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Report on the individual review of the inventory submission of Canada submitted in 2015*

Note by the expert review team

* In the symbol for this document, 2015 refers to the year in which the inventory was submitted, and not to the year of publication.

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I. Introduction

1. This report covers the review of the 2015 inventory submission of Canada organized by the UNFCCC secretariat, in accordance with the "Guidelines for the technical review of information reported under the Convention related to greenhouse gas inventories, biennial reports and national communications by Parties included in Annex I to the Convention" (hereinafter referred to as the UNFCCC review guidelines) and particularly part III, "UNFCCC guidelines for the technical review of greenhouse gas inventories from Parties included in Annex I to the Convention".[1] The review took place from 12 to 17 October 2015 in Bonn, Germany, and was coordinated by Ms. Lisa Hanle (UNFCCC secretariat). Table 1 provides information on the composition of the expert review team (ERT).

Table 1
Composition of the expert review team

Area of expertise	*Name*		*Party*
Generalist	Ms.	Olia Glade	New Zealand
	Ms.	Batima Punsalmaa	Mongolia
Energy	Mr.	Ioannis Sempos	Greece
	Mr.	Jongikhaya Witi	South Africa
	Mr.	Shengmin Yu	China
IPPU	Mr.	Roman Kazakov	Russian Federation
	Mr.	Mauro Meirelles de Oliveira Santos	Brazil
	Mr.	Jacek Skośkiewicz	Poland
Agriculture	Ms.	Anna Romanovskaya	Russian Federation
	Mr.	Asaye Ketema Sekie	Ethiopia
LULUCF	Mr.	Sandro Federici	San Marino
	Mr.	Atsushi Sato	Japan
	Mr.	Javier Fernandez	Costa Rica
Waste	Mr.	Qingxian Gao	China
	Ms.	Violeta Hristova	Bulgaria
Lead reviewers	Ms.	Glade	
	Mr.	Gao	

Abbreviations: IPPU = industrial processes and product use, LULUCF = land use, land-use change and forestry.

2. An overview of the total greenhouse gas (GHG) emissions[2] reported under the Convention for Canada is provided in annex I; table 6 shows total GHG emissions for

[1] Annex to decision 13/CP.20.

[2] In this report, unless otherwise specified, "total GHG emissions" refers to the aggregated national GHG emissions expressed in carbon dioxide (CO_2) equivalent, excluding land use, land-use change and forestry, and including indirect CO_2 if reported by the Party.

selected years, and tables 7 and 8 show GHG emissions reported under the Convention by gas and by sector, respectively.

3. This report contains findings based on the assessment by the ERT of the 2015 inventory submission against the UNFCCC review guidelines. The ERT has made recommendations to resolve those findings related to issues.[3] Other findings and, where applicable, the ERT's encouragements to resolve them, are also included.

II. Summary and general assessment of the 2015 inventory submission

4. Table 2 provides the ERT's assessment of the inventory submission with respect to the tasks undertaken during the review. Further information on the issues identified below, as well as additional findings, may be found in tables 3 and 5.

Table 2
Summary of review results and general assessment of the inventory

Assessment			*Issue ID number(s) in tables 3 and/or 5*[a]
Dates of submission	Original submission: 17 April 2015 (NIR), 17 April 2015, v1 (CRF tables)		
Review format	Format of review: centralized		
Adherence to the UNFCCC Annex I inventory reporting guidelines	Have any issues been identified in the following areas:		
	1. Identification of key categories	No	
	2. Selection and use of methodologies and assumptions	Yes	G.7, E.15, I.17, A.5, L.18, W.7, W.12, W.13, W.14, W.20
	3. Development and selection of emission factors	Yes	E.3, E.11, I.5, I.6, I.7, W.22
	4. Collection and selection of activity data	Yes	E.27, I.6, I.15
	5. Reporting of recalculations	No	
	6. Reporting of a consistent time series	No	A.11
	7. Reporting of uncertainties, including methodologies	Yes	G.5, L.2
	8. Quality assurance/quality control	Yes	I.16, I.19, A.6, A.9, A.13, A.14, A.15, W.19
	9. Other departures from the UNFCCC Annex I inventory reporting guidelines related to transparency, comparability, accuracy, and adherence to the UNFCCC Annex I inventory reporting guidelines	Energy: Yes	E.4, E.7, E.9, E.13, E.16, E.17, E.18, E.19, E.20, E.21, E.23, E.25, E.26, E.28, E.29, E.30,

[3] Issues are defined in decision 13/CP.20, annex, paragraph 81.

Assessment			*Issue ID number(s) in tables 3 and/or 5[a]*
			E.32, E.34
		IPPU: Yes	I.9, I.12, I.13, I.14, I.18
		Agriculture: Yes	A.12
		LULUCF: Yes	L.5, L.6, L.9, L.14, L.17, L.19,L.22, L.23
		Waste: Yes	W.3, W.10, W.11, W.15, W.16, W.17, W.23
Completeness	Is the inventory complete?	Energy: No	E.22, E.24, E.27
	Missing categories that affect completeness, if any, are included in annex II to this document	IPPU: No	I.10, I.11
		Agriculture: No	A.16, A.17
		LULUCF: No	L.4, L.13, L.24
		Waste: No	W.9, W.18, W.21
	If one or more categories is not estimated because the Party determined that estimated emissions would be insignificant, has the Party provided information showing that the likely level of emissions meets the criteria in paragraph 37(b) of the UNFCCC Annex I inventory reporting guidelines?	Not sufficient	E.24
Corrections	Have emissions been reported without corrections (e.g. related to climate variations or electricity trade)?	Yes	
National inventory arrangements	Have there been any changes to the national inventory arrangements?	No	
	Taking into account any changes to the national inventory arrangements, are the institutional, procedural and legal arrangements effective and reliable for estimating GHG emissions?	NA	
Implementation of previous recommendations	The ERT notes that the previous review report was published on 23 April 2015. On the basis of this publication date and taking into consideration national circumstances, the ERT concludes that the Party has demonstrated sufficient progress in implementing improvements in its submission	General: No	G.5
		Energy: No	E.8
		IPPU: Yes	
		Agriculture: Yes	
		LULUCF: Yes	
		Waste: No	W.2, W.9
Response from the Party during the review	Has the Party provided the ERT with responses to the questions raised, including the data and information necessary for the assessment of conformity with the UNFCCC Annex I inventory reporting guidelines and any further guidance adopted by the Conference of the	Yes	

Assessment			*Issue ID number(s) in tables 3 and/or 5*[a]
	Parties?		
Recommendation for an exceptional in-country review	On the basis of the issues identified, does the ERT recommend that the next review be conducted as an in-country review?	No	

Abbreviations: CRF = common reporting format, ERT = expert review team, GHG = greenhouse gas, IPPU = industrial processes and solvent and other product use, LULUCF = land use, land-use change and forestry, NIR = national inventory report, UNFCCC Annex I inventory reporting guidelines = "Guidelines for the preparation of national communications by Parties included in Annex I to the Convention, Part I: UNFCCC reporting guidelines on annual greenhouse gas inventories", NA = not applicable.

[a] Additional issues and findings may be included in tables 3 and/or 5.

III. Status of implementation of issues raised in the previous review report

5. Table 3 compiles all the recommendations made in the previous review report. For each issue, the ERT specified whether it believes the issue has been resolved by the conclusion of the review of the 2015 inventory submission and provided the rationale for its determination.

Table 3
Status of implementation of issues raised in the previous review report

ID#	*Issue classification*[a]	*Recommendation made in previous review report*	*ERT assessment and rationale*
General			
G.1	Other (table 3 and para. 59, 2014), (9, 2013), (90, 2012) Completeness	Estimate and report emissions from all mandatory categories	Resolved. Improvements have been made in the 2015 inventory submission in the agriculture and waste sectors
G.2	QA/QC and verification (table 3, 2014), (10, 2013), (35, 2012) Adherence to UNFCCC Annex I inventory reporting guidelines	Implement further QA/QC measures to ensure the consistency of reporting in the NIR and CRF tables	Resolved. Canada further implemented QC measures improving the consistency of numerical information between the CRF tables and NIR and identified coordinators for the CRF tables who perform additional QC checks before generating the official CRF submission
G.3	QA/QC and verification (table 3, 2014) Transparency	Improve description on the use of the Canadian GHGRP data for QA/QC and verification of the inventory, especially for the relevant sectors and categories	Resolved. Relevant information was provided in the NIR (section 1.3)
G.4	Inventory planning (10, 2014) Transparency	Provide further details on planned improvements	Resolved. Relevant information was provided in the NIR (sections 1.2 and 1.3)
G.5	Uncertainty analysis (table 4, 2014), (18, 2013), (24,	Calculate the trend uncertainty, including LULUCF	Not resolved. Canada did not calculate the trend uncertainty, including

ID#	*Issue classification*[a]	*Recommendation made in previous review report*	*ERT assessment and rationale*
	2012), (19, 2011) Adherence to UNFCCC Annex I inventory reporting guidelines		LULUCF, as required in the UNFCCC Annex I inventory reporting guidelines
Energy			
E.1	General (energy sector) (17, 2014) (25, 2013) Transparency	Document QA/QC procedures and outcomes	Resolved. QA/QC procedures applied by Canada were satisfactorily described in the NIR. (See sections 3.2.4.4, 3.2.5.4, 3.2.6.4, 3.2.7.4, 3.3.1.4, 3.3.2.4 and A4.2 of the NIR)
E.2	General (energy sector) (18, 2014) Adherence to UNFCCC Annex I inventory reporting guidelines	Report NGLs and LPG as liquid fuels for the full time series and include information describing these changes in the NIR	Resolved. The change in reporting was made and properly documented (see CRF table 1A(b))
E.3	General (energy sector) (19, 2014) Transparency	Document how the EFs and ECFs map on to the AD and describe problems associated with obtaining annual provincial ECFs. Document progress on efforts in the improvement plan and in the NIR	Addressing. EFs of natural gas have been mapped (table A6-1 of NIR)
E.4	General (energy sector) (19, 2014) Transparency	Take steps to ensure that the conversion of volumes of natural gas to energy units be completed appropriately for both marketable and non-marketable natural gas. Document progress on efforts in the improvement plan and in the NIR	Not resolved. During the review, Canada replied that this will be included "in planned improvements"
E.5	Reference approach (21, 2014) Adherence to UNFCCC Annex I inventory reporting guidelines	Incorporate planned changes to the allocation of NGLs and LPG, which will be reported as liquid fuels, for the full time series and include information describing these changes in the NIR	Resolved. The change in reporting was made and properly documented (see CRF table 1A(b) and 1A(c))
E.6	International bunkers (23, 2014), (28, 2013), (57, 2012) Transparency	Include similar text in part 1 of the NIR (e.g. section 3.4.1 or 3.4.1.1) to what is included in part 2, pointing out that the AGEM allocations to international bunkers means that it is not practical to make a direct comparison of the unadjusted data from Statistics Canada with data reported to IEA	Resolved. Sufficient information was included in A3.1.4.2.3 in the 2015 NIR, Annex 3-Methodologies
E.7	1.A.3.B Road transportation Liquid fuels – CO2 (27, 2014) Accuracy	Carry out the analysis to evaluate the opportunities to repeat portions of the McCann (2000)[b] study to investigate the evolution and current applicability of the final applied EF, and document progress on this in the improvement plan and the NIR	Not resolved. During the review, Canada replied that this will be in its planned improvements
E.8	1.A.3.D Domestic navigation Liquid fuels – CO2,	Report on the progress of investigations regarding the availability of data which would enable the accurate disaggregation of domestic and international navigation	Not resolved. No progress was reported

