 72); and improve its documentation of the national methodology, including the scientific basis that underpins the estimation of N_2O emissions from summer fallow (see paragraph 94).

34. Furthermore, some minor inconsistencies were found between the NIR and the CRF. For instance, due to rounding up of numbers in the NIR, emission data are not always consistent with those of the CRF. The ERT recommends Canada to improve the consistency between the NIR and the CRF in this regard.

Consistency

35. The ERT concluded that Canada's national inventory generally provides a consistent time series in accordance with the IPCC good practice guidance. Furthermore, the ERT identified some inconsistencies in coal data after 2002. Canada noted that these are due to the fact that imports of coal are not correctly reported by Statistics Canada, in particular imported sub-bituminous coal may be reported as bituminous coal, which results in the use of an incorrect EF. The ERT recommends that Canada resolve this data issue with Statistics Canada for its next inventory submission.

Comparability

36. Canada's inventory is comparable with those of other Annex I Parties, as defined in the "Guidelines for the preparation of national communications by Parties included in Annex I to the Convention, Part I: UNFCCC reporting guidelines on annual inventories" (hereinafter referred to as the UNFCCC reporting guidelines, Part I). In the revised emission estimates submitted on 23 January 2008 for all years of the inventory time series, the Party allocates its source/sink categories in accordance with the Revised 1996 IPCC guidelines. The ERT notes that in Canada's response to questions raised by the ERT on energy industries (combustion of landfill gas for energy) – CO_2. The emissions have been removed from the waste sector, but these have not been included in the public electricity and heat

production category in the CRF tables. Canada reported these in its resubmission of 23 January 2008, but by oversight omitted the calculation in the CRF. The Party has indicated that it intends to include emissions from the consumption of landfill gas in the energy sector in its next inventory submission.

Accuracy

37. Canada's inventory is in general accurate, as defined in the UNFCCC reporting guidelines. During the in-country visit, the ERT identified that the calculation of emissions in the base year was not consistent with the Revised 1996 IPCC Guidelines and the IPCC good practice guidance in that the inventory overestimated emissions for the following categories: combustion of liquid fuels – CO_2 (paragraphs 58 and 59); electrical equipment – SF_6 (paragraph 82); other (2.G) – CO_2 (paragraph 77); enteric fermentation – CH_4 (paragraph 90); direct soil emissions – N_2O (paragraph 92); indirect emissions – N_2O (paragraph 94); solid waste disposal on land – CH_4 (paragraph 111); and wastewater handling – N_2O (paragraph 114). During the in-country visit the ERT recommended Canada to revise the calculation of emissions from these categories. The ERT commends Canada for submitting on 23 January 2008 revised emission estimates for categories identified above for all years of the inventory time series. This review report is based on these revised emission estimates. The ERT concludes that the emission estimates are consistent with the Revised 1996 IPCC Guidelines and the IPCC good practice guidance.

38. During the in-country visit, the ERT also noted that the inventory may underestimate emissions in the base year for the following categories: combustion of solid fuels (coal) – CO_2 (paragraph 60); ammonia production – CO_2 (paragraph 76); production of HCFC-22 – HFC-23 (paragraph 81); manure management (sheep and lamb) – CH_4 and N_2O (paragraph 91); direct soil emissions – N_2O (paragraph 92); and wastewater handling (industrial) – CH_4 and N_2O (paragraph 113). The ERT recommended that the Party consider submitting revised emission estimates for these categories. Canada elected not to submit revised estimates for minor categories, such as manure management (sheep and lamb) – CH_4 and N_2O and wastewater handling (industrial) – CH_4 and N_2O as AD were not readily available. Canada has committed to further research the outstanding issues and, if warranted, to include corrections in its future inventory submissions. Furthermore, Canada's response to questions raised by the ERT on energy industries (combustion of landfill gas for energy) – CO_2 indicates that the Party identified a misallocation of these emissions to the waste sector instead of the public electricity and heat production category; however, these emission estimates were removed from the waste sector, but not allocated to the public electricity and heat production category in the CRF tables (CO_2 as a memo item, and CH_4 and N_2O). The ERT encourages the Party to address these remaining potential underestimations in its next inventory submission. This report is based on the revised emission estimates.

39. The ERT recommends that Canada improve the accuracy of the inventory by incorporating all the improvements identified by the ERT into its next inventory submission.

Recalculations

40. The national system ensures that recalculations of previously submitted estimates of GHG emissions by sources and removals by sinks are prepared in accordance with the IPCC good practice guidance and the IPCC good practice guidance for LULUCF. The rationale for these recalculations is provided in the NIR and also in CRF table 8, and these recalculations have resulted in real improvements to the inventory.

41. The ERT noted that recalculations reported by the Party for the time series from the base year to 2003 had been undertaken to take into account the recommendations of the previous review (2005): new results from facilities in the upstream oil and gas and oil refining industries; updating of Statistics Canada's underlying energy data for 2003; revision of the estimation model for emissions from landfills; and improved, country-specific methodologies and factors for N_2O emission from agricultural soils. As a result of these recalculations the emissions (excluding LULUCF) increased by 1.4 per cent in 2003 and

decreased by 0.3 per cent in 1990. The overall impact of these changes is that emission growth over the period 1990–2003, previously reported to be 24 per cent is now estimated to be 26 per cent. The major changes include: CO_2 emissions from energy industries; CH_4 fugitive emissions from fuels (oil and natural gas); N_2O from agricultural soils and CH_4 from solid waste disposal on land. In addition significant recalculations in the LULUCF sector have been carried out due to an improvement in the methodology used.

Uncertainties

42. Canada has reported a tier 2 uncertainty analysis for each category (excluding LULUCF categories) and for the inventory in total. This analysis generally follows IPCC good practice guidance; however, the ERT recommends that the uncertainty analysis be improved by including the LULUCF sector in the analysis. The 2006 submission incorporates additional information from a tier 2 study undertaken in 2005 based on the 2003 inventory submission; this information was not included in the 2005 submission and comprises information on the overall trend in the inventory uncertainty for 1990–2001 and the sensitivity of the overall inventory uncertainty to uncertainties identified at the category level.

43. The reported overall level of uncertainty of the national inventory (without LULUCF) falls within a range of −3 per cent to +6 per cent for all GHGs combined. The largest contributor to the inventory, CO_2, demonstrates an uncertainty of −4 per cent to 0 per cent. Although the study of uncertainty was performed on the 2003 submission data, Canada states that the level uncertainties assessed are assumed to be representative of the current inventory uncertainty for the majority of cases.

44. Some of the sector estimates in Canada's tier 2 uncertainty analysis are considered by the ERT to be improbable. For example, the uncertainty estimates for the trend are often higher than the estimates for level, which deviates from similar analysis in other countries. Canada has also included uncertainty estimates for global warming potential values, which is not relevant for reporting under the UNFCCC reporting guidelines. Although Canada to a large extent uses the results of its uncertainty analysis to prioritize improvements in the inventory, the ERT recommends Canada to improve its uncertainty analysis and to include LULUCF categories. The ERT also recommends Environment Canada to update the uncertainty analyses more regularly, to develop in-house expertise to perform the analysis, and to use the results in inventory improvement and development.

3. Areas for further improvement identified by the Party

45. The NIR identifies several areas for improvement. For Canada a key priority will be the full implementation of a complete, formal QA/QC plan, including source/sink category-specific tier 2 QA/QC procedures, pending sufficient and predictable funding. This also includes the consolidation and expansion of the documentation of the inventory process and of QA/QC activities, and development of a data management system for the entire GHG inventory. In addition, Canada plans to further develop its uncertainty analysis by documenting and quantifying uncertainties in all LULUCF categories. Future inventory improvement plans also include the development of a tier 2 key category analysis model including uncertainty analysis results.