ID#	*Issue classification*[a]	*Recommendation made in previous review report*	*ERT assessment and rationale*
	CH4, N2O (28, 2014) (29, 2013), (58, 2012) (38, 2011), (38, 2010) (47, 2009) (36, 2008/2007) (36, 2006) Accuracy	fuels. If new data become available, revise the emission estimates for the entire time series	
E.9	1.B.2.A Oil and natural gas and other: Liquid fuels – CH4 (29, 2014) Accuracy	Continue to explore ways to review and update the bitumen model to capture industry changes and document progress on this in the improvement plan and in the NIR	Not resolved. During the review, Canada replied that this will be in its planned improvements
IPPU			
I.1	General (IPPU) (Table 3, 2014) Completeness	Make the following changes in notation keys and conduct the appropriate QA/QC steps: a. PFC emissions from aerosols/metered dose inhalers should be reported as "NA". b. N2O emissions from ammonia production should be reported as "NA". c. N2O emissions from adipic acid production should be reported as "NA" through 2009 and "NO" thereafter. d. CH4 emissions from aluminium production should be reported as "NA"	Resolved. The notation keys were changed, as described. The ERT notes that the CRF tables no longer allow data entry for CH4 emissions from aluminium
I.2	General (IPPU) (34, 2014) Transparency	Consider the underlying AD further and whether there is an opportunity for further disaggregation of the category other (industrial processes)	Not relevant. This issue appeared twice in the previous review report and is further assessed in I.6 below as the emissions from other (industrial processes) are now reported under non-energy products from fuels and solvent use
I.3	2.A.1 Cement production – CO2 (35, 2014), (39, 2013), (71, 2012), (67, 2011), (54, 2010), (59, 2009) Accuracy	Evaluate plant-level data further and, as appropriate, develop a country-specific CO2 EF and CKD value. Document the development of these factors in the NIR	Resolved. Country-specific EF and CKD values were developed
I.4	2.A.2 Lime production – CO2 (42, 2014) (49, 2013), (72, 2012), (68, 2011) Transparency	Include information in the NIR to explain the large decline in the share of dolomitic lime in the 1999–2000 and 2008–2009 periods	Resolved. Relevant information was provided in the NIR (see section 4.3.2)
I.5	2.C.1 Iron and steel production – CO2 (37, 2014) Transparency	Canada allocated emissions from the non-energy use of the other identified reductants (such as coal) to the energy sector or other (industrial processes) because they are currently not disaggregated in the energy statistics. Include allocation of non-energy use of other reductants identified in this category in the	Addressing. Canada is making efforts to identify other fuels used as reductants and still being reported in the energy sector (such as coal and natural gas) for reporting

ID#	*Issue classification*[a]	*Recommendation made in previous review report*	*ERT assessment and rationale*
		improvement plan to further disaggregate the energy statistics and other (industrial processes) category	in IPPU. Some other such fuels (like heavy fuel) have already been displaced to non-energy products from fuels and solvent use (2.D) and not under iron and steel production. See related issue I.6 below
I.6	2.D Non-energy products from fuels and solvent use – CO2 and CH4 (37 and 41, 2014) (47, 2013) (78, 2012) (77, 2011) Transparency	Implement the scheduled improvements for this category, reporting on progress in future inventory submissions, and continue the improvements necessary to document the methods and sources of AD and EFs in the NIR	Addressing. The inventory reported on progress in this category but the issue has not been fully resolved
I.7	2.F Product uses as substitutes for ozone depleting substances – HFCs, PFCs and SF6 (40, 2014) (44, 2013), (76, 2012), (75, 2011), (59, 2010), (63, 2009), (51, 2008) Accuracy	Continue to work on incorporating into the inventory the results of a study on country-specific EFs for halocarbons and SF6, and continue to improve the transparency and comparability of the inventory	Addressing. Although new information was included in the current inventory submission, new errors were found in the calculations and extra effort should be applied in this category
Agriculture			
A.1	General (agriculture) – CH4 (45, 2014) (53, 2013) Transparency	Provide further documentation that mules and asses are not occurring, and if they are occurring, use default methods to estimate CH4 emissions or report emissions as “NE”, as appropriate	Resolved. Canada reported CH4 emission from mules and asses using the notation key “NE”
A.2	3.A Enteric fermentation – CH4 (46, 2014) Transparency	Provide an explanation for the use of the IPCC default methane conversion factor of 4 per cent for non-dairy cattle	Resolved. Canada used the 2006 IPCC Guidelines for National Greenhouse Gas Inventories (hereinafter referred to as the 2006 IPCC Guidelines) default MCF of 6.5 per cent
A.3	3.A Enteric fermentation – CH4 (47, 2014) Adherence to UNFCCC Annex I inventory reporting guidelines	Fix the production error that occurred in the 2014 NIR, which led to the insertion of an incorrect table for table 6-4	Resolved. Canada reported emission from enteric fermentation and manure management according to the 2006 IPCC Guidelines
A.4	3.A Enteric fermentation – CH4 (48, 2014) Accuracy	Use the updated live weight data for bulls published on the Agriculture and Agri-Food Canada website	Resolved. The observed error on the Agriculture and Agri-Food Canada website was corrected and carcass weight was re-evaluated from 1990–2012

ID#	*Issue classification*[a]	*Recommendation made in previous review report*	*ERT assessment and rationale*
A.5	Manure management – CH4 (50, 2014) Transparency	Provide an explanation for the MCF values used in the NIR for poultry (0.2 (liquid systems), 0.015 (solid storage and dry lot), 0.015 (pasture, range and paddock) and "NA" (other systems)), which are derived from the 2006 IPCC Guidelines	Not resolved. Canada indicated that this is an issue for further research but that the values currently used for the MCF for poultry are more appropriate for Canada's poultry manure storage systems
A.6	3.B Manure management – CH4 (50, 2014) Adherence to UNFCCC Annex I inventory reporting guidelines	Correct the transcription errors between the NIR and CRF tables for poultry, whereby in the NIR "NA" was reported for the MCF of poultry in other systems, but in CRF table 4.B(a) an MCF value of 0.01 was reported	Not resolved. In the 2015 NIR, table A6-29, Canada reported "NA" for MCF of "other systems" and 0.01 in the CRF table
A.7	3.B Manure management – CH4 (51, 2014) Adherence to UNFCCC Annex I inventory reporting guidelines	Address the observed inconsistencies between the NIR and CRF table for the percentages of different manure management systems	Resolved. Canada reported corrected MMS data for dairy cattle
A.8	3.B Manure management – CH4 (51, 2014) Adherence to UNFCCC Annex I inventory reporting guidelines	Correct the transcription error that results in the values for solid storage and pasture, range and paddock for goats exceeding 100 per cent	Resolved. Canada reported corrected MMS data for goats
A.9	3.D Agricultural soils – N2O (52, 2014) Adherence to UNFCCC Annex I inventory reporting guidelines	Address the observed inconsistency between the NIR and the CRF table regarding the amount of nitrogen excretion for buffalo and provide revised estimates	Not resolved. In the 2015 NIR (table A3-41) Canada reported a nitrogen excretion rate of 67.6 kg N/head/year for buffalo but CRF table 3.B(b) reports 125.142 kg N/head/year
LULUCF			
L.1	General (LULUCF) (57, 2014) Transparency	Include more information clarifying that transition times (20 years) for the allocation of carbon stock change in the CRF tables are more procedural than related to the processes involved in the emissions calculations	Resolved. The ERT considers that the procedure for the allocation of carbon stock changes into remaining land and converted land is working well in Canada
L.2	General (LULUCF) (57, 2014) Transparency	Provide a summary table including all uncertainties that have been calculated, including the overall uncertainty of the sector	Not resolved. A summary table was not provided. An overall uncertainty assessment is a planned improvement
L.3	General (LULUCF) (59, 2014)	Use the notation key "NO" when a category does not exist or cannot occur	Resolved. The notation keys referenced in the previous

ID#	*Issue classification*[a]	*Recommendation made in previous review report*	*ERT assessment and rationale*
	Adherence to UNFCCC Annex I inventory reporting guidelines		review report have been modified
L.4	General (LULUCF) (59, 2014) (9 and 63, 2013) Completeness	Improve the completeness of its reporting of the pools in all mandatory categories currently reported as "NE" and include a description on how notation keys have been used	Addressing. Canada reported some pools and gases of mandatory categories as "NE" and provided information on the reason for reporting "NE". A list of categories reported as "NE" is included in annex II of this report. See also L.16
L.5	4.A Forest land – CO2, CH4 and N2O (61, 2014) Accuracy	Provide evidence that drainage does not occur on forest land and consider whether the notation key "NE" should be used instead of "NO" for emissions of CH4 or N2O	Addressing. During the review, Canada explained its ongoing work to gather information on the extent to which forestry practices are applied in peatlands
L.6	4.A Forest land – CO2, CH4 and N2O (63, 2014) Transparency	Provide further numerical examples on verification activities of the CBM-CFS-3 model at the pool level, as well as pool-specific uncertainties in its NIR	Not resolved. The 2015 submission provided neither evidence of verification activities at the pool level, nor pool-specific uncertainties
L.7	4.A Forest land – CO2, CH4 and N2O (64, 2014) Transparency	Provide information on comparisons of the different data sources used in the NIR to confirm that data for wildfire quantification is consistent over the reported time series	Resolved. Canada explained in the NIR that the difference between the two time series datasets used for wildfire estimations was small and not biased. During the review, Canada provided background information confirming this statement. The ERT concluded that there was sufficient consistency among datasets across the time series
L.8	4.B Land converted to cropland – CO2 (65, 2014) (64, 2013) Completeness	Find a solution to include the emissions/removals from the reporting zone "Boreal Cordillera" that were previously not included for confidentiality reasons	Resolved. The information was reported in the neighbour reporting zone
L.9	4.B Land converted to cropland – CO2 (66, 2014) Accuracy	Evaluate the method used; consider how to combine the results from the CBM-CFS-3 model and the equation for carbon loss (equation A3-66) used in the estimates; and clearly explain in the NIR which components are included in the estimates	Not resolved. During the review, Canada explained that the issue has not been resolved. (Note: equation A3-66 in the 2014 inventory submission was equation A3-72 in the 2015 inventory submission)
L.10	4.B Land converted to cropland – CO2 (67, 2014)	Enhance the QA/QC process when transferring data into the reporting tables	Resolved. The errors in the previous submission have been corrected

ID#	*Issue classification*[a]	*Recommendation made in previous review report*	*ERT assessment and rationale*
	Adherence to UNFCCC Annex I inventory reporting guidelines		
L.11	4.C Grassland remaining grassland – CO2 (69, 2014) Completeness	Report the areas for grassland and report "NE" or "NO" for emissions/removals as appropriate, including information to explain the respective use of notation keys	Resolved. The areas have been reported and the appropriate notation keys ("NE" and "NO") were used for emissions/removals with an explanation for the respective use of notation keys
Waste			
W.1	General (waste) (72, 2014) (67, 2013) Transparency	Improve the consistency in reporting recalculations in the NIR and CRF tables	Not relevant. Reporting of recalculations in CRF table 8 is not required in the 2015 inventory submission
W.2	General (waste) (73, 2014) (83, 2013) (53, 2012) (31, 2011) Comparability	Report all emissions related to energy recovery in the energy sector	Addressing. The NIR reports that a waste incineration survey, which will be used to reallocate recent historical emissions from waste incineration with energy recovery to the energy sector, is under way
W.3	General (waste) (74, 2014) (76, 2013) Transparency	Include a detailed overview of waste streams, including at least the information provided to the ERT during the 2014 review process (i.e. amounts of waste generated, waste disposal (landfill and incineration) and waste diversion (recycling and composting))	Not resolved. The relevant information was not provided in the NIR
W.4	5.A Solid waste disposal on land – CH4 (76, 2014) Transparency	Provide a justification for using an exponential (negative) growth function, starting from 2004 data, for AD for estimating CH4 emissions from wood waste landfills and conduct detailed checks at intervals to confirm the continued validity of the trend	Resolved. Canada has provided relevant information in the NIR on how AD were obtained (see section 7.2.2 of the NIR)
W.5	5.A Solid waste disposal on land – CH4 (77, 2014) (70, 2013) Transparency	Provide adequate justification for using country-specific values for the United States as a basis for the Canadian-specific values for the methane generation constant. Justify the use of a linear function between k values and precipitation values for values between the three precipitation levels from the RTI study (rather than only making use of the three values, as the United States does)	Resolved. Relevant information was provided in the NIR (see section 7.2.2)
W.6	5.A Solid waste disposal on land – CH4 (77, 2014) Transparency	Provide justification for the assumption that the waste composition in Canadian landfills is similar to the waste of the landfills sampled in the RTI study	Resolved. Relevant information was provided in the NIR (see section 7.2.2)
W.7	5.A Solid waste disposal on land –	Document the source of data for, and the methods used to estimate, the CH4 recovery values for 1990–1996. In	Addressing. Canada indicated that the data collection of