4. Areas for further improvement identified by the ERT

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

(a) In order to maintain and improve the quality of Canada's GHG inventory the ERT recommends Canada to allocate sufficient resources to its inventory preparation;

(b) Improve the exchange of data between different governmental and non-governmental institutions involved in the inventory preparation;

(c) Further develop the mandatory facility reporting programme in order to improve and expand the use of emission data from the industry;

(d) Develop a tier 2 key category analysis;

(e) Update the uncertainty analyses more regularly and develop in-house expertise on uncertainty;

(f) Include the LULUCF sector in the uncertainty analysis;

(g) Further develop the improvement plan in order to better link QA/QC findings, uncertainty and key category analyses and new scientific knowledge;

(h) Finalize the implementation of tier 2 category-specific and peer review procedures and consider conducting category-specific QA/QC activities more frequently than over a seven-year cycle;

(i) Improve the description of methodologies in the NIR;

(j) Improve the consistency between the NIR and CRF;

(k) Improve the completeness of the inventory by including estimates in its next inventory submission for all identified categories for which emissions occur in the country.

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

5. Energy

Sector overview

48. In the base year, the energy sector accounted for 79.4 per cent of the total national GHG emissions. Emissions from this sector have increased by 30.3 per cent between the base year and 2004. Energy industries was the most important category in the base year, contributing 31.4 per cent to total sector emissions, while transport, other sectors, manufacturing industries and construction and fugitive emissions from fuels contributed 30.8, 15.2, 13.4 and 9.2 per cent, respectively. Emissions from road transportation contributed 22.0 per cent to total national GHG emissions in the base year. CO_2 is the dominant GHG, contributing 90.3 per cent to total sector emissions (71.7 per cent to total national GHG emissions), with CH_4 and N_2O emissions from this sector contributing 7.9 and 1.8 per cent, respectively.

49. The ERT acknowledges a major improvement to the inventory as a result of a study in the upstream oil and gas industries, including oil sand production. This study, which is based on facility-level information, now includes emissions from flaring and venting and gives improved coverage of the fugitive and combustion emissions in these sectors. The fugitive emissions component is reported under category oil and natural gas (1.B.2), while combustion emissions from oil sand production are reported under manufacture of solid fuels and other energy industries. Due to confidentiality issues data in the CRF on oil sand production are not separated from fuel combustion in the mining industry, which reduces the transparency of the inventory. The ERT encourages Canada to explore the feasibility of reporting this in the correct category.

50. While much of the information on coke oven gas in the NIR is listed under coal (e.g. Table 3-12, A7-4, A13-4), according to CRF table 8(b) reporting of emissions from the use of coke oven gas has been moved from solid fuels in earlier inventories to gaseous fuels. The 1996 Revised IPCC Guidelines specify coke oven gas under solid fuels (coal and coal products) (Volume I, Chapter 1.2). The ERT recommends the reporting of coke oven gas under solid fuels. Canada's view is that fuels of the same physical state should be placed together as, firstly, this follows the IPCC heading and, secondly, they

have similar densities and heat contents and can therefore be analyzed more conveniently and appropriately when grouped together.

51. According to the second footnote to table 1A(a) Canada moved reporting of emissions from petroleum coke and catalytic coke in this sector from liquid to solid fuels. The 1996 Revised IPCC Guidelines specify reporting petroleum coke under liquid (crude oil and petroleum products) (Volume I, Chapter 1.2). The ERT recommends reporting petroleum coke under liquid fuels, and, as the catalytic coke is also a petroleum product, it should also be reported under liquid fuels. The view of Canada raised in paragraph 50 is also relevant here.

52. The major recalculation in the 2006 inventory of the base year estimates was the use of the new information on emissions from the oil and gas industry CPPI (2004), CAPP (2005). This involved a facility-level analysis of potential emissions and enabled flaring and venting to be correctly reported, as well as introducing improved estimates from the upstream oil and gas industry and petroleum refining. A minor improvement was the inclusion of ethanol as a road transport fuel. Overall, these changes, including the impact of revised estimates submitted to the ERT on 23 January 2008, decreased emissions from the energy sector in the base year by 0.4 per cent for CO_2, and increased emissions by 14.3 per cent for CH_4 and 0.4 per cent for N_2O.

Reference and sectoral approaches

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

53. In general, the differences between the reference approach and the sectoral approach are explained in the NIR. Furthermore, Canada provided additional explanations to the ERT during the in-country visit and these additional explanations are recommended to be included in its next inventory submission of the NIR. The main factors resulting in differences between the two approaches are biomass, flaring and venting from the oil and gas industry and the non-energy use of fuels. However, the ERT noted two errors in CRF table 1.A(b). Firstly, the carbon (C) content for sub-bituminous coals in the base year (and to a lesser extent 1991−1997) are too high (it should lie between the values for lignite and bituminous coal), and secondly, the import data for other kerosene, LPG, naphtha, refinery feedstocks and other oil are negative values because the imports column includes items from the original Canadian energy balance which are better reported in the stock changes column. The ERT recommends that Canada correct these in its next inventory submission. The difference between the sectoral and reference approach emissions of CO_2 as given in the CRF is 11.7 per cent in the base year. The NIR estimates the impact of the factors causing the difference and these result in a residual difference of 4.0 per cent in the base year.

54. Canada, like many other Parties, has had difficulty reconciling the energy data presented in the CRF with data from the IEA. This is partly due to the IEA receiving energy data from NRCan, while Environment Canada relies on data from Statistics Canada as the basis for compiling the inventories. The timing of data submissions, definitional differences between data from these organisations and the IEA and different energy conversion factors all contribute to differences between these sources of data. As noted in the NIR, Canada has established a formal working group on energy statistics, consisting of members from Environment Canada, NRCan, and Statistics Canada, to address and improve the quality of the underlying energy statistics (for the Report on Energy Supply–Demand in Canada, RESD, Statistics Canada, 2005), and the Industrial Consumption of Energy Survey (Statistics Canada, 2005) used, inter alia, for the emissions inventory. The ERT thinks this is an important task for the energy sector and encourages Canada to conclude this work rapidly, as it should lead to improvements in the accuracy and transparency of both the sectoral and reference approaches.

International bunker fuels

55. The method used to estimate international aviation bunkers is to split fuel deliveries to Canadian airlines into domestic and international bunkers based on estimates for all years from a model based on tonne-kilometre data, which is then adjusted to be equal to the results for the year 2000 of the System for Assessing Aviation's Global Emissions (SAGE) model from the United States Federal Aviation Administration (FAA). All non-Canadian airline flights are assumed to be international flights. This results in an estimate of the split between domestic and international aviation fuel use in accordance with the IPCC good practice guidance for 2000, but, as the national/international split varies from year to year, it will not correctly show the values for other years or the trend. Canada informed the ERT that it is developing a new model based on flight origins and destinations to improve these estimates in accordance with the IPCC good practice guidance. The ERT encourages the Party to complete and implement this model.

56. For marine bunkers the fuel deliveries are allocated to domestic use or international bunkers according to the flag of the vessel. This is not in line with the IPCC good practice guidance. In recent years the trend in fuels allocated to international bunkers and their emissions has been diverging from the increasing trend in the amount shipped internationally into and out of Canada, indicating a potential discrepancy with the current estimates. The Party informed the ERT that it has been examining alternative data sources, such as shipping movements. The ERT recommends that Canada develop a model that produces results for all years in line with the IPCC good practice guidance.

Feedstocks and non-energy use of fuels

57. The allocation of feedstocks and non-energy use of fuels is in line with the UNFCCC reporting guidelines and the Revised 1996 IPCC guidelines.

Key categories

Fuel combustion: liquid fuels – CO_2

58. During the in-country visit a problem was identified by the ERT in relation to the C factors for liquid fuels. The source of the C content factors used was Jaques (1992) which states that "with the exclusion of propane the highest value reported by Keeling (1973) has been used". The same C content value (87 per cent) was used for all liquid fuels, however, in practice, they would be expected to vary with fuel density and calorific value. Jaques uses fuel densities (usually selecting the median value) from the Institute of Petroleum (1973) (United Kingdom of Great Britain and Northern Ireland data) and Perry and Chilton (1973). However, where Canadian fuels were measured, McCann, (2000), indicates fuel densities lower than assumed by Jaques, implying that the emissions are likely to be overestimated. Following the ERT review, Canada submitted revised estimates based on consistent data from McCann (2000) for both C content and fuel densities. The impact of this, combined with a revision in the oxidation factor (paragraph 59) is to reduce the emission estimates for the base year from 194,707.5 Gg CO_2 to 190,824.6 Gg (a decrease of 2.0 per cent, or 3,882.9 Gg). The ERT recommends that Canada review and update annually fuel properties such as C content and fuel density, by type of fuel and category, in order to track any trend in these values.

59. The oxidation factor assumed was 98.5 per cent for liquid fuels. The ERT considered that this may be too low for the entire time series, as efficient modern fuel combustion would be expected to oxidise a higher fraction of the fuel. This value was not well documented or justified either in the NIR or during the in-county visit. Therefore, the ERT considers that the inventory was likely to have underestimated emissions of CO_2 from the combustion of all liquid fuels. This is particularly true for motor vehicles in recent years of the time series, as these vehicles are equipped with pollution control devices that oxidise unburnt fuel, exhaust emissions and evaporative emissions from the fuel system. As a result of the review Canada submitted revised estimates with an assumed oxidation factor of 99 per

cent (in line with the Revised 1996 IPCC Guidelines). This has resulted in an increase in the emission estimate for the base year of 969 Gg CO_2. The ERT recommends that Canada review the oxidation factor for the most recent years of the inventory time series as combustion technologies and control equipment improve.

Fuel combustion: solid fuels – CO_2

60. During the in-country visit Canada informed the ERT that, in the base year, the EFs for CO_2 for American bituminous coal in Nova Scotia should be 2,500 g/kg, not 2,300 g/kg (as stated in the NIR), while for Canadian bituminous coal in New Brunswick it should be 2,330g/kg, not 2,230 g/kg (also as stated in the NIR). As these values are the basis of an interpolation between 1990 and 1998, intermediate values are also incorrect. This appears to have arisen as an error in transcribing the factors from the original source (Lauer, 1990). Thus the ERT concluded that the emissions were underestimated. Canada submitted revised estimates (a correction of these errors) to the ERT, which resulted in an increase in base year emissions from 91,815.9 Gg CO_2 to 91,856.9 Gg (an increase of 0.04 per cent or 40.9 Gg).

61. The ERT noted that the coal CO_2 EFs are based on Lauer (1990) (data for 1978–1988) and McCann (2000) (data for 1998). The ERT recommends that Canada review CO_2 EFs used from the base year to 2004, and that, to the extent possible, it derive revised EFs based on more recent data and reflecting possible changes in C content. Furthermore, the ERT recommends that Canada institute an annual process to check C content by type of fuel and category, and collect C content data for the most recent year.

62. Canada informed the ERT during the in-country visit that some inconsistencies in the coal data after 2002 are due to the fact that imports of coal are not correctly recorded or reported by Statistics Canada: in particular, some imported sub-bituminous coal is reported as bituminous coal, which results in the use of an incorrect EF. The ERT recommends that Canada resolve this data issue with Statistics Canada for its next inventory submission.

Stationary combustion: gaseous fuels – CO_2.

63. The NIR shows that the EFs for natural gas were constant for all years from the base year to 2004. The ERT notes that this factor can change from year to year and, as for solid and liquid fuels, encourages Canada to institute an annual review and updating of this factor.

Road transportation – N_2O

64. Canada conducted an extensive study and literature review of all the N_2O (and CH_4) EFs for the entire transport sector as a result of the 2003 in-country review. The 2003 review report identified a problem with the N_2O EF for cars with petrol-engines with three-way catalysts, as there appeared to be a problem with the conversion of the factor from its original units. Canada has not yet recorded the results in the latest inventory. The ERT commends the Party on this work and recommends Canada to record the revised EFs in its next inventory submission.

Oil and natural gas – CO_2, CH_4

65. Canada has used the results of studies of the oil and gas industry (CPPI, 2004, CAPP, 2005) to provide significant improvements to the emission estimates in this category as well as associated changes to fuel combustion reported in petroleum refining, the manufacture of solid fuels and other energy industries, and other means of transporting oil and natural gas, that is, via pipelines. However, the issues raised in paragraph 49 above are also relevant here. These studies are based on facility-level information and therefore give a good picture of this complex sector, especially where its fuel use is not well represented by the national energy balance. These changes have resulted in correct reporting of flaring and venting under the fugitive sector and also provide improved estimates of emissions from the entire energy sector.

6. Industrial processes and solvent and other product use

Sector overview

66. In the base year, the industrial processes sector accounted for 9.2 per cent of total national GHG emissions. Emissions from this sector have increased by 1.4 per cent between the base year and 2004. Metal production was the most important category in the base year, contributing 35.5 per cent to total sector emissions, while the chemical industry, other (2.G), mineral products, consumption of halocarbons and SF_6 and production halocarbons and SF_6 contributed 30.1, 15.1, 15.1, 2.8 and 1.4 per cent, respectively. Solvent and other product use, a relatively minor category, accounted for just 0.1 per cent of total national GHG emissions. These emissions were from the use of N_2O in anaesthesia and from propellants.

67. Canada estimates emissions in accordance with the Revised 1996 IPCC Guidelines and the IPCC good practice guidance using higher-tier methods for most key categories. The ERT commends Canada for undertaking an extensive survey of limestone and dolomite use and for including emission estimates for magnesite use.

68. The inventory in general is complete in terms of coverage of years, categories and gases. Actual and potential emissions of SF_6 are reported for all years of the inventory time series, however, actual and potential emissions of HFCs and PFCs are reported from 1995 onwards. Some minor categories are missing, such as emissions of HFC-23 from HCFC-production (paragraph 81). Canada has reported CRF table 2(II).F due to technical difficulties in using the CRF Reporter software. Canada informed the ERT that it intends to start filling in CRF table 2(II).F in the 2008 or 2009 inventory submission depending on the CRF Reporter software.

69. The ERT noted that the reported uncertainty estimates are based on analysis of the 2001 inventory undertaken in 2004, and in some instances (e.g. lime production and ammonia production) are not fully understood. The ERT recommends that Canada revise the uncertainty estimates for this sector and establish a process to review these periodically.

70. The ERT noted that QC procedures for emission estimates provided by external sources can be improved. The ERT recommends that Canada establish more explicit QC procedures to be applied to external emissions data. The overall provisions on QC in section 6 of the QA/QC plan were found to be rather general. The ERT also recommends that the Party provide information on category-specific tier 2 QC procedures, where applicable, in the tables of the process maps in section 6 of the aforementioned plan.

71. The ERT noted that the transparency of the NIR section on industrial processes could be improved by combining information on each of the sub-categories into one section for that category, rather than presenting this information in a fragmented manner under sub-headings. In order to improve the user-friendliness and readability of the text, the ERT recommends Canada to consider re-formatting this information within the possibilities of the UNFCCC reporting guidelines.

72. Canada is recommended to revise its policy on rounding-up of emissions data in the NIR. The rounding-up principle is governed by significant numbers. Currently many inconsistencies are observed in emissions data when comparing the CRF data and the NIR. This practice also leads to an incorrect estimation of the time trend in emission levels for a number of categories.

73. Recalculations of previously submitted estimates of GHG emissions are prepared in accordance with the IPCC good practice guidance. The rationale for these recalculations is provided in the NIR, and these recalculations have resulted in real improvements to the inventory.

Key categories

Cement production – CO_2

74. Canada reports a value of 1.02 for the cement kiln dust (CKD) correction. During the in-country visit Canada informed the ERT that it has received anecdotal information from the industry that this CKD correction may underestimate emissions. Canada is encouraged to explore alternative values for its CKD factor from technical literature and/or from the Canadian cement industry reflecting the fact that CKD values can vary from 1.02 to 1.2 (for modern to less modern plants), as suggested in the most recently published recognized international scientific literature.

75. The ERT recommends Canada to develop a country-specific EF which reflects the real raw material base for clinker production.