ID#	*Issue classification*[a]	*Recommendation made in previous review report*	*ERT assessment and rationale*
	CH4 (78, 2014) Transparency	the absence of such justification, assume no recovery for the 1990–1996 period	CH4 gas collected from 1983 to 1996 was obtained from ad hoc surveys conducted by Environment Canada
W.8	5.C Incineration and open burning of waste – CO2, CH4 and N2O (83, 2014) (81, 2013) Transparency	Provide the justification for not using the same source for the composition of landfilled MSW and incinerated MSW	Resolved. Relevant information was provided in the NIR (see section 7.4.1)
W.9	5.C Incineration and open burning of waste – CO2, (84, 2014) (84, 2013) Completeness	Estimate the CO2 emissions from clinical waste incineration in dedicated clinical waste incinerators	Not resolved. This issue is not included in Canada's improvement plan
W.10	5.D Wastewater treatment and discharge – CH4 and N2O (80, 2014) Transparency	Correct the description in the NIR to improve the transparency of the AD used for estimating CH4 emissions from domestic and commercial wastewater handling	Not resolved. During the review, Canada indicated that efforts to address this issue are ongoing
W.11	5.D Wastewater treatment and discharge – CH4 and N2O (81, 2014) Transparency	Include a detailed overview of wastewater streams and of wastewater treatment discharge pathways in the NIR to improve transparency and to underpin the use of the selected EFs	Not resolved. Canada indicated that this issue and improvement is under consideration
W.12	5.D Wastewater treatment and discharge – CH4 and N2O (82, 2014) Transparency	Justify the assumption that there is 100 per cent efficient combustion and flaring at anaerobic wastewater treatment systems servicing urban municipalities	Not resolved. Canada indicated that this issue and improvement is under consideration

Abbreviations: AD = activity data, AGEM = Aviation Greenhouse Gas Emission Model, BOD = biochemical oxygen demand, CKD = cement kiln dust, CRF = common reporting format, DOC = degradable organic carbon, ECF = energy conversion factor, EF = emission factors, ERT = expert review team, GHGRP = Greenhouse Gas Reporting Program, IE = included elsewhere, IEA = International Energy Agency, IEF = implied emission factor, IPCC= Intergovernmental Panel on Climate Change, IPPU = industrial processes and solvent and other product use, LPG = liquefied petroleum gas, LULUCF = land use, land-use change and forestry, MCF = methane conversion factor, MMS = manure management systems, MSW = municipal solid waste, NA = not applicable, NE = not estimated, NGLs = natural gas liquids, NIR = national inventory report, NO = not occurring, QA/QC = quality assurance/quality control, RESD = Report on Energy Supply and Demand in Canada, RTI = Research Triangle Institute.

[a] References in parentheses are to the paragraph(s) and the year(s) of the previous review report(s) where the issue was raised. Issues are further classified as defined in decision 13/CP.20, annex, paragraph 81.

[b] TJ McCann and Associates Ltd and Clearstone Engineering Ltd. March 2000. *1998 Fossil Fuel and Derivative (CO_2 per Unit of Fuel and Heating Values) Factors*. Prepared for Pollution Data Branch, Environment Canada. Final Draft.

IV. Issues identified in three successive reviews and not addressed by the Party

6. In accordance with paragraph 83 of the UNFCCC review guidelines, the ERT noted that the issues included in table 4 have been identified in three or more successive reviews, including the review of the 2015 inventory submission of Canada, and have not been addressed by the Party.

Table 4
Issues identified in three or more successive reviews and not addressed by the Party

ID#	*Issue identification*	*Number of successive reviews issue not addressed*
General		
G.5	Calculate the trend uncertainty, including LULUCF	5 (2011–2015)
Energy		
E.8*	Report on the progress of investigations regarding the availability of data which would enable the accurate disaggregation of domestic and international navigation fuels. If new data become available, revise the emission estimates for the entire time series	10 (2006–2015)
IPPU		
I.6*	Implement the scheduled improvements for non-energy products from solvent use, reporting on progress in future inventory submissions, and continue the improvements necessary to document the methods and sources of AD and EFs in the NIR	5 (2011–2015)
I.7*	Continue the work on incorporating into the inventory the results of a study on country-specific EFs for halocarbons and SF6, and continue to improve the transparency and comparability of the inventory	8 (2008–2015)
Agriculture: No such issues in the agriculture sector were identified		
LULUCF		
L.4*	Improve the completeness of reporting of the pools in mandatory subcategories currently reported as “NE” and include a description on how notation keys have been used	3 (2013–2015)
Waste		
W.2	Report all emissions related to energy recovery in the energy sector	5 (2011–2015)
W.3	Include a detailed overview of waste streams, including at least the information provided to the ERT during the 2014 review process (i.e. amounts of waste generated, waste disposal (landfill and incineration) and waste diversion (recycling and composting))	3 (2013–2015)
W.9*	Estimate the CO2 emissions from clinical waste incineration in dedicated clinical waste incinerators	3 (2013–2015)

Note: An asterisk is included after any issue ID# where the underlying issue is related to accuracy or completeness of a key category, a missing category or a potential key category, as indicated in decision 13/CP.20, annex, paragraph 83.

Abbreviations: AD = activity data, CRF = common reporting format, EF = emission factor, IPPU = industrial processes and solvent and other product use, LULUCF = land use, land-use change and forestry, NE = not estimated, NIR = national inventory report, QA/QC = quality assurance/quality control.

V. Additional findings made during the 2015 technical review

7. Table 5 contains findings made by the ERT during the review of the 2015 inventory submission of Canada that are additional to those identified in table 3.

Table 5
Additional findings made during the 2015 technical review

ID#	*Finding classification*	*Description of the finding with recommendation or encouragement*[a]	*Is the finding an issue? If yes, classify by type*	
General				
G.6	QA/QC and verification	Tier 1 QC checklists have been developed, but a sample of the checklist or a relevant reference to the updated QA/QC plan was not included in the NIR. The ERT encourages the Party to include sample checklists or references to the updated QA/QC plan in the list of literature presented after chapter 1 in the NIR to improve transparency	No	
G.7	Methods	The ERT noted that there were instances of inconsistent references to the applied methodology between the NIR and the CRF tables in the energy sector without appropriate clarification in either document. During the review, the Party suggested that the relevant clarifications will be made in both the CRF tables and the NIR in the next inventory submission. The ERT recommends that the Party ensure consistency between the NIR and CRF summary table 3 in the description of the method applied for subcategories within transport, in the energy sector	Yes	Adherence to UNFCCC Annex I inventory reporting guidelines
Energy				
E.10	General (energy sector) All fuels – CO2	The ERT notes that a 100 per cent oxidation factor has been applied to all combustion-based CO2 EFs for the entire time series (1990–2013) and that Canada used tier 2 methods in the estimation of CO2 combustion emissions for some categories in the energy sector. The ERT also notes that when a tier 2 method is used for key categories, it is good practice to use country-specific oxidation factors when it is known that the non-oxidized part of the fuel is not negligible. During the review, Canada indicated that the 100 per cent oxidation factor was used because it is consistent with the default oxidation factor in the 2006 IPCC Guidelines for National Greenhouse Gas Inventories (hereinafter referred to as the 2006 IPCC Guidelines), and that the Party has longer-term plans to develop country-specific oxidation factors, prioritizing fuels used in large quantities within Canada, including solid fuels. Acknowledging Canada's long-term plans to develop country-specific oxidation factors, the	No	

ID#	Finding classification	Description of the finding with recommendation or encouragement[a]	Is the finding an issue? If yes, classify by type	
		ERT encourages Canada to document progress on its efforts in its improvement plan in the NIR		
E.11	General (energy sector) All fuels – CO2	The ERT notes that the carbon content factors to most fuel types are quite outdated, in most cases obtained from a study on fossil fuels and derivative factors (McCann 2000). During the review, Canada explained that multi-year projects are necessary to obtain reliable carbon contents owing to the challenge of limited up-to-date information. Canada further noted that carbon content factors for fuels with high carbon variabilities (such as coal, petroleum coke and refinery (still) gas) have been updated and are no longer based on the McCann 2000 study to ensure accurate estimates. Furthermore, according to Canada, a number of fuels (e.g. natural gas and refined petroleum products such as diesel and gasoline) are required to meet specific standards, so they have low carbon-content variability and the uncertainty range of EFs associated with these fuels would take into account the minor carbon variation. While commending Canada's efforts in updating the carbon content factors of coal, petroleum coke and refinery (still) gas, the ERT recommends that Canada develop a plan that provides a timeline for updating the carbon content factors regularly, prioritizing fuels used in large quantities within Canada, as well as fuels with high carbon content variabilities	Yes	Accuracy
E.12	Reference approach All fuels – CO2	The ERT noted that in the reference approach for primary fuels the stock change data have been adjusted to account for interproduct transfers, stock variation and other adjustments. The stock change data for secondary fuels take into consideration imports, exports, international bunkers, stock variations, non-energy use and other adjustments. During the review, Canada indicated that: (a) Statistics Canada provides a data line in the national energy balance called 'other adjustments' which encompasses "cyclical billing variations, metering differences and losses in transportation". This number is treated as part of 'stock change'; (b) In the reference approach, there is one stock change line, which must account for several lines in Canada's energy balance, such as interproduct transfers and other adjustments. For a particular fuel, the 'interproduct transfer' line in the national energy balance removes or adds to the total fuel volume available for consumption and, therefore, effectively acts in the same way as the 'stock change' line in the national energy balance; (c) Stock change, stock variation, other adjustments and interproduct transfers are all reported separately by Statistics Canada, but all have the effect of varying the 'availability' of a given fuel. For example, in cases where imports or exports are reported as "C" (confidential) in the reference approach, stock change has been adjusted to achieve the correct apparent consumption. Moreover, for the purposes of the reference approach, bituminous coal sent to cokers is shown as part of stock change The ERT notes that the above-described adjustments cause deviations between the CRF	No	

ID#	*Finding classification*	*Description of the finding with recommendation or encouragement*[a]	*Is the finding an issue? If yes, classify by type*	
		tables and IEA energy consumption data. The ERT encourages Canada to document these adjustments of stock changes in the NIR, which will explain the differences between the reference approach and IEA statistics. Moreover, the ERT encourages Canada to not make any adjustment to 'stock change' of fuels that is related to non-energy use, because the effect of the non-energy use to the reference approach is reflected in the 16th column of CRF table 1.A(b) and the 3rd column of CRF table 1.A(c)		
E.13	Reference approach All fuels – CO2	The NIR (part II, page 186) states that the estimation of CO2 emissions from fuel combustion activities by reference approach follows the Revised 1996 IPCC Guidelines designated method. In response to a question raised by the ERT about the scope of the 'carbon excluded' in CRF tables 1.A (b) and 1.A (d), Canada acknowledged that carbon excluded only includes carbon stored for long periods of time, instead of the "total carbon" as required by the 2006 IPCC Guidelines. The ERT recommends that Canada revise its implementation of the reference approach to follow the 2006 IPCC Guidelines	Yes	Adherence to UNFCCC Annex I inventory reporting guidelines
E.14	Reference approach All fuels – CO2	The ERT notes that, for most fuel types, the energy conversion factors (ratios of energy to volume or mass) taken directly from the Statistics Canada document "Report on Energy Supply and Demand (RESD) in Canada: 2012"[b] do not reflect any year-to-year changes in fuel physical properties (e.g. one value of the factor for 1990 to 1997 and a different value from 1998 onwards). During the review, Canada explained that Statistics Canada has tried several approaches over the years to collect energy conversion information from reporting facilities. However, owing to insufficient quality and quantity of information it has been a challenge to regularly develop statistically representative updated values except for crude oil and natural gas at a national level. Considering that Canada's GHG inventory for fuel combustion in the sectoral approach is based on the physical quantity (volume or mass) of fuel combusted rather than on the energy content of fuels, the ERT acknowledges that the quality of the energy conversion factors from the RESD will not affect the CO2 emission estimates of the sectoral approach. However, in order to obtain reliable emission estimates in the reference approach, and for a better verification of the sectoral approach, the ERT encourages Canada to regularly update the energy conversion factors of fuels in as short time intervals as possible	No	
E.15	1.A.1.a Stationary combustion: All fuels – CO2, CH4 and N2O	The ERT noted that Canada's inventory submitted in 2015 does not disaggregate CO2, CH4 and N2O emissions from public electricity and heat production into the three subcategories of the CRF tables (i.e. electricity generation, combined heat and power generation, and heat plants). During the review, Canada indicated that the 2016 NIR will include disaggregated public electricity and heat production data, based on facility-level data.	No	