Ammonia production – CO_2

76. Canada produces ammonia and exports part of it as urea, that is, after reaction with CO_2. The CO_2 which is chemically bound in the urea is released at the moment of application of the urea as fertilizer. Taking the exportation of chemically-bound CO_2 into account, Canada in its 2006 submission has subtracted for all years of the inventory time series emissions of CO_2 from this category. In response to questions raised by the ERT during the in-country visit Canada submitted revised estimates including CO_2 emissions for exported urea. The revised estimates resulted in an increase of CO_2 emissions from this category in the base year from 3,941.7 Gg CO_2 to 5,007.5 (an increase of 27.0 per cent or 1,065.8 Gg).

Other – CO_2

77. Canada has reported coal used for making graphite electrodes, used in electric arc furnaces, in the category other (2.G), as well as in iron and steel production, for all years of the inventory time series. The ERT estimated the impact of the double-counting to be 23 Gg CO_2 in the base year rising to 32 Gg in 2004. This is not in line with the IPCC good practice guidance. In response to questions raised by the ERT during the in-country visit Canada submitted revised estimates for this category. The revised estimates resulted in a decrease in CO_2 emissions from this category in 1990 from 8,312.3 Gg CO_2 to 8,291.7 (a decrease of 0.2 per cent or 20.7 Gg).

Non-key categories

Lime production – CO_2

78. The ERT commends Canada for deriving emission estimates based on the results of a comprehensive industry survey of lime producers, including captive lime production in other industries.

79. Canada does not collect AD for high-calcium and dolomitic lime. The ERT encourages the Party to establish a process to collect production data for both relevant types of lime.

80. Canada is encouraged to develop country-specific EFs for the two major lime types.

Production of halocarbons – HFCs

81. During the in-country visit the ERT identified production of roughly 1,800 tonnes of HCFC-22 in the base year in a plant belonging to Allied-Signal in Amherstburg, which was closed in 1993. Canada did not report emissions of HFC-23 from the production of HCFC-22 between the base year and 1992. In response to questions raised by the ERT during the in-country visit Canada submitted revised estimates for this category. The revised estimate resulted in an increase of actual HFC emissions in the base year by 65.6 Gg HFC-23 (767.3 Gg CO_2 eq).

Consumption of halocarbons and SF_6 – SF_6

82. Canada has estimated SF_6 emissions between the base year and 1994 by scaling the 1995 emissions estimate using the results of a survey performed by the RAND Corporation. The RAND survey estimated worldwide sales in different economic sectors. However, it has come under much scrutiny in expert discussions in international fora due to the inter-sector allocation of SF_6. The ERT questioned whether the global trend derived from the RAND survey is relevant to Canada. Furthermore, Canada informed the ERT that awareness of SF_6 emissions started to spread in the utility sector only in the second half of the 1990s. Based on these considerations, the ERT concluded that the methodology used by Canada to derive the declining trend in lieu of country-specific evidence is not in accordance with the IPCC good practice guidance. Therefore, during the in-country visit the ERT recommended that Canada obtain genuine data from the utility sector to support the declining trend of emissions reported by Canada in its 2006 submission. In response to questions raised by the ERT Canada submitted revised estimates for this category. The revised estimates resulted in a decrease of SF_6 emissions in the base year from 75.2 to 63.8 tonnes of SF_6 (decrease of 15.2 per cent or 272.8 Gg CO_2 eq).

7. Agriculture

Sector overview

83. In the base year, GHG emissions from the agriculture sector amounted to 48,076.0 Gg CO_2 eq and accounted for 8.1 per cent of total GHG emissions. Emissions increased by 27.6 per cent between the base year and 2004 due to the growth in the population of non-dairy cattle, swine and poultry, and fertilizer consumption in Canada. N_2O was the dominant gas emitted in the base year, contributing 57.8 per cent to total sector emissions, while CH_4 contributed 42.2 per cent. Agricultural soils was the largest emitting category in the base year, contributing 50.2 per cent to total sector emissions, while enteric fermentation and manure management contributed 36.8 and 13.0 per cent, respectively.

84. Canada did not submit a key category analysis for the base year. The key categories included in this review report are those identified by the secretariat, and for the agriculture sector these include: CH_4 from enteric fermentation (level and trend); N_2O from direct soil emissions (level and trend); N_2O from indirect emissions (level); N_2O from manure management (level); and N_2O from pasture, range and paddock manure (level).

85. Prescribed burning of savannas does not occur in Canada. Rice cultivation and field burning of agricultural residues are reported as not estimated ("NE"). The ERT recommends that Canada investigate and confirm whether these practices exist in Canada and provide appropriate estimates in its next inventory submission. Furthermore, Canada is encouraged to report emissions from some minor animal categories (e.g. mules and asses, llamas, ducks and geese).

86. Canada reported recalculations for all years of the inventory time series in its 2006 submission. These recalculations arise from: revisions of population data for sheep and poultry categories; implementation of a tier 2 CH_4 EF for enteric fermentation and a tier 2 CH_4 EF from manure management (dairy cattle); implementation of tier 2 methods for estimating direct N_2O emissions for synthetic fertilizers, animal manure applied to soils and crop residue; revision of some parameters (e.g. methane-producing potential (B_0), CH_4 conversion factors (MCFs), nitrogen (N) excretion rates) and EFs (e.g. for N_2O emissions from manure on pasture, range and paddock, N_2O from leaching and runoff, NH_3 and NO_X emissions from manure management systems) from recently published recognized international scientific literature; development of a country-specific fraction of leached N ($Frac_{LEACH}$); addition of country-specific categories for N_2O emissions from agricultural soils (e.g. summer fallow and winter emissions); and the subtraction of N_2O emissions from N fixation. The recalculation of the base year agriculture inventory, including revised estimates, resulted in a decrease of 7.8 per cent in total sector emissions.

87. Canada has developed and implemented complex methodologies at provincial level to estimate emissions from all categories, in accordance with the Revised 1996 IPCC Guidelines and the IPCC good practice guidance. Canada has also introduced revised parameters and EFs from recently published recognized international scientific literature. Some country-specific categories of N_2O emissions from cropland have been reported (e.g. summer fallow and winter emissions). Sector-specific QA procedures include peer review of methodology applied for enteric fermentation and manure management of cattle. The ERT commends Canada on its continued efforts to improve the coverage and quality of the agriculture inventory. However, the ERT identified uncertainty analysis as an area for further improvement, as it currently does not include the uncertainty of total agriculture emissions.

88. During the in-country visit, Canada informed the ERT that several improvements are planned, including the impact of tillage, soil texture and soil C mineralization on N_2O emissions; the addition of a country-specific category on irrigation in agricultural soils; and the extension of tier 2 QC and QA checks to validate CH_4 EFs for enteric fermentation and N_2O EFs for manure management with measured data.

Key categories

Enteric fermentation – CH_4

89. The ERT noted that the population data for cattle and sheep in the base year is 5.6 per cent higher and 38.1 per cent lower, respectively, than data from the Food and Agriculture Organization of the United Nations (FAO). The differences between the national inventory and the FAO data are not explained in the NIR. In the course of the review Canada explained that national data are based on statistics on the average annual population published by Statistics Canada, while the source of FAO animal population statistics is unknown at present. Furthermore, sheep population data from the FAO includes both adult animals and lambs, for which emissions are estimated separately in the inventory. The ERT recommends that Canada provide these explanations in its next inventory submission.

90. The ERT noted that the same average weight for non-dairy cattle has been used in the calculations of the tier 2 CH_4 EF for all years of the inventory time series. Furthermore, this average weight is based on a provincial survey for the year 2001 (Boadi et al, 2004). During the in-country visit, Canada provided the ERT with data on carcass weight, which shows an increasing trend (up by 15 per cent) between 1993 and 2006. In the course of the review Canada revised the estimates of the average live weight for relevant subcategories of non-dairy cattle (bulls, beef cows, beef heifers, heifers for slaughter and steers) by using the data on the carcass weight as a driver in accordance with the recommendations of the ERT. In response to questions raised by the ERT during the in-country visit, Canada submitted revised estimates. The revision resulted in a decrease of base year CH_4 emissions from 877.3 Gg CH_4 to 841.9 Gg (a decrease of 4.0 per cent or 743.8 Gg CO_2 eq). This revision cascades to other categories within the agriculture sector, namely revised estimates of CH_4 emissions from manure management from 123.3 Gg CH_4 to 123.14 Gg (a decrease of 0.1 per cent or 3.0 Gg CO_2 eq); N_2O emissions from manure management from 13.2 Gg N_2O to 11.8 Gg (a decrease of 10.0 per cent or 406.0 Gg CO_2 eq); and N_2O emissions from animal manure on pasture, range and paddock from 10.3 Gg N_2O to 9.0 Gg (a decrease of 12.7 per cent or 405.5 Gg CO_2 eq).