ID#	Finding classification	Description of the finding with recommendation or encouragement[a]	Is the finding an issue? If yes, classify by type	
		Acknowledging that the UNFCCC Annex I inventory reporting guidelines do not require, but instead encourage Parties to disaggregate emissions from these subcategories, the ERT commends Canada for its plan for the 2016 inventory submission to disaggregate the category and encourages the Party to implement these plans. The ERT is of the view that, since the disaggregation will be based on a bottom-up inventory, the accuracy of the category will be also improved		
E.16	1.A.1.a Stationary combustion: All fuels – CO2, CH4, N2O	The ERT noted that although there are nuclear installations in Canada for power production, the NIR does not describe where the associated CO2, CH4 and N2O emissions are included in the inventory. During the review, Canada explained that, with respect to uranium fuel production and processing, this occurs at separate facilities, and any emissions associated with these facilities are reported under manufacturing industries and construction.	Yes	Transparency
		The ERT recommends that Canada indicate in the NIR under which category emissions from uranium fuel production and processing are reported		
E.17	1.A.1.b and 1.A.1.c Stationary combustion: Liquid and gaseous fuels – CO2, CH4, N2O	Canada estimates CO2, CH4 and N2O emissions from petroleum refining and manufacture of solid fuels and other energy industries using all fuel use attributed to these categories by RESD data. The fuel use data in the RESD include volumes of flared fuels. However, flaring emissions are calculated and reported separately in CRF table 1.B.2 (oil, natural gas and other emissions from energy production). The fuel use and emission data associated with flaring are subtracted to avoid double counting. During the review, Canada indicated that, concerning the flaring emissions from oil and natural gas production, the provinces that report producer consumption of natural gas to Statistics Canada accounted for most of all oil and natural gas production in Canada (for example, 98.4 per cent) in 2013. Flaring emissions for those provinces are estimated using the amount of fuel flared as reported to Statistics Canada (RESD). Three provinces (Manitoba, Ontario and New Brunswick) accounted for the remaining 1.6 per cent of oil and natural gas produced in 2013. Flaring emissions for these provinces are estimated using oil and gas production volumes, because the amount of fuel flared is not tracked by the respective provinces and therefore not reported to Statistics Canada. As such, the flaring estimates for these provinces are not subtracted from the stationary combustion estimates because these emissions are not included in the RESD data.	Yes	Transparency
		The ERT recommends that Canada describe in the NIR how flaring emissions for the various provinces are calculated and reported, clearly noting that around 98 per cent of flaring emissions from upstream oil and gas and oil sands/bitumen are estimated using the amount of fuel flared as reported to Statistics Canada (RESD)		
E.18	1.A.1.b Stationary combustion: Liquid and gaseous fuels – CO2, CH4, N2O	The ERT noted that flaring emissions (CO2, CH4 and N2O) from petroleum refining are based on a study[c] and production data by Canadian refineries. The study provided emissions for the years 1990, 1994–1998 and 2000–2002, and these emissions were correlated to refinery annual production. Flaring emissions for the years 1991–1993, 1999 and 2003	Yes	Accuracy

ID#	*Finding classification*	*Description of the finding with recommendation or encouragement*[a]	*Is the finding an issue? If yes, classify by type*	
		onwards were estimated based on this correlation and known production data. Furthermore, as in the RESD, the amount of fuel flared at refineries is aggregated together with all other producer-consumed fuels from refineries, the fuel flared and associated emissions are subtracted from the fuel use and emission data associated with the subcategory petroleum refining, to ensure that emissions are not double counted. The ERT recommends that Canada develop and implement QA/QC procedures in order to ensure that the subtracted flaring emissions from the subcategory petroleum refining do not cause an underestimation of the reporting emissions. For example, Canada may develop a verification procedure that compares the flared fuel volumes reported by refineries to Statistics Canada with the flared volumes estimated in CRF table 1.B.2		
E.19	1.A.1.c Stationary combustion: All fuels – CO2, CH4, N2O	The ERT noted that, according to the NIR (page 70), the subcategory manufacture of solid fuels and other energy industries includes CO2, CH4 and N2O emissions associated with own fuel consumption (e.g. a coal mine burning coal that it produced), while emissions from the consumption of purchased fuels by the same industries are included in the subcategories mining (manufacturing industries and construction) and pipeline transport (other transportation). During the review, Canada explained that emissions are allocated in this way because fuel consumption data at a lower level of disaggregation are not available. The ERT noted that according to the 2006 IPCC Guidelines and the definition of "comparability" in the UNFCCC Annex I inventory reporting guidelines, the emissions associated with all fuels used, both own on-site and purchased fuels, should be reported under manufacture of solid fuels and other energy industries (i.e. the category where the combustion occurs). The ERT recommends that Canada report the CO2, CH4 and N2O emissions from the purchased fuels used in manufacture of solid fuels and other energy industries in that category. The ERT notes that experts from the oil and gas industry may be contacted in order to provide approximate non-confidential data and expert judgement, in order to assist the Canadian inventory team with this reallocation task	Yes	Comparability
E.20	1.A.2.a Stationary combustion: All fuels – CO2, CH4, N2O	The ERT noted that CO2, CH4 and N2O emissions from the combustion of fuels for coke production are reported under iron and steel production (manufacturing industries and construction) and not under manufacture of solid fuels and other energy industries (energy industries), as required by the 2006 IPCC Guidelines and the UNFCCC Annex I inventory reporting guidelines. During the review, Canada explained that disaggregating coke production emissions from the four integrated iron and steel plants would not be possible, owing to the structure of the energy balance data supplied by Statistics Canada. The ERT recommends that Canada reallocate emissions from fuels used for coke production to the subcategory manufacture of solid fuels and other energy industries. The ERT notes that experts from the four integrated iron and steel plants may be contacted in order to provide approximate non-confidential data and expert judgement, in order to assist the	Yes	Comparability

ID#	Finding classification	Description of the finding with recommendation or encouragement[a]	Is the finding an issue? If yes, classify by type	
		Canadian inventory team with this reallocation task		
E.21	1.A.2.e Stationary combustion: All fuels – CO2, CH4, N2O	The ERT noted that emissions from food processing, beverages and tobacco are reported as "IE" and included under other manufacturing (other). The ERT recommends that Canada reallocate emissions from fuels used in food industries to the subcategory food processing, beverages and tobacco, as required by the 2006 IPCC Guidelines and the UNFCCC Annex I inventory reporting guidelines	Yes	Comparability
E.22	1.A Stationary combustion: Liquid fuels – CH4	The ERT noted that, according to table A6-4 of the NIR, the CH4 EFs of refinery (still) gas and motor gasoline used in stationary combustion were reported as not available. During the review, Canada indicated that the lack of CH4 EFs for refinery (still) gas and motor gasoline was an error, and that it is Canada's intention to use the default CH4 EFs from the 2006 IPCC Guidelines for its 2016 inventory submission. The ERT recommends that, in the absence of country-specific data, Canada apply the IPCC default CH4 EFs from table 2.5 of the 2006 IPCC Guidelines and estimate and report CH4 emissions from combustion of refinery (still) gas and motor gasoline used in stationary combustion	Yes	Completeness
E.23	1.A.3.b Road transportation: Liquid fuels – CO2	The ERT identified that the CO2 EF of gasoline for road transportation is around 69.6 t CO2/TJ (NCV) (equivalent to 66.17 t CO2/TJ (GCV)). This CO2 EF is close to the lower value of the range provided by the 2006 IPCC Guidelines (67.5 t CO2/TJ (NCV)); 3.4 per cent lower than the EF that the United States applies (71.2 t CO2/TJ (NCV)); and the lowest CO2 EF among Annex I Parties for the 2014 inventory submission. During the review, Canada provided a study (McCann, 2000) and other supplementary information about the development of the EFs of Canada. Based on this information, the ERT calculated the carbon content in terms of weight per cent to be 86.3 wt%. The ERT is of the view that this carbon content value is technically/scientifically acceptable and that most likely it does not cause any underestimation of the inventory. However, the ERT is of the view that the GCV values used by Canada, in order to convert the amount of gasoline from kt into TJ, are outdated and higher than typical values (they range from 45.1 to 46.0 TJ (NCV)/kt depending on the geographical area, while the IPCC default values range from 42.5 to 44.8 TJ (NCV)/kt), and that this is the reason for the low IEF of gasoline reported in the CRF tables. In the NIR, Canada confirmed that the GCV values used, in order to convert the amount of gasoline from kt into TJ, have not been updated since the McCann study. The ERT recommends that Canada provide an explanation in its NIR that the low IEF of gasoline reported in the CRF tables is attributed to the outdated GCVs used to convert AD and EF from physical to energy units. The ERT also encourages Canada to take steps to develop up-to-date and representative GCVs for gasoline, and document progress on its efforts in its improvement plan and in the NIR	Yes	Transparency

ID#	*Finding classification*	*Description of the finding with recommendation or encouragement*[a]	*Is the finding an issue? If yes, classify by type*	
E.24	1.A.3.c Railways: Solid fuels – CO2, CH4, N2O	According to the NIR, emissions associated with steam trains are assumed to be negligible and not included in the inventory. During the review, Canada indicated that steam trains are used for a few tourist attractions in Canada and emissions are not quantified owing to lack of data availability. The ERT notes that, according to the UNFCCC Annex I inventory reporting guidelines, emissions from a specific category should only be considered insignificant if the likely level of emissions is below 0.05 per cent of the national total GHG emissions, and does not exceed 500 kt CO2 eq. Moreover, Parties should use approximated AD and default EFs to derive a likely level of emissions for the respective category. The ERT recommends that Canada either estimate and include in the inventory CO2, CH4 and N2O emissions from steam trains, or provide a justification in the NIR, consistent with the UNFCCC Annex I inventory reporting guidelines, that these emissions are considered insignificant	Yes	Completeness
E.25	1.A.3.e Other transportation: All fuels – CO2, CH4, N2O	The ERT noted that emissions from fisheries are reported under the country-specific category, off-road, under other transportation or other (manufacturing industries and construction) and not under agriculture/forestry/fishing, as required by the UNFCCC Annex I inventory reporting guidelines. The ERT recommends that Canada reallocate emissions from fuels used in fisheries into the subcategory agriculture/forestry/fishing	Yes	Comparability
E.26	1.A.3.e Other transportation: All fuels – CO2, CH4, N2O	The ERT noted that emissions from off-road activities from the agriculture and forestry activities under agriculture/forestry/fishing are reported under transport. According to the UNFCCC Annex I inventory reporting guidelines these emissions should be reported under off-road vehicles and other machinery (agriculture/forestry/fishing). During the review, Canada indicated that it is planning to implement a new off-road model based on the United States Environmental Protection Agency's NONROAD model. The model is based on equipment AD and will allow further disaggregation in the off-road subcategory than is currently possible. The ERT welcomes Canada's efforts in addressing this issue and recommends that Canada document its progress to reallocate the associated emissions from the subcategory fuels used in off-road activities under agriculture and forestry into the subcategory off-road vehicles and other machinery (agriculture/forestry/fishing)	Yes	Comparability
E.27	1.A.4.c. Agriculture/ forestry/fishing All fuels – CO2, CH4, N2O	As noted in previous review reports, and in the 2015 NIR, fuels sold to foreign marine vessels are assumed to be used for international travel and fuels sold to Canadian vessels are assumed to be domestic navigation. During the review, Canada indicated that a vessel is identified as Canadian or foreign by its registry (flag). The ERT notes that it seems likely that the emissions associated with fishing have been underestimated for the entire time series because of the likelihood that there are fishing vessels that refuel in Canada and fish in the Atlantic or the Pacific ocean but have a foreign flag. Such emissions should be reported in	Yes	Completeness

ID#	Finding classification	Description of the finding with recommendation or encouragement[a]	Is the finding an issue? If yes, classify by type	
		Canada's inventory. The ERT notes that, according to the 2006 IPCC Guidelines ,"fishing should cover vessels of all flags that have refuelled in the country (include international fishing)", and the ERT therefore recommends that Canada identify ways to collect the necessary data for the disaggregation between domestic and international navigation (please refer to table 3, issue E.8) to revise the CO2, CH4 and N2O emission estimates for the entire time series for the subcategory fishing		
E.28	1.A.5.b Other (mobile): Liquid fuels – CO2, CH4, N2O	The ERT noted that no information is reported in the NIR about which category domestic military navigation emissions are reported. During the review, Canada indicated that fuel use and associated emissions by Canada's national defence and coast guard are reported under "public administration" and cannot be split out for reasons of confidentiality. The ERT recommends that Canada indicate in the NIR under which category emissions from domestic military navigation emission are reported	Yes	Transparency
E.29	1.B.1.a.i Coal mining and handling: Solid fuels – CO2	The ERT noted that Canada reported CO2 emissions from underground mines as "NE". During the review, Canada indicated that it has no underground mines with active drainage systems and that flaring does not occur at Canada's two active underground (drift) mines The ERT recommends that Canada report the CO2 emissions from underground mines as "NA" and indicate in the NIR that no CO2 emissions associated with flaring and drainage systems of underground mines occur in the country	Yes	Transparency
E.30	1.B.1.a.i Coal mining and handling: Solid fuels – CH4	The ERT noted that, according to CRF table 1.B.1, the IEF of CH4 from underground mines is 2.05 kg CH4/t for 2013. The three regions with underground mines listed in table A3-7 of the NIR have CH4 EFs of 14.49 kg/t (Nova Scotia), 1.69 kg/t (Alberta) and 2.78 kg/t (British Columbia). So, in order for the reported IEF to be 2.05 kg/t, more than 90 per cent of annual coal production should come from Alberta mines, while less than 2 per cent should come from Nova Scotia mines. During the review, Canada indicated that all underground production ceased in Nova Scotia in 2001. The ERT recommends that Canada document in the NIR that production in Nova Scotia mines stopped in 2001	Yes	Transparency
E.31	1.B.1.a.i Coal mining and handling: Solid fuels – CO2, CH4	The ERT noted that Canada estimated and reported CH4 emissions from abandoned underground mines for the first time in the 2015 inventory submission, as required by 2006 IPCC Guidelines. For abandoned underground coal mines, Canada applied a hybrid IPCC tier 2 and tier 3 methodology. The ERT commends Canada for estimating these emissions using methodologies consistent with the 2006 IPCC Guidelines	No	

ID#	*Finding classification*	*Description of the finding with recommendation or encouragement*[a]	*Is the finding an issue? If yes, classify by type*	
E.32	1.B.1.a.ii Coal mining and handling: Solid fuels – CH4	For estimating the fugitive emissions from surface mines for 16 out of the 23 coal mines located in Eastern Canada, Canada applies a tier 1 approach, developed by the IEA (Coal Industry Advisory Board Method, CIABM). However, this approach is adjusted based on data from Canadian surface mines.[d] Moreover, because the CIABM method does not account for emissions from surrounding unmined strata, a correction factor for the CH4 EF was inserted based on a study by Cape Breton Coal Research Laboratory (CBCRL) (1993). During the review, Canada indicated that the Hollingshead study[d] was not prepared for Environment Canada and, because of its confidential nature, Canada does not have the authority to share it. The CBCRL study is unavailable and the organization no longer exists. Data from this study, which was used to develop the correction factor, would apply to mines in the Cape Breton area of the province of Nova Scotia – none of which are now in production. For the other seven mines, located in the provinces of British Columbia and Alberta, the CH4 EFs are based on a Cheminfo/Clearstone study,[e] which uses a ground-based mobile plume transect system for area sources and tracer tests for volume and point sources (tier 3 method). The ERT commends Canada for improving the accuracy of the inventory of coal mining sector, by applying a tier 3 model. However, the ERT noted that it cannot assess the adjusted CIABM methodology and assumptions used by Canada. The ERT recommends that Canada transparently explain in the NIR the assumptions, country-specific surface mines data, parameters and information from the national studies that were used, in order to justify the accuracy of the emission calculations. If this information is not available, then the ERT recommends that Canada, as a first step, for emissions from surface mines which were estimated by using the adjusted CIABM method, apply the respective tier 1 method from the 2006 IPCC Guidelines, and afterwards to plan and implement the application of a tier 2/tier 3 method that will be transparently described in the NIR, provided that it is developed in a manner consistent with the 2006 IPCC Guidelines and following the provisions of paragraph 41 of the UNFCCC reporting guidelines	Yes	Transparency
E.33	1.B.1.b Solid fuel transformation: Solid fuels – CH4	The ERT noted that, according to the NIR, fugitive emissions from coke production and briquette manufacturing are not estimated owing to lack of data. During the review, Canada indicated that there is only one briquette facility in Saskatchewan associated with an above-ground lignite mine. Fugitive emissions from post-mining activities are attributed to the mine and reported under post mining activities (surface mines). The ERT encourages Canada to estimate and report fugitive emissions from coke production, recognizing that there are no methods for estimating fugitive emissions from coke and charcoal production in the 2006 IPCC Guidelines. The ERT also encourages Canada to include in the NIR the information that emissions from briquette manufacturing	No	

ID#	Finding classification	Description of the finding with recommendation or encouragement[a]	Is the finding an issue? If yes, classify by type	
		are reported under the post-mining activities (surface mines)		
E.34	1.B.1.b Solid fuel transformation: Solid fuels – CO2, CH4, N2O	The ERT noted that emissions from the flaring of coke oven gas during coke manufacturing are not reported in the CRF tables. During the review, Canada explained that flaring of coke oven gas is not included in the flared volumes reported in the national energy balance (RESD). Moreover, Canada explained that, while the integrated iron and steel plants within Canada do flare coke oven gas and blast furnace gas, it has no information on the actual flared amounts. In the light of this, Canada assumes that all coke oven gas is combusted for energy purposes. The ERT recommends that Canada verify that the emissions from all coke oven gas both consumed and flared at the four integrated iron and steel plants are included in the inventory and report accordingly in the NIR	Yes	Completeness
E.35	1.B.1.b Solid fuel transformation: Solid fuels – CO2, CH4, N2O	During the review, Canada prepared a carbon mass balance for the coke production of Canada for 2013. Based on the results of this verification exercise, the carbon contained in the input was calculated to be around 7 per cent higher than the carbon in the following products of the coke oven process: coke and coke oven gas. The 7 per cent difference was attributed to the carbon contained in the other by-products of the coke-oven process, such as coal tar and pitch, which are not consumed as a fuel. Canada also explained that, while there is some data about coal tar and pitch use in the aluminium industry, these data do not differentiate between imported or exported products, and therefore there is no reliable way of including these data in the provided balance. The ERT encourages Canada to calculate and report, in the NIR, the carbon mass balance for coke production	No	
E.36	1.C.1 Carbon dioxide transport and storage: Gaseous fuels – CO2	The ERT noted that Canada estimated and reported CO2 emissions from CO2 transport for the first time in the 2015 inventory submission, as required by 2006 IPCC Guidelines. These emissions were estimated according to the tier 1 methodology from the 2006 IPCC Guidelines. The ERT commends Canada for estimating these emissions	No	
IPPU				
I.8	General (IPPU) – CO2	The ERT noticed small inconsistencies within the NIR (e.g. the use of an oxidation factor of 99 per cent for non-energy use of coal, different from the 100 per cent used in the energy sector, although the CRF tables consistently used the energy sector value). The ERT also noticed small inconsistencies between the NIR and new information provided during the review. For example, the CO2 EF for coke in iron ore reduction is reported as 3,200–3,300 kg CO2/t in the NIR (annex 6, page 201), but Canada referenced 2,480 kg CO2/t during the review week, and the CO2 EF for anthracite is reported as 2,411 kg CO2/t in the NIR (annex	No	

ID#	*Finding classification*	*Description of the finding with recommendation or encouragement*[a]	*Is the finding an issue? If yes, classify by type*	
		6, page 197), which is different from the later information of 2,387 kg CO2/t. The ERT encourages Canada to correct the inconsistency in the oxidation factor for non-energy use of coal in the NIR and confirm and accurately report the EFs for coke and anthracite		
I.9	2.A.4 Other process uses of carbonates – CO2	The ERT noted that the NIR did not included AD for limestone and dolomite use other than that used for iron and steel production, although AD are fully reported in the CRF tables. During the review, Canada provided the missing AD, comprising: uses for pulp and paper mills; non-ferrous smelters; glass factories; and other chemical uses. The ERT recommends that Canada include AD for all emissive uses of carbonates in the NIR	Yes	Transparency
I.10	2.A.4 Other process uses of carbonates – CO2	The ERT noticed that Canada reports "NE" for AD and CO2 emissions from ceramics production. The ERT recommends that Canada include CO2 emissions from this category in its inventory or demonstrate that emissions are insignificant, as defined in paragraph 37(b) of the UNFCCC Annex I inventory reporting guidelines	Yes	Completeness
I.11	2.B.8 Petrochemical and carbon black production – CO2 and CH4	The ERT noted that Canada reports "NE" for CO2 and CH4 emissions from ethylene oxide production, although there are methods to estimate these emissions in the 2006 IPCC Guidelines. The ERT recommends that Canada include emissions from this category in its inventory or demonstrate that emissions are insignificant, as defined in paragraph 37(b) of the UNFCCC Annex I inventory reporting guidelines	Yes	Completeness
I.12	2.D Non-energy products from fuels and solvent use – CO2	This key category is highly aggregated and has significant variations: approximately a 24.5 per cent increase in CO2 emissions from 1995 (8,025.69 kt) to 1996 (9,991.27 kt), more than 10 per cent each year from 2001 (11,482.79 kt) to 2004 (16,214.00 kt) and 21.5 per cent from 2011 (15,456.76 kt) to 2012 (18,775.24 kt). Since 1990 (7,359.53 kt) CO2 emissions increased 146.7 per cent. During the review, Canada provide disaggregated fuels and CO2 EFs for the category. Although the NIR indicates that the emissions from non-energy use of natural gas for ammonia production were included in another IPPU category (ammonia production), the information the ERT received indicates that these emissions are reported in the category other (non-energy products from fuels and solvent use). In the list of fuels with non-energy use provided by Canada during the review, the most significant, almost 50 per cent of the category in 2012 and 2013, is a group called "other products (petroleum – or waxes, paraffins, and unfinished products from refineries)" which, according to table A4-2 of the NIR, comprises "other liquid fuels – other product feedstock". The exact share of each of these fuels could not be estimated prior to 2011 because of confidentiality issues, nor was	Yes	Transparency