Manure management – N_2O

91. The ERT noted that for sheep and lambs only one value of average live weight is reported, as well as for volatile solids (VS) production and N excretion rate, which tends to underestimate emissions of CH_4 and N_2O emissions from manure management and subsequent N_2O emissions from soils. The ERT recommends Canada to consider the possibility of developing separate parameters for these livestock categories. The ERT also noted that the sum of N excreted by poultry in the base year is 3.0 per cent lower than the multiplication of the population and the average N excretion rate. Canada informed the ERT during the in-country visit that the N excretion rate reported in the CRF was obtained

on the basis of average national live weight, which is used for reporting in the CRF, while actual provincial data on live weight of different poultry categories are used to calculate emissions. The ERT recommends that Canada harmonize reporting in the CRF with actual calculations to ensure consistency.

Direct soil emissions – N_2O

92. A country-specific EF for direct N_2O emissions from all categories of agricultural soils has been developed. However, the ERT noted that regression analysis of measured data includes both year-round and vegetation season emissions. This could lead to an underestimation of emissions in the inventory time series. The ERT recommends that Canada harmonize data in relation to the period of measurement before the regression analysis. In response to questions raised by the ERT during the in-country visit, Canada submitted revised estimates. The revised estimate resulted in an increase in direct N_2O emissions in the base year from 35.3 Gg N_2O to 40.3 Gg (an increase of 14.2 per cent or 1,555.5 Gg CO_2 eq).

93. A country-specific category of direct N_2O emission from summer fallow was estimated in the category direct soil emissions. The ERT acknowledges Canada's efforts to submit an agriculture inventory that to the extent possible is complete in terms of coverage of all emission categories. The ERT considers that the current emission estimates for this country-specific category may include emissions already covered by the IPCC category direct N_2O emissions, and thus may overestimate base year emissions. The ERT strongly recommends Canada to improve the transparency of the emissions estimate by providing improved documentation of the national methodology, including the scientific basis, and, if appropriate, to revise the emission estimates in its next inventory submission. The ERT concludes that Canada should continue reporting emissions from this category in its future inventory submissions, and subject this emission estimate along with the recommended improved documentation to expert review.

Indirect emissions – N_2O

94. The ERT noted that the EF for leaching and runoff (0.0125 kg N_2O-N/kg N) is lower than the default EF recommended in the Revised 1996 IPCC Guidelines (0.0225 kg N_2O-N/kg N). In the course of the review Canada clarified that in the absence of domestic data this could better reflect national circumstances. In response to questions raised by the ERT during the in-country visit, Canada has opted to revert to the default EF recommended in the Revised 1996 IPCC Guidelines (0.0225 kg N_2O-N/kg N) and submitted revised estimates. The revised estimates result in an increase in N_2O emissions in the base year from leaching and runoff from 11.5 Gg N_2O to 22.6 Gg (increase of 95.8 per cent or 3,426.2 Gg CO_2 eq).

8. Land use, land-use change and forestry

Sector overview

95. In 1990, GHG emissions from the LULUCF sector amounted to a net sink of 81,765.1 Gg of CO_2 eq, offsetting 13.8 per cent of the net national GHG emissions. GHG emissions from this sector have fluctuated from a net sink to a net source through the inventory time series. The high variability in the reported emissions/removals is associated with the immediate impact of wildfires. Net emissions from the LULUCF sector have changed from being a net sink of 81,765.1 Gg CO_2 eq in 1990 to a net source of 80,839.9 Gg CO_2 eq in 2004. In 1990, the forest land net sink of 114,270.3 Gg CO_2 dominates the sector, particularly forest land remaining forest land. In the same year, land-use categories cropland, wetlands and settlements are a net source, mostly because of the immediate and residual emissions from deforestation in these categories since 1970.

96. Canada reported CO_2, CH_4 and N_2O emissions by sources and CO_2 removals by sinks for the land-use categories forest land, cropland, wetlands and settlements. The land-use category grassland is reported as "NE", included elsewhere ("IE") (for CO_2 only) and not occurring ("NO").

97. Tier 1 and tier 2 QA/QC procedures have been adopted, but it is not clear to which categories these procedures are applied. For example, with regard to forest land remaining forest land, the NIR refers to Annex 6, but the annex does not explain to which categories the different procedures are applied. The ERT recommends providing improved information on the QA/QC procedures applied on a category basis.

98. Canada has implemented a LULUCF MARS system. Forest CO_2 emissions and removals are estimated based on the C model CBM-CFS3. The CENTURY model is adopted for estimating the cropland CO_2 emissions and removals.

Key categories

Forest land remaining forest land – CO_2

99. This category is the most important category of the LULUCF sector, identified as a key category in the secretariat's analysis for level (1990) and trend assessments. The ERT commends Canada for adopting a tier 3 approach (C budget model CBM-CFS3) for this key category. The CBM is a semi-empirical model, with forest inventory and disturbance data as the empirical input, and modelled dead organic matter decay; it generates estimates of tree growth, litter fall, tree mortality, emissions from decomposition and immediate emissions from forest conversion. EFs are country-specific and model-derived. AD come from multiple national sources. The area under the managed forest is estimated according to 3 spatially-delineated sub-categories, namely, the area used for allowable cut, harvest and fire control. Forest management activities are documented in the national forest database. The ERT could not establish whether provincial and territorial governments adopt the same definition, however, the NIR states that data has been harmonized. The ERT recommends that documentation in the NIR on definitions be improved.

100. The ERT recommends Canada to explore improvements in the documentation in the NIR describing or explaining trends in C emissions. The ERT recommends that Canada explain the large decrease (88,656.7 Gg) in C during the base year from forest land remaining forest land. Furthermore, the ERT recommends the inclusion of a table in the NIR which provides the components of increases and decreases reported for the different C pools to enhance the transparency of the C fluxes.

Cropland remaining cropland – CO_2

101. The land sub-categories used for reporting cropland categories are identical to those of forest land. The NIR mentions that land management practices are shown to be important determinants of CO_2 emissions and removals. The living biomass and dead organic matter stocks are shown to decline during the base year. The ERT recommends that Canada provide information in the NIR on the reported decline in living biomass, dead organic matter and soil C in many land-use sub-categories, in the next inventory submission. EFs are derived from empirical data and from the CENTURY model.

Land converted to wetland – CO_2

102. The ERT commends Canada for reporting emissions and removals from wetlands, according to the IPCC good practice guidance for LULUCF. Canada reports estimates for managed peatland and flooded land. The total area of wetland covers 14 per cent of Canada's geographic area, with managed wetland covering an area of 896 kilo hectares (kha). Emissions are reported for both wetland remaining wetland and land converted to wetland, even though it is optional for a Party to report emissions for wetland remaining wetland. Tier 2 methods are adopted based on nationally-derived EFs. The NIR includes information on the high uncertainty concerning the area and EFs associated with this land use, but no quantitative uncertainty estimates are reported in the NIR. A single estimate of preconversion is used by Canada due to data limitations. The ERT recommends improvements in estimates of area- and region-specific EF for managed peatland in future inventory submissions. The area under land converted

to wetland seems to have continuously increased, however, no explanation for this increase is provided in the NIR.

Settlements – CO_2

103. The NIR reports that the conversion of cropland to settlements is known to occur, but this activity is reported as "NE" in the CRF. The ERT recommends that Canada report cropland converted to settlements in its next inventory submission.