ID#	Finding classification	Description of the finding with recommendation or encouragement[a]	Is the finding an issue? If yes, classify by type	
		their application explained. The ERT welcomes Canada's progress in the reporting of emissions from this category. Nevertheless, the ERT recommends that Canada include in the improvement plan acknowledged in the previous review report (see I.6 above) an analysis that will allow the Party to disaggregate this category by fuels, indicating related uses, EFs and the fraction of stored carbon in products, at least for the main components, with full documentation in the NIR, in order to increase the transparency in this key category		
I.13	2.C.3 Aluminium production – SF6	Canada reported a significant drop in the SF6 IEF for aluminium production between 2011 (0.001086 kg/t) and 2012 (0.000075 kg/t). During the review, Canada indicated that this difference is caused by the use of cover gas as well as a degassing (purifying) agent, before and during the aluminium casting stage of the aluminium production process. The ERT recommends that Canada include the reasons for the significant changes in the trend in the SF6 IEF its NIR	Yes	Transparency
I.14	2.C.3 Aluminium production – CO2 and PFCs	The ERT found some inconsistencies in the description of methods used to estimate CO2 and PFCs emissions for this category. During the review, Canada clarified the information on the use of the methodology described in the "Framework Agreement on Voluntary Greenhouse Gas Reductions in Quebec entered into between the Government of Quebec and the Aluminium Association of Canada", and how it is now replaced by WCI (World Climate Initiative) methodologies. The ERT recommends that Canada update information in the NIR regarding the methods used to estimate CO2 and PFC emissions for the entire time series	Yes	Transparency
I.15	2.E Electronics industry – NF3	Regarding NF3 emissions from integrated circuit or semiconductor production, the ERT noted that Canada uses a varying EF through the years (steadily declining between 1990 (180.69 kg/tonne) and 2010 (161.28 kg/tonne) before sharply increasing since then, up to 187.01 kt/t in 2013). During the review Canada provided possible reasons for this, specifically that an error was discovered in the time series for the consumption of NF3, specifically in the heel factor for 2013. The ERT recommends that Canada provide information on the parameters for estimating emissions from this category, and use a constant EF for the entire time series	Yes	Accuracy
I.16	2.F Product uses as substitutes for ozone depleting substances – HFCs	Canada made recalculations for the category product uses as substitutes for ODS, with updates in methodology as well as in country-specific EFs, which significantly decreased emissions in the last years (between the 2014 and 2015 inventory submissions, HFC emissions declined by 20.9 per cent for 2012). The ERT noted that the Party reported AD on decommissioning of equipment containing HFCs in domestic refrigeration, commercial refrigeration and mobile air-conditioning equipment, but did not report HFC emissions	Yes	Comparability

ID#	*Finding classification*	*Description of the finding with recommendation or encouragement*[a]	*Is the finding an issue? If yes, classify by type*	
		(some emissions were reported in previous submissions). During the review, Canada indicated that this was a result of an error in the calculation routine and revised data will be available for the 2016 inventory submission. The ERT recommends that Canada fix the acknowledged errors, update the time series and develop an appropriate QC check to ensure that such errors do not occur again		
I.17	2.F Product uses as substitutes for ozone depleting substances – HFCs	During the review, Canada provided the models used for the estimation of HFC emissions for this category, as well as the forms used by companies for voluntary surveys, from 2006 to 2011 (covering AD in the period 2005 to 2010), and the 2014 mandatory survey, which covered AD in the period 2008–2012. The ERT noticed that the amounts going into servicing are also used for estimating manufacturing emissions. Furthermore, the provided models do not keep track of the amount of HFC entering the market each year in terms of appliances, which would be important to estimate their end of life emissions. Canada acknowledges that errors exist in the estimates for manufacturing and servicing/maintenance emissions, as well as in the foam blowing, fire protection, aerosols, solvents and electrical equipment subcategories. The ERT encourages Canada to continue to conduct these surveys and recommends that Canada correct the identified problems in order to allow the correct utilization of either the tier 2a method (with data for emissions related to the management of refrigerant containers, emissions related to the refrigerant charge, annual emissions from the banks of refrigerants and servicing emissions at system disposal) or the tier 2b method (with data for annual sales of new refrigerant, total charge of new equipment, original total charge of retiring equipment, and amount of intentional destruction) from the 2006 IPCC Guidelines	Yes	Comparability
I.18	2.F.1 Product uses as substitutes for ozone depleting substances – HFCs	Canada does not use the rates in the 2006 IPCC Guidelines in the refrigeration and air conditioning category for the years 1995–1998. During the review, Canada explained that it has little detail on the equipment emission rates for these years, so it was decided to keep the emission rates from the previous inventory submission and consider implementation of the 2006 IPCC Guidelines for the 2016 inventory submission. The ERT recommends that Canada apply the methodology presented in the 2006 IPCC Guidelines for the entire time series, and if this is not possible use one of the techniques provided in the 2006 IPCC Guidelines to estimate the missing values	Yes	Consistency
I.19	2.G.1 Other product manufacture and use – SF6	The ERT noted that SF6 emissions from manufacturing of electrical equipment were estimated, while AD were reported as "NE". According to the NIR, there should be only emissions from use, decommission and failure, although values for average annual stocks and amount remaining in products at decommissioning are also reported as "NE" for the entire time series. During the review, Canada confirmed the NIR information and stated that emissions had been incorrectly allocated to manufacturing.	Yes	Comparability

ID#	*Finding classification*	*Description of the finding with recommendation or encouragement*[a]	*Is the finding an issue? If yes, classify by type*	
		The ERT recommends that Canada correctly report SF6 emissions from manufacturing, use and disposal of electrical equipment and report the corresponding AD		
Agriculture				
A.10	General (agriculture) – CH4 and N2O	Owing to the use of the new UNFCCC Annex I inventory reporting guidelines, llamas and alpacas, which were previously reported separately by Canada under camels and llamas, are now reported together with wild boars under the subcategory other livestock. During the review, Canada provided the population trend used to calculate emissions for llamas and alpacas, as well as for wild boars.	No	
		The ERT recognizes that the CRF tables no longer allow for the disaggregation of llamas, alpacas and wild boars and encourages Canada to include the population trends for these animals in the NIR		
A.11	General (agriculture) – CH4 and N2O	The ERT noted an inconsistency in the time series for the population trend of "other (other livestock)" between the years 1996 (8,669) and 1997 (18,718), an increase of 115.9 per cent. During the review, Canada explained that the population of "other (other livestock)" includes the population of "llamas and alpacas" and "wild boars". However, the Party reported a wild boar population of 0 (zero) for the years between 1990 to 1996 since the population of wild boar only began to be reported in the 1996 census.	Yes	Consistency
		The ERT recommends that Canada provide documentation to support its reporting that there were no wild boar between 1990 and 1996 or extrapolate from the available data,[f] to fill the population data gap instead of using 0 (zero) for the years between 1990 and1996		
A.12	3.A Enteric fermentation – CH4	Canada reported emissions from enteric fermentation from fur-bearing animals and rabbits using the notation key "NO"; however, it reported a population of 795,513 and 184,935 for these animals in 2013, respectively. During the review, Canada explained that the notation key "NO" was used because no country-specific or default CH4 EF for enteric fermentation is available for fur-bearing animals or rabbits. However, as Canada cannot definitively state that emissions do not occur, it acknowledged that the notation key "NE" should have been reported. The ERT agrees with the Party's response.	Yes	Comparability
		The ERT recommends that Canada use the notation key "NE" for CH4 emissions from enteric fermentation from fur-bearing animals and rabbits		
A.13	3.A Enteric fermentation – CH4	The ERT noted that different live weight data for non-dairy cattle are used to estimate emissions from enteric fermentation and manure management for the entire time series. For instance, in 2013, in CRF table 3.A the live weight used to calculate emissions from enteric fermentation was 624.51 kg; however, in CRF table 3.B(a) the live weight used to estimate emission from manure management for the same category was 634.95 kg. During the review, Canada acknowledged that there were issues in the transfer of data and upload to the CRF	Yes	Adherence to UNFCCC Annex I inventory reporting guidelines

ID#	*Finding classification*	*Description of the finding with recommendation or encouragement*[a]	*Is the finding an issue? If yes, classify by type*	
		Reporter, as some data from the previous submission were not correctly overwritten. In addition, Canada provided supplementary information with the correct live weight used for the non-dairy cattle category (634.95 kg). The ERT recommends that Canada review its QA/QC procedures in the light of the new CRF Reporter and ensure that the same live weight data are used to calculate CH4 emissions from enteric fermentation and manure management for non-dairy cattle for the time series		
A.14	3.B Manure management – CH4	The ERT noted that in the NIR (table A3-32), the values for VS for sheep and lambs (0.6), mature horses (3.6), swine (0.23), goats (0.72), bison (3.1) and poultry (0.023), differed from the values in CRF table 3.B(a), which reported 0.70, 3.20, 0.24, 0.64, 2.66 and 0.16 respectively. During the review, Canada acknowledged that there were issues in the transfer of data and upload to the CRF Reporter, as some data from the previous submission were not correctly overwritten. In addition, Canada indicated that VS values reported in the 2015 NIR (table A3-32) for sheep and lambs were not properly updated, and provided documentation with the correct value of VS during the review. The ERT recommends that Canada review its QA/QC procedures in the light of the new CRF Reporter and ensure that the correct VS values are reported in the CRF tables for all animal types	Yes	Adherence to UNFCCC Annex I inventory reporting guidelines
A.15	3.B Manure management – CH4 and N2O	In the NIR (table A3-36), the MMS for dairy cattle is reported as 0 (zero) for "other systems"; however, in CRF table 3.B(a) 0.11 is reported for the same category. During the review, Canada acknowledged that, in table A3-36 of the 2015 NIR, the MMS of dairy cattle for "other systems" should be 0.11 instead of 0 (zero), which is due to a rounding issue, and indicated the issue will be corrected in the next inventory submission. The ERT recommends that Canada correct the rounding of the MMS allocation of other systems for dairy cattle in the NIR	Yes	Adherence to UNFCCC Annex I inventory reporting Guidelines
A.16	3.D Agricultural soils – N2O	The ERT noted that Canada reports direct N2O emissions from sewage sludge applied to soils and other organic fertilizers applied to soils (organic nitrogen fertilizers) using the notation key "NE". During the review, Canada explained that the notation key "NE" was used because no AD are available at this time. However, the Party noted that efforts are ongoing to scope potential sources of data for sewage sludge and other organic fertilizers and their application on agricultural land. The ERT welcomes the Party's effort and recommends that Canada report direct N2O emissions from sewage sludge and other organic fertilizers applied to soils	Yes	Completeness
A.17	3.G Liming	In CRF table 3.G-I, Canada reported CO2 emissions from dolomite using the notation key "IE", indicating in a cell comment that the use of dolomite is included in the limestone data. However, the tier 1 IPCC default value for limestone is 0.12 t CO2-C/t and for dolomite is	Yes	Completeness

ID#	Finding classification	Description of the finding with recommendation or encouragement[a]	Is the finding an issue? If yes, classify by type	
		0.13 t CO2-C/t. During the review, Canada explained that the data source for lime use only reports agricultural use of lime as limestone. In addition, the reported amount of lime consumption may include dolomite or other impurities, but the relative proportion of dolomite to limestone is not known. The ERT recommends that the Party either obtain data on the use of dolomite and estimate CO2 emissions using the IPCC default value (0.13 t CO2-C/t) or use the notation key "NE" instead of the notation key "IE"		
LULUCF				
L.12	General (LULUCF)	In the 2015 inventory submission, Canada has made some improvements using the 2006 IPCC Guidelines, including new estimations of CO2 emissions from harvested wood products, off-site peat and urban trees in settlements, and the incorporation of updated information for the estimation of emissions from wildfires, slash burning, harvesting and AD for cropland and settlements. The ERT commends Canada for the efforts	No	
L.13	General (LULUCF)	The ERT identified that the total reported area decreased over time from 1990 (291,689.31 kha) to 2013 (290,689.31 kha). Some land-use changes were not reported (see annex II to this report) and total settlements area was not reported independently and was reported with the unmanaged area in the land use matrix. The ERT notes the information in the NIR, which states that Canada is working on completing the inventory, and also notes the explanation provided by Canada during the review that the potential key categories have already been estimated and reported. The ERT recommends that the Party improve the completeness for representing land areas in the LULUCF sector by amending the reporting (both the land-use change matrix and the estimates for category-specific emissions/removals in the CRF tables) by including all land areas and making it clear which categories and subcategories do occur in Canada and whether the emissions/removals are calculated or not. This includes both managed land areas where no emissions/removals are expected (for instance grassland remaining grassland in Canada) as well as unmanaged areas	Yes	Completeness
L.14	General (LULUCF)	As noted by the ERT in issue L.1 above, Canada has provided additional information in the submission to explain the application of the 20-year transition time. During the review, Canada provided additional information on the procedure showing how areas of land converted to forest land over 20 years are classified under forest land remaining forest land. The ERT recommends that the Party include information to explain the application of the 20-year transition time, specifically showing how areas of land converted to forest land over 20 years are classified under forest land remaining forest land in the NIR, as this procedure was	Yes	Transparency