Non-key categories

Land converted to cropland – N_2O

104. CRF Table 5 (III) reports that the total area converted to cropland is 9,031 kha with regard to the estimation of N_2O, whereas the corresponding value in CRF Table 5.B is 1,655 kha. The ERT encourages Canada to include in the NIR an explanation for the difference in area reported, since this would improve transparency and understanding of the completeness of reporting within this category.

Biomass burning – CH_4, N_2O

105. CH_4 and N_2O gases resulting from biomass burning are reported. The emissions from biomass burning in forest land are determined using a tier-3 approach, using a model based on spatially-referenced data on natural disasters, including fires. According to the NIR and CRF tables the forest area subject to biomass burning during 1990 was 350.9 kha. According to the NIR, changing the spatial configuration of managed forest areas affected the areas subject to wildfires, although not in a consistent manner. The ERT encourages Canada to consider a consistent approach with regard to determining the area subject to fires.

9. Waste

Sector overview

106. In the base year, emissions from the waste sector accounted for 3.2 per cent of total GHG emissions. Emissions from this sector increased 10.9 per cent between the base year and 2004, due mainly to increased emissions from municipal solid waste (MSW) landfills as a result of the growth in population over this period. CH_4 was the dominant GHG emitted in the base year, contributing 95.0 per cent to total sector emissions, while N_2O and CO_2 contributed 3.6 and 1.4 per cent, respectively. Solid waste disposal on land was the largest emitting category in the base year, contributing 93.8 per cent to total sector emissions, followed by wastewater handling and waste incineration which contributed 4.1 and 2.1 per cent, respectively.

107. The NIR covers emissions from all categories: solid waste disposal on land, domestic wastewater, human sewage and waste incineration. Emissions from industrial wastewater are considered to be negligible. The ERT concluded that the methodologies and EFs are described transparently. However, the ERT recommends that Canada improve the reporting of AD in the NIR in its next inventory submission.

108. Recalculations were performed for all categories in the waste sector due to improvements identified by Canada and following the recommendations of the 2005 review report. Recalculations reported by Canada are due to the following: revision of three of the provincial/territorial specific Scholl Canyon model parameters (CH_4 generation rate (k), the CH_4 generation potential (L_0), and the quantity of waste landfilled from 1991 to the present); new information on the process type of industrial wastewater treatment; and revised AD for waste incineration. The recalculation for the base year, along with submission of revised estimates by Canada in response to questions raised by the ERT during the in-country visit, resulted in a decrease of sectoral emissions by 23.8 per cent.

109. Canada has conducted a tier 1 sector-specific QA/QC procedure which identified a number of transcription errors in the solid waste disposal on land category. Uncertainties have been calculated for categories in this sector based on a study undertaken in 2005, and are high for all categories. However, modifications have been made to the methodology, AD and EFs, and the ERT expects that these improvements will improve the quality (and certainty) of the emissions estimate. The ERT encourages Canada to revise the uncertainty analysis for the waste sector.

Key categories

Solid waste disposal on land – CH_4

110. Canada has estimated CH_4 emissions from this category using a tier 2 IPCC first order decay model (Scholl Canyon model). During the in-country visit the ERT noted that there was insufficient documentation to support the use of the reported degradable organic content (DOC); the DOC fraction dissimilated (DOC_F); and the composition of the non-hazardous industrial, commercial and institutional (ICI) waste in landfill. The ERT concluded that the reported DOC value is based on waste composition generated at household level, and that it includes paper and textiles, which are important determinants for the DOC value. The ERT also concluded that the DOC_F value from the Revised 1996 IPCC Guidelines (0.77) should be replaced by a value in the range recommended by the IPCC good practice guidance (0.5–0.6). Canada is recommended to review the chosen DOC and DOC_F values, including underlying assumptions and the parameters for estimating emissions from ICI waste, and to improve documentation of these in its next inventory submission.

111. In response to questions raised by the ERT during the in-country visit, Canada submitted revised estimates based on revised values for DOC, DOC_F, and the share of ICI waste. The revised DOC_F value of 0.6 reflects the lower concentration of lignin in the MSW, as Canada estimates CH_4 emissions from dedicated industrial wood waste landfills (pulp and paper and saw mills) separately from MSW sites. The revised estimate for solid waste disposal on land and for wood waste landfills (6.C) resulted in a decrease in base year CH_4 emissions from 994.2 Gg to 727.3 Gg (a decrease of 26.8 per cent or 5,605.5 Gg CO_2 eq), and 120.8 Gg to 120.4 Gg (a decrease of 1.4 per cent or 8.4 Gg CO_2 eq), respectively. The ERT recommends that Canada include this new information and underlying data and assumptions in its next inventory submission.

112. The ERT also noted that the amount of waste disposed of annually is derived from two data sources over the time series: 1941 to 1990 (the base year) data are based upon information on the number of abandoned and active landfills (from a study by Levelton, 1991); and the 1998, 2000 and 2002 data are based on biennial surveys (waste management industry survey, Statistics Canada, 2000, 2003 and 2004) minus the amount of waste incinerated or exported. The 1991 to 1997 and 2003 to 2004 values are interpolated using an Excel linear regression; and 1999 and 2001 data are based on an average from adjacent years. During the in-country visit, Canada provided the ERT with the model used for the AD calculation. However, this model could not be reviewed by the ERT due to its complexity, thus the ERT could not conclude whether the applied approach is in accordance with the IPCC good practice guidance. However, the Party informed the ERT that the model had been verified to be in accordance with the IPCC Good Practice Guidance by a study conducted by the University of Manitoba for Environment Canada. The ERT recommends that Canada include sufficient documentation in the NIR that will allow the ERT to recreate the amount of waste generated annually. During the in-country visit the ERT was informed that Canada had implemented a revised approach in its 2007 submission and would be replacing the Excel multiple regression interpolation method in its future inventories.

Non-key categories

Wastewater handling – CH_4

113. Canada reports that CH_4 emissions from industrial wastewater facilities are negligible ("NO"), as they utilize aerobic systems, and N_2O emissions are reported as "NE". The ERT encourages Canada firstly to review the above assumption, and secondly to improve documentation of the used assumption concerning the aerobic condition for industrial wastewater treatment and handling.

Wastewater handling – N_2O

114. Canada has reported a constant protein consumption for the complete inventory time series. This constant value is 13 per cent higher for the base year than the equivalent FAO data. The ERT concluded that this is an overestimation of emissions in the base year. In response to questions raised by the ERT during the in-country visit, Canada submitted revised estimates for this category. The revised estimates are based on protein consumption data from Statistics Canada which cover the years 1991, 1996, 2001, 2002, 2003 and 2004. The revised estimate for this category in 1990 decreased emissions from 2.8 Gg N_2O to 1.79 Gg (a decrease of 36.1 per cent or 313.1 Gg CO_2 eq). During the in-country visit, the ERT was informed by Canada that the aforementioned protein consumption issue was corrected in its 2007 inventory submission.

Waste incineration – CO_2, N_2O

115. Emissions in 1990 were estimated in line with the methodology described in the IPCC good practice guidance. Country-specific C content of waste types and EFs were used to derive these emissions. The ERT noted that all emissions from waste incineration of MSW and sludge with energy recovery and usage are reported in the waste sector due to insufficient information on the type of incinerators. The ERT recommends Canada to correctly allocate to the energy sector emissions arising from energy recovery and usage from waste incineration operations, in accordance with the Revised 1996 IPCC Guidelines.

C. Calculation of the assigned amount

116. The assigned amount pursuant to Article 3, paragraph 8, is calculated in accordance with the annex to decision 13/CMP.1.

117. Canada's base year is 1990 and the Party has chosen 1990 as its base year for HFCs, PFCs and SF_6. Canada's quantified emission limitation is 94 per cent, as included in Annex B to the Kyoto Protocol.

118. Based on Canada's base year emissions submitted with the initial report, 598,911,219 tonnes CO_2 eq, and its Kyoto Protocol target (94 per cent), the Party calculated its assigned amount to be 2,814,882,729 tonnes CO_2 eq.