ID#	*Finding classification*	*Description of the finding with recommendation or encouragement*[a]	*Is the finding an issue? If yes, classify by type*	
		not clearly explained in the 2015 NIR		
L.15	General (LULUCF)	The ERT acknowledges that Canada is making efforts to improve the completeness and transparency of this sector (see L.13 above). The ERT encourages Canada to provide a summary table showing the relationship between the IPCC's land use categories and the country-defined reporting zones, eco-zones and reconciliation units, if appropriate. The ERT also encourages Canada to think of ways to improve land representation by qualitatively identifying sources of uncertainty and including these findings in future improvement plans, such as potential overlapping of spatial analysis units which may result in under- or overestimation of emissions and removals	No	
L.16	General (LULUCF) – CO2	In relation to the effort to resolve the use of the notation key "NE" in reporting (issue L.4 above), the ERT encourages Canada to consider the application of the insignificant threshold set out in paragraph 37(b) of the UNFCCC Annex I inventory reporting guidelines	No	
L.17	4.A Forest land – CO2	In the previous review report (para. 62), Canada was encouraged to improve the graphical description of the structure of the CBM-CFS-3 model in the NIR. The previous and current ERTs conclude that such illustration is important to give the reader of the NIR a quick introduction to the model structure and an understanding of how the processes included in the model are connected. The current ERT noted that Canada included graphical references indirectly in the 2015 NIR, especially through the paper by Kurz et al. (2009). However, this paper is not publicly available and does not include a reference (or graphical description) of the new country-specific model entitled "National Forest Carbon Monitoring, Accounting and Reporting System for Harvested Wood Products", which was used for the 2015 inventory submission. The ERT recommends that Canada improve the graphical description of the structure of the CBM-CFS-3 model in the NIR by adding a figure for example, including references to IPCC carbon pools including harvested wood products	Yes	Transparency
L.18	4.A Forest land remaining forest land – CO2	Canada explained in its NIR (pages 123–125 of Part II) that CO2 emissions from salvage logging and conventional harvesting are both modelled using the CBM-CFS3 model, but that salvage logging is only distinguishable from conventional harvesting in certain situations. During the review, Canada explained that the two activities result in different carbon transfers and are registered as independent outputs from the ecosystem model. Namely, that clear-cut harvesting has an impact on the amount of carbon in biomass and that salvage logging has an impact on the amount of carbon from dead organic matter, both ultimately transferred to the category harvested wood products (see L.21 below). Additionally, Canada confirmed that it will revise the current text of the NIR (annex 3.5) in its next inventory submission to clearly describe the currently methodology used. The ERT encourages Canada to increase the transparency of its reporting by including	No	

ID#	Finding classification	Description of the finding with recommendation or encouragement[a]	Is the finding an issue? If yes, classify by type	
		information on the methodology used to distinguish salvage logging and conventional harvesting		
L.19	4.A Land converted to forest land – CO2	Canada reported annual area conversions to forest land for the period 2009–2013 as zero (0), because of the lack of AD. Canada indicated during the review that this may cause a small underestimation of removals in land converted to forest land. The ERT recommends that Canada providing additional information on why using zero for this period is considered reasonable compared with other alternative ways to construct the time series and also recommends that Canada continue with its efforts to acquire missing AD of land converted to forest land	Yes	Accuracy
L.20	4.D Wetlands remaining wetlands, land converted to wetlands – CO2, CH4 and N2O	Canada reported the non-mandatory subcategory of other wetlands as "NE" and explained that it is assessing the possibility of applying the IPCC 2013 Supplement to the 2006 IPCC Guidelines for National Greenhouse Gas Inventories: Wetlands (Wetlands Supplement). The ERT encourages Canada to use the Wetlands Supplement in preparing its annual inventories for future annual submissions	No	
L.21	4.H Harvested wood products – CO2	Harvested wood products were included in the national GHG inventory for the first time in the 2015 submission. The estimation for harvested wood products was based on the "production approach", one of the three proposed approaches in the 2006 IPCC guidelines (e.g. Annex 12.A.1). The emissions were reported in this category and transfer between carbon pools was reported under the appropriate land-use categories. Harvested wood product pools were not counted as a loss or gain in each pool in order to avoid double counting the emissions between land-use categories and the category harvested wood products. As a result, a large recalculation due to the re-allocation of emissions from each land-use category to the category harvested wood products occurred in the 2015 inventory submission (e.g. 140.37 kt CO2 in 1990, 152.42 kt CO2 in 2012). This reporting approach is in line with the simple decay approach, which is a sub-approach of the production approach in the 2006 IPCC Guidelines. The ERT commends the effort made by Canada and encourages further elaboration of estimation and reporting including the recommendations in L.17 and L.22	No	
L.22	4.H Harvested wood products – CO2	The 2006 IPCC Guidelines recommend going back to 1900 to estimate production, imports and exports of harvested wood products. However, Canada has not included 1900–1941 data from the estimation and explained during the review that extending that period to 1900 would require greater effort and less certain estimates and assumptions. The ERT notes that Canada has planned improvements related to the estimation of emissions for the category harvested wood products, which are explained in the NIR. The ERT recommends that Canada include 1900–1940 data for estimating emissions from	Yes	Accuracy

ID#	*Finding classification*	*Description of the finding with recommendation or encouragement*[a]	*Is the finding an issue? If yes, classify by type*	
		the category harvested wood products, as part of the improvement work in relation to the category, and consider how uncertainty may be affected		
L.23	4(V) Biomass burning – CO2	Canada did not include CO2 emissions from the carbon loss due to biomass burning in the relevant land-use categories (i.e. forestland, cropland, wetlands and settlements). CO2 emissions from biomass burning were reported in CRF table 4(V) and the total CO2 emissions of the LULUCF sector included the CO2 emissions reported in CRF table 4(V). Emissions of carbon monoxide (CO) that occur during biomass burning were included as CO2 emissions in the total CO2 emissions from biomass burning, thus the total emissions of the LULUCF sector included indirect CO2 emissions. According to the CO emission data provided by Canada during the review, the contribution of indirect CO2 resulting from CO is estimated to be offset about 0.6–8.3 per cent of net removals (without fire emissions) in forest land remaining forest land and about 0.3–4.7 per cent of national total national emissions without LULUCF. In accordance with paragraph 29 of the "UNFCCC Annex I inventory reporting guidelines", a country shall present values for emissions both "with indirect CO2 and without indirect CO2" when a country decides to report indirect CO2 emissions. The ERT recommends that Canada include in its inventory submission: (1) information on total CO2 emissions with and without indirect CO2; and (2) the explanation of the methodology and assumption(s) used to convert from CO to CO2 that the Party provided during the review. The ERT also recommends that Canada reflect the information on emissions with and without indirect CO2 in CRF table 10	Yes	Adherence to UNFCCC Annex I inventory reporting guidelines
L.24	4 (III), 4 (IV) Direct and indirect N2O emissions – N2O	Under the 2006 IPCC Guidelines, N2O emissions from nitrogen mineralization/immobilization associated with loss/gain of soil organic matter cover not only land converted to cropland and grassland (which were already included in the IPCC good practice guidance for LULUCF), but also new land-use categories including all forest land, grassland remaining grassland, all wetlands and all settlements. Canada reported "NE" for these N2O emissions for all new land-use categories. During the review, Canada explained that the applicability of this methodology to Canada requires evaluation and verification against country-specific scientific literature and also provided numerical information that the emissions in forest land remaining forest land are not considered to exceed the threshold of "insignificant" set out in paragraph 37(b) of the annex to decision 24/CP.19. The ERT recommends that Canada estimate all the direct N2O emissions as well as associated indirect N2O emissions from nitrogen mineralization/immobilization associated with loss/gain of soil organic matter. Until the estimation is implemented, the ERT recommends that Canada provide information on the planned improvement and assessment of the quantitative impact of this missing category in accordance with the provisions in paragraph 37(b) of the "UNFCCC Annex I inventory reporting guidelines"	Yes	Completeness

ID#	*Finding classification*	*Description of the finding with recommendation or encouragement*[a]	*Is the finding an issue? If yes, classify by type*	
Waste				
W.13	5.A Solid waste disposal on land – CH4	The ERT noted that the Party used the equations from the IPCC good practice guidance for estimating methane generation from landfills, which differ from the 2006 IPCC Guidelines, replacing some default parameters in the waste decay equation with country-specific parameters. During the review, the Party explained that the country-specific parameters were consistent with the FOD approach as set out in the 2006 IPCC Guidelines. The ERT commends Canada for its efforts to calculate key country-specific parameters. The ERT recommends that Canada implement the equations in the 2006 IPCC Guidelines for estimating methane emissions from landfills and provide an explanation of how the country-specific parameters were calculated	Yes	Adherence to UNFCCC Annex I inventory reporting guidelines
W.14	5.A Solid waste disposal on land – CH4	The ERT noticed that the DOC calculation equation does not follow the equation for calculating DOC in the 2006 IPCC Guidelines. Canada indicated during the review that the DOC calculation used (equation 7-4 from the IPCC Good Practice Guidance and Uncertainty Management in National Greenhouse Gas Inventories) is mathematically equivalent to equation 3.7 in the 2006 IPCC Guidelines (volume 5, chapter 3, section 3.2.3). The ERT agrees with Canada that in both cases the calculation formulas presented in the IPCC good practice guidance and the 2006 IPCC Guidelines are mathematically equivalent. The ERT recommends that the Party update its documentation on estimating DOC to use the references and equations from the 2006 IPCC Guidelines	Yes	Adherence to UNFCCC Annex I inventory reporting guidelines
W.15	5.A Solid waste disposal on land – CH4	The ERT noticed that an MCF of 0.8 was used for wood waste landfills and that emissions from wood waste landfills were reported in CRF table 5.A as uncategorized waste disposal sites. The NIR did not provide the reasons for this classification. During the review, Canada clarified that it assumed that the wood waste landfills in Canada are treated in unmanaged deep landfills. The ERT recommends that Canada include in the NIR the rationale for the allocation of emissions from wood waste landfills to the category of uncategorized waste disposal sites	Yes	Transparency
W.16	5.A Solid waste disposal on land – CH4	Canada uses an oxidation value of zero in the estimation of CH4 emissions from solid waste disposal sites, but does not report the justification for the choice of this value in the NIR. During the review, Canada indicated that it is considering implementing the 2006 IPCC Guidelines default oxidation factor of 0.1 for “managed covered with CH4 oxidising material” for the next inventory submission. The ERT recommends that Canada either improve the transparency of the justification for an oxidation value of zero, or apply the default value from the 2006 IPCC Guidelines	Yes	Transparency

ID#	*Finding classification*	*Description of the finding with recommendation or encouragement*[a]	*Is the finding an issue? If yes, classify by type*	
W.17	5.A Solid waste disposal on land – CH4	The ERT noticed that in the NIR, reported quantities of waste landfilled for 2011, 2012 and 2013 were extrapolated from values derived from the Statistics Canada waste management survey. However, the NIR did not provide enough information about the extrapolation. During the review, Canada provided a detailed explanation for the approach used. The ERT commends Canada for its effort to survey its waste management practices and recommends that the Party explain the approach used to extrapolate the AD for the amount of waste landfilled	Yes	Transparency
W.18	5.B Biological treatment of solid waste – CH4 and N2O	The ERT noted that Canada reports "NE" for CH4 and N2O emissions from composting. The ERT also noted that the 2006 IPCC Guidelines provide equations for estimating CH4 and N2O emissions from biological treatment. The ERT recommends that Canada report CH4 emissions and N2O emissions from composting	Yes	Completeness
W.19	5.B Biological treatment of solid waste – CH4 and N2O	The ERT noticed an inconsistency between the NIR and the CRF tables, whereby the NIR reports that "this source [anaerobic digestion at biogas facilities] has not been estimated", while CRF table 5.B reports the notation key "NO" for anaerobic digestion at biogas facilities. During the review, Canada indicated that, to its knowledge, no commercial-scale operations exist. The ERT recommends that the Party improve QA/QC for the waste sector and ensure that the use of notation keys is consistent between the NIR and the CRF tables	Yes	Adherence to UNFCCC Annex I inventory reporting guidelines
W.20	5.C Incineration and open burning of waste – CO2	The ERT noticed that the methodology used for estimating CO2 emissions from waste incineration referenced the IPCC good practice guidance (equation 5.11). During the review, Canada noted that equation 5.11 is mathematically equivalent to equation 5.1 in the 2006 IPCC Guidelines. The ERT recommends that Canada update its references and equations to use of those in the 2006 IPCC Guidelines, particularly given that the approaches are mathematically equivalent	Yes	Adherence to UNFCCC Annex I inventory reporting guidelines
W.21	5.C Incineration and open burning of waste – N2O	The ERT notes that Canada does not estimate N2O emissions from clinical waste incinerated in dedicated waste incinerators. During the review, Canada indicated that efforts to address this issue are ongoing. The ERT recommends that Canada estimate N2O emissions from clinical waste incinerated in dedicated waste incinerators	Yes	Completeness
W.22	5.C Incineration and open burning of waste – N2O	The ERT noted that N2O emissions from MSW incineration are estimated using the Revised 1996 IPCC Guidelines methodology and EF (0.148 kg/t waste incinerated). The ERT further noted that the 2006 IPCC Guidelines provide an updated methodology and EFs for estimating N2O emissions from this category (see table 5.4 from volume 5, section	Yes	Accuracy