119. In response to inventory issues identified during the review, Canada submitted a revised estimate of its base year inventory value, which resulted in a revised calculation of the assigned amount. Based on the revised estimates, Canada calculates its assigned amount to be 2,791,792,771 tonnes CO_2 eq. The ERT agrees with this figure.

D. Calculation of the commitment period reserve

120. The calculation of the required level of the CPR is in accordance with paragraph 6 of the annex to decision 11/CMP.1.

121. Based on its calculated assigned amount – 2,814,882,729 tonnes CO_2 eq – Canada calculated its CPR to be 2,533,394,456 tonnes CO_2 eq.

122. In response to inventory issues identified during the review, Canada submitted a revised estimate of its base year inventory value, which resulted in a revised calculation of the CPR. Based on the revised estimates, Canada calculates its CPR to be 2,512,613,494 tonnes CO_2 eq. The ERT agrees with this figure.

E. National registry

123. Canada has not provided all information on the national registry system as required by the reporting guidelines under Article 7, paragraphs 1 and 2, of the Kyoto Protocol (decision 15/CMP.1). The Party provided information to the ERT after the in-country visit on the registry administrator (Environment Canada Legislative and Regulatory Affairs Directorate); the host of the national registry (Environment Canada's Chief Information Officer Branch); the roles and responsibilities within Environment Canada with regard to preparing the required documentation (e.g., disaster recovery plan, security plan, operational plan, etc.); a schedule of activities to be performed to establish the national registry and to initialise with the ITL; and internal security considerations (Environment Canada e.g., encryption technology) for Perrin Quarles Associates (PQA) to establish the national registry. The ERT recommends that Canada provide complete and detailed information in its next inventory submission under the Kyoto Protocol.

124. Canada, in response to the draft report, informed the ERT that the contract to establish the national registry was awarded to Perrin Quarles Associates (PQA) on 14 February 2008. Furthermore, the Party informed the ERT that VPN (virtual private network) connectivity testing was successfully completed on 23 January 2008; that initialisation with the ITL is expected to be completed by 28 May 2008; and that it is expected the national registry will begin live operations with the ITL by the second week of July 2008. Information on the registry is not publicly available through the web.

125. Table 5 summarises the information on the mandatory reporting elements on the national registry system, as stipulated by decisions 15/CMP.1, which describes how Canada's national registry system performs functions defined in the annexes to decision 13/CMP.1 and decision 5/CMP.1.

Table 5. Summary of information on the national registry system

Reporting element	Provided in the initial report	Comments
Registry administrator		
Name and contact information	No	Provided by Canada in response to ERT questions
Cooperation with other Parties in a consolidated system		
Names of other Parties with which Canada cooperates, or clarification that no such cooperation exists.	No	
Database structure and capacity of the national registry		
Description of the database structure	No	
Description of the capacity of the national registry	No	
Conformity with data exchange standards (DES)		
Description of how the national registry conforms to the technical DES between registry systems	No	Partial information provided by Canada in response to ERT questions
Procedures for minimizing and handling of discrepancies		
Description of the procedures employed in the national registry to minimize discrepancies in the transaction of Kyoto Protocol units	No	
Description of the steps taken to terminate transactions where a discrepancy is notified and to correct problems in the event of a failure to terminate the transaction	No	
Prevention of unauthorized manipulations and operator error		
An overview of security measures employed in the national registry to prevent unauthorized manipulations and to prevent operator error	No	Partial information provided by Canada in response to ERT questions
An overview of how these measures are kept up to date	No	
User interface of the national registry		
A list of the information publicly accessible by means of the user interface to the national registry	No	Partial information provided by Canada in response to ERT questions
The Internet address of the interface to Canada's national registry	No	Partial information provided by Canada in response to ERT questions
Integrity of data storage and recovery		
A description of measures taken to safeguard, maintain and recover data in order to ensure the integrity of data storage and the recovery of registry services in the event of a disaster	No	Partial information provided by Canada in response to ERT questions
Test results		
The results of any test procedures that might be available or developed with the aim of testing the performance, procedures and security measures of the national registry undertaken pursuant to the provisions of decision 19/CP.7 relating to the technical standards for data exchange between registry systems.	No	

126. As Canada did not have an operational national registry by the publication date of this initial review report, no independent assessment report was forwarded to the ERT by the administrator of the ITL, pursuant to decision 16/CP.10. Canada is recommended to include the results of the technical assessment of the national registry, including the results of standardized testing, as reported in the independent assessment report, in its next inventory submission under the Kyoto Protocol.

F. Land use, land-use change and forestry parameters and election of activities

127. Table 6 shows the Party's choice of parameters for forest definition as well as elections for Article 3, paragraphs 3 and 4, activities in accordance with decision 16/CMP.1.

Table 6. Selection of LULUCF parameters

Parameters for forest definition		
Minimum tree cover	25%	
Minimum land area	1.0 ha	
Minimum tree height	5 m	
Elections for Article 3, paragraphs 3 and 4, activities		
Article 3, paragraph 3, activities	**Election**	**Accounting period**
Afforestation and reforestation	Mandatory	Commitment period
Deforestation	Mandatory	Commitment period
Article 3, paragraph 4, activities		
Forest land management	Not elected	Not applicable
Cropland management	Elected	Commitment period
Grazing land management	Not elected	Not applicable
Revegetation	Not elected	Not applicable

128. The definition is consistent with decision 16/CMP.1. In addition, Canada has adopted the minimum width value of 20 metres to define its forests. This is consistent with the IPCC good practice guidance for LULUCF.

129. The definition differs from the information that has historically been reported to the FAO. However, a new national forest inventory is being established and, in the future, this will allow greater consistency in the minimum values for Canada's forest definition reported to the FAO and under the Kyoto Protocol.

III. Conclusions and recommendations

A. Conclusions

130. The ERT concluded that the information provided by Canada in its initial report is largely complete and has been submitted in accordance with the relevant provisions of paragraphs 5, 6, 7 and 8 of the annex to decision 13/CMP.1, section I of the annex to decision 15/CMP.1, and relevant decisions of the CMP; that the assigned amount pursuant to Article 3, paragraphs 7 and 8, of the Kyoto Protocol is calculated in accordance with the annex to decision 13/CMP.1, and is consistent with the Party's reviewed and submitted revised inventory estimates; and that the calculated CPR is in accordance with paragraph 6 of the annex to decision 11/CMP.1.

131. Canada has made significant improvements since last year's inventory submission in response to recommendations made by the 2005 review and other improvements identified by the Party. The improvements include the implementation of a QA/QC plan in accordance with the IPCC good practice guidance and the establishment of a centralized archiving system. In addition, significant recalculation in the LULUCF sector has been carried out due to methodological improvements. The ERT commends Canada on its efforts to improve the estimates in the inventory.

132. Canada's national system is prepared in accordance with the guidelines for national systems under Article 5, paragraph 1, of the Kyoto Protocol (decision 19/CMP.1). This includes legal and institutional arrangements for the preparation of the inventory, procedures for official approval, a QA/QC plan, a working archive system, a description of the process for collecting data and developing estimates, identification of key categories, a quantitative uncertainty analysis and a process for making

recalculations to improve the inventory. However, the ERT has identified some areas for improvement, such as the continued allocation of sufficient resources for inventory planning, preparation and management, and improvement of some of the QA/QC procedures. In response to the draft review report, Canada indicated the inventory program, and in particular its QA/QC work, as a priority.

133. In conjunction with the initial report, Canada has submitted a complete set of CRF tables for the years 1990–2004, which includes most of the tables required, with data reported for all relevant categories and gases. During the in-country visit Canada submitted revised emission estimates for all years of the inventory time series in response to overestimation and underestimation of GHG emissions identified by the ERT. The ERT concludes that the Canada GHG inventory is accurate, as defined in the UNFCCC reporting guidelines, and is largely consistent with the Revised 1996 IPCC Guidelines and the IPCC good practice guidance.