ID#	Finding classification	Description of the finding with recommendation or encouragement[a]	Is the finding an issue? If yes, classify by type	
		5.4.3). During the review, Canada indicated it would consider using the updated EF. The ERT recommends that Canada either justify the continued use of the default EF from the Revised 1996 Guidelines, as appropriate to its national circumstances, or update the EF to that used in the 2006 IPCC Guidelines		
W.23	5.D Wastewater treatment and discharge – CH4 and N2O	Previous review reports have included recommendations and encouragements that Canada improve the transparency of the methods used in this category by providing more information on the wastewater treatment systems and their linkage with the parameters used for calculating the CH4 and N2O EF (e.g. fractions of facilities per type/technique and justification for the parameters used, such as MCF and B0 for domestic and commercial wastewater handling). During the review, Canada indicated that this issue is under consideration. The ERT recommends that Canada investigate possibilities to disaggregate the national level AD used (population) in line with the different treatment systems used. The ERT also recommends that Canada investigate whether the organic load per capita per day (BOD) of 0.05 kg/person/day used in the estimates from municipal wastewater treatment (which is different from the 2006 IPCC Guidelines default EF value of 0.6 kg CH4/kg BOD) could be used in the Party's inventory as a country-specific value	Yes	Transparency

Abbreviations: AD = activity data, CRF = common reporting format, DOC = degradable organic carbon, EF = emission factor, ERT = expert review team, FOD = first order decay, GCV = gross calorific value, GHG = greenhouse gas, IE = included elsewhere, IEA = International Energy Agency, IEF = implied emission factor, IPPU = industrial processes and solvent and other product use, IPCC = Intergovernmental Panel on Climate Change, IPCC good practice guidance = IPCC *Good Practice Guidance and Uncertainty Management in National Greenhouse Gas Inventories*, IPCC good practice guidance for LULUCF = IPCC *Good Practice Guidance for Land Use, Land-Use Change and Forestry*, LULUCF = land use, land-use change and forestry, MMS = manure management systems, MSW = municipal solid waste, NA = not applicable, NE = not estimated, NFCMARS-HWP = National Forest Carbon Monitoring, Accounting and Reporting System for Harvested Wood Products, NIR = national inventory report, NO = not occurring, ODS = ozone depleting substances, QA/QC = quality assurance/ quality control, Revised 1996 IPCC Guidelines = *Revised 1996 IPCC Guidelines for National Greenhouse Gas Inventories*, SWDS = solid waste disposal sites, VS = volatile solids, wt% = weight per cent.

[a] Recommendations are related to issues as defined in decision 13/CP.20, annex, paragraph 81, identified by the ERT during the review. Encouragements are made to the Party to address all findings not related to issues.

[b] Statistics Canada. February 2014. *Report on Energy Supply and Demand in Canada: 2012 Preliminary.* Published by the Minister responsible for Statistics Canada. Available at <http://www5.statcan.gc.ca/olc-cel/olc.action?objId=57-003-X&objType=2&lang=en&limit=0>.

[c] Levelton Consultants Ltd. 2004. *Economic and Environmental Impacts of Removing Sulphur from Canadian Gasoline and Distillate Production*, prepared for the Canadian Petroleum Products Institute (CPPI), Natural Resources Canada (NRCan), Environment Canada and Industry Canada.

[d] Hollingshead B. 1990. Methane Emissions from Canadian Coal Operations: A Quantitative Estimate. Devon (AB): Coal Mining Research Company. Report CI 8936.

[e] Cheminfo Services Inc., and Clearstone Engineering Ltd. 2014. Compilation of a National Inventory of Greenhouse Gas and Fugitive VOC Emissions by the Canadian Coal Mining Industry. Final report submitted to the Energy Group, PIRD, Environment Canada.

[f] Statistics Canada. 2008. Alternative Livestock on Canadian Farms: Census years 1981, 1986, 1991, 1996, 2001, and 2006 (Catalogue # 23-502-X). Available at <http://www.statcan.gc.ca/pub/23-502-x/23-502-x2007001-eng.pdf>.

Annex I

Overview of greenhouse gas emissions and removals for Canada for submission year 2015

Table 6 shows total greenhouse gas (GHG) emissions, including and excluding land use, land-use change and forestry and, for Parties that have decided to report indirect carbon dioxide (CO_2) emissions, with and without indirect CO_2. Tables 7 and 8 show GHG emissions reported under the Convention by Canada by gas and by sector, respectively.

Table 6
Total greenhouse gas emissions for Canada, base year[a] to 2013
(kt CO_2 eq)

	Without indirect CO2		*With indirect CO2*[b]	
	Total with LULUCF	*Total without LULUCF*	*Total with LULUCF*	*Total without LULUCF*
Base year (1990)	525 253.32	612 752.70	525 253.32	612 752.70
1990	525 253.32	612 752.70	525 253.32	612 752.70
1995	851 936.43	663 810.45	851 936.43	663 810.45
2000	668 283.72	744 883.18	668 283.72	744 883.18
2010	788 419.30	707 038.12	788 419.30	707 038.12
2011	791 431.12	709 228.45	791 431.12	709 228.45
2012	775 313.29	715 220.26	775 313.29	715 220.26
2013	710 977.17	726 050.66	710 977.17	726 050.66

Note: If emissions from the sector "other" are reported, they are excluded from total greenhouse gas emissions.
Abbreviation: LULUCF = land use, land-use change and forestry.
[a] "Base year" refers to the base year for the Party under the Convention specified in decision 24/CP.19, annex, paragraph 8.
[b] Canada chose not to report indirect CO_2 emissions.

Table 7
Greenhouse gas emissions by gas, base year[a] to 2013
(kt CO_2 eq)

	CO2	*CH4*	*N2O*	*HFCs*	*PFCs*	*SF6*	*NF3*
Base year (1990)[a]	462 702.71	96 036.07	42 257.75	970.58	7 557.90	3 227.36	0.32
1990	462 702.71	96 036.07	42 257.75	970.58	7 557.90	3 227.36	0.32
1995	494 406.83	114 050.84	45 771.34	955.34	6 349.22	2 276.59	0.28
2000	572 023.14	121 274.74	40 106.95	3 587.94	4 985.57	2 904.60	0.24
2010	556 400.64	104 186.05	38 407.69	5 745.55	1 859.18	438.86	0.15
2011	558 944.05	104 164.21	38 113.05	5 924.14	1 687.38	395.47	0.15
2012	562 009.30	105 369.62	39 449.27	6 156.05	1 798.64	437.23	0.15
2013	569 657.26	106 758.44	41 183.13	6 401.74	1 617.10	432.84	0.15
Per cent change base year–2013	23.1%	11.2%	–2.5%	559.6%	–78.6%	–86.6%	–53.4%

Note: CO_2, CH_4 and N_2O emissions do not include emissions and removals from the land use, land-use change and forestry sector. Canada does not report indirect CO_2 emissions in CRF table 6.

[a] "Base year" refers to the base year for the Party under the Convention specified in decision 24/CP.19, annex, paragraph 8.

Table 8
Greenhouse gas emissions by sector, base year[a] to 2013
(kt CO_2 eq)

	Energy	*IPPU*	*Agriculture*	*LULUCF*	*Waste*	*Other*
Base year (1990)	484 635.65	55 094.73	49 086.45	–87 499.38	23 935.86	NA
1990	484 635.65	55 094.73	49 086.45	–87 499.38	23 935.86	NA
1995	526 275.15	56 322.04	55 794.35	188 125.98	25 418.90	NA
2000	606 394.46	53 454.45	58 593.88	–76 599.46	26 440.39	NA
2010	572 768.11	50 737.80	56 888.69	81 381.18	26 643.52	NA
2011	575 934.90	50 886.24	56 032.87	82 202.67	26 374.44	NA
2012	576 541.65	55 022.15	58 048.43	60 093.03	25 608.02	NA
2013	588 014.48	52 198.52	60 497.43	–15 073.50	25 340.24	NA
Per cent change base year–2013	21.3%	–5.3%	23.2%	–82.8%	5.9%	NA

Note: Canada does not report indirect CO_2 emissions in CRF table 6.
Abbreviations: IPPU = industrial processes and solvent and other product use, LULUCF = land use, land-use change and forestry, NA = not applicable.
[a] "Base year" refers to the base year for the Party under the Convention specified in decision 24/CP.19, annex, paragraph 8.

Annex II

Additional information to support findings in table 2

A. Missing categories that affect completeness

The following categories were reported as "NE" or the ERT otherwise determined that there is an issue with the completeness of reporting in Canada's inventory:

- Stationary combustion: liquid fuels (refinery (still) gas and motor gasoline) – CH_4 emissions (see E.22 above);
- Railways, solid fuels – CO_2, CH_4, N_2O: from steam engines (see E.24 above);
- Agriculture/forestry/fishing (other sectors) – CO_2, CH_4, N_2O (see E.27 above);
- Solid fuel transformation – CO_2, CH_4, N_2O from coke oven gas consumed and flared at integrated iron and steel facilities (see E.34 above);
- Ceramics – CO_2 (see I.10 above);
- Ethylene oxide production (CO_2 and CH_4) (see I.11 above);
- Sewage sludge applied to soils – N_2O (see A.16 above);
- Wetlands and settlements converted to cropland (all carbon pools) – CO_2
- Grassland remaining grassland – CO_2 for the following pools (see L.13 above):
    - RZ12 Semi-arid prairies, RZ13 Taiga Plain, RZ14 Montane Cordillera, RZ15 Pacific Maritime (soils);
- Settlements remaining settlements – CO_2 for the following pools (see L.4 above):
    - RZ4 Taiga Shield East, RZ8 Hudson Plains, RZ13 Taiga Plain, RZ16 Boreal Cordillera, RZ17 Taiga Cordillera, RZ18 Taiga Shield West (all carbon pools);
    - Other reporting zones (soils);
- Cropland and wetlands converted to settlements (all carbon pools) (see L.4 above);
- Grassland converted to settlements (DOM and soil pools) (see L.4 above);
- Emissions and removals from drainage and rewetting and other management of organic and mineral soils: from organic soil under forest land – CO_2 and N_2O (see L.4 above);
- Direct and indirect N_2O emissions from nitrogen mineralization/immobilization associated with loss/gain of soil organic matter resulting from change of land use or management of mineral soils on forest land, wetlands and settlements, and grassland remaining grassland (see L.24 above);
- Composting – CH_4 and N_2O (see W.18 above);
- Clinical waste incineration – CO_2 and N_2O (see W.9 and W.21 above).

B. Recommendation for an in-country review: list of issues

The ERT does not recommend that an exceptional in-country review be carried out.

Annex III

Documents and information used during the review

A. Reference documents

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

"Guidelines for the preparation of national communications by Parties included in Annex I to the Convention, Part I: UNFCCC reporting guidelines on annual greenhouse gas inventories". Annex to decision 24/CP.19. Available at <http://unfccc.int/resource/docs/2013/cop19/eng/10a03.pdf#page=4>.

"Guidelines for the technical review of information reported under the Convention related to greenhouse gas inventories, biennial reports