134. Based on Canada's base year emissions – 593,998,462 tonnes CO_2 eq, including the revised emission estimates provided in the energy, industrial processes, agriculture and waste sectors – and its Kyoto Protocol target of 94 per cent, Canada calculates its assigned amount to be 2,791,792,771 tonnes CO_2 eq and its CPR to be 2,512,613,494 tonnes CO_2 eq. The ERT agrees with these figures.

135. Canada has elected to account for Article 3, paragraph 3, activities over the entire commitment period, and has also elected to account for the Article 3, paragraph 4, activity cropland management over the commitment period.

136. Canada's choice of parameters to define forest is in accordance with decision 16/CMP.1. This includes minimum tree crown cover of 25 per cent, minimum land area of 1.0 hectare and a minimum tree height of 5 metres. Canada has further added another criterion to define forest: a minimum width value of 20 metres. The ERT concludes that these values are not consistent with corresponding values reported to the FAO, but acknowledges that greater consistency will be achieved with the next national forest inventory.

137. Canada has not established a fully operational national registry in accordance with the provisions of decision 13/CMP.1 and 5/CMP.1.

B. Recommendations

138. In the course of the review, the ERT formulated a number of recommendations relating to the completeness and transparency of Canada's initial report and inventory submission, including recommendations relating to the accuracy of the base year emissions estimate. Many of the recommendations were implemented during the review process and all potential problems that could have led to an overestimation of the base year emissions were resolved with a submission of revised emission estimates. The key recommendations[3] are that Canada:

(a) Expedite work on establishing a fully operational national registry in accordance with the requirements defined by decisions 13/CMP.1 and 5/CMP.1, and provide detailed information on the implementation of these activities in its next inventory submission under the Kyoto Protocol;

(b) Allocate sufficient resources to its inventory preparation in order to maintain and improve the quality of its GHG inventory;

(c) Improve the exchange of data between different governmental and non-governmental institutions involved in the inventory preparation;

[3] For a complete list of recommendations, the relevant sections of this report should be consulted.

(d) Further develop the mandatory facility reporting programme in order to improve and expand the use of emission data from the industry;

(e) Develop a tier 2 key category analysis;

(f) Update the uncertainty analyses more regularly and develop in-house expertise on uncertainty;

(g) Include the LULUCF sector in its uncertainty analysis;

(h) Further develop the improvement plan in order to better link QA/QC findings, uncertainty and key category analyses, and new scientific knowledge;

(i) Finalize the implementation of tier 2 category-specific and peer review procedures and consider conducting category-specific QA/QC activities more frequently than over a seven-year cycle;

(j) Improve the description of methodologies in the NIR as far as possible;

(k) Improve the consistency between the NIR and the CRF;

(l) Improve the completeness of the inventory by including estimates in its next inventory submission for all identified categories for which emissions occur in the country.

C. Questions of implementation

139. The status of Canada's national registry is not in accordance with the provisions of the modalities for the accounting of assigned amounts under Article 7, paragraph 4, of the Kyoto Protocol (decision 13/CMP.1). Furthermore, Canada has not provided information, as required by the guidelines for the preparation of the information required under Article 7 of the Kyoto Protocol (decision 15/CMP.1), to the ERT on how its national registry performs the functions defined in the annex to decision 13/CMP.1 and the annex to decision 5/CMP.1, nor how the registry complies with the requirements of the technical standards for data exchange between registry systems. Also, no independent assessment report was forwarded to the ERT by the administrator of the ITL, pursuant to decision 16/CMP.1, on the results of the technical assessment of the national registry, including the results of standardized testing.

140. The ERT concludes, after consideration of the provisions of the guidelines for review under Article 8 of the Kyoto Protocol (decision 22/CMP.1), that the status of Canada's national registry on the publication date of this report is neither in accordance with the provisions of the guidelines for the preparation of the information required under Article 7 of the Kyoto Protocol (decision 15/CMP.1) nor the provisions of the modalities for the accounting of assigned amounts under Article 7, paragraph 4, of the Kyoto Protocol (decision 13/CMP.1) and therefore a question of implementation on the national registry has been listed by the ERT.

Annex I

Documents and information used during the review

A. Reference documents

IPCC. Good practice guidance and uncertainty management in national greenhouse gas inventories, 2000. Available at: <http://www.ipcc-nggip.iges.or.jp/public/gp/english/>.

IPCC. Good practice guidance for land use, land-use change and forestry, 2003. Available at: <http://www.ipcc-nggip.iges.or.jp/public/gpglulucf/gpglulucf.htm>.

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UNFCCC secretariat. Canada: Report of the individual review of the greenhouse gas inventory submitted in the year 2005. FCCC/WEB/IRI/2005/CAN. Available at: <http://unfccc.int/recategory/docs/2006/arr/can.pdf>.

B. Additional information provided by the Party

Responses to questions during the review were received from staff of Environment Canada, namely Mr. Art Jaques, Mr. Frank Nietzert, Mr. Scott McKibbon, Ms. Chia Ha, Mr. Pascal Bellavance,

Ms. Alice Au, Mr. Chiang Liang, Mr. Craig Palmer and Ms. Nicole Folliet including additional material on the methodology and assumptions used, and key category analysis for the base year.

References used in the general sector

Quality Manual. Canada's Greenhouse Gas Inventory. Quality Management and Verification Group, Greenhouse Gas Division.

References used in the energy sector

CAPP. 1999. CH4 and VOC Emissions from the Canadian Upstream Oil and Gas Industry. Volume 1: Organic and Common-Pollutant Emissions by the Canadian Upstream Oil and Gas Industry, CAPP Pub. #1999-0009

CAPP. 1999. CH4 and VOC Emissions from the Canadian Upstream Oil and Gas Industry. Volume 2: Development of the Upstream Emissions Inventory, CAPP Pub. #1999-0010.

CAPP. 1999. CH4 and VOC Emissions from the Canadian Upstream Oil and Gas Industry. Volume 4: Fugitive Emission measurement Technologies, CAPP Pub. #1999-0012.

CAPP. 2004. A National Greenhouse Gas (GHG), Criteria Air Contaminant (CAC) and Hydrogen Sulphide (H2S) Emissions by the Upstream Oil and gas Industry Volume 1 Overvew of the GHG Emissions Inventory, 2005-0011.

CAPP. 2004. A National Greenhouse Gas (GHG), Criteria Air Contaminant (CAC) and Hydrogen Sulphide (H2S) Emissions by the Upstream Oil and gas Industry Volume 2 Overview of the CAC Inventory 2005-0012.

CAPP. 2004. A National Greenhouse Gas (GHG), Criteria Air Contaminant (CAC) and Hydrogen Sulphide (H2S) Emissions by the Upstream Oil and gas Industry Volume 3, Methodology for Greenhouse Gases. 2005-0013.

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Annex II

Acronyms and abbreviations

AD	activity data
CH_4	methane
CO_2	carbon dioxide
CO_2 eq	carbon dioxide equivalent
CRF	common reporting format
EC	European Community
EIT	economy in transition
EF	emission factor
ERT	expert review team
EU	European Union
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
GJ	gigajoule (1 GJ = 10^9 joule)
GWP	global warming potential
HFCs	hydrofluorocarbons
IEA	International Energy Agency
IPCC	Intergovernmental Panel on Climate Change
kg	kilogram (1 kg = 1 thousand grams)
kgoe	kilograms of oil equivalent
LULUCF	land use, land-use change and forestry
m^3	cubic metre
Mg	megagram (1 Mg = 1 tonne)
Mt	million tonnes
Mtoe	millions of tonnes of oil equivalent
NA	not applicable
NE	not estimated
N_2O	nitrous oxide
NIR	national inventory report
NO	not occurring
PFCs	perfluorocarbons
PJ	petajoule (1 PJ = 10^{15} joule)
QA/QC	quality assurance/quality control
SF_6	sulphur hexafluoride
SO_2	sulphur dioxide
Tg	teragram (1 Tg = 1 million tonnes)
TJ	terajoule (1 TJ = 10^{12} joule)
UNFCCC	United Nations Framework Convention on Climate Change

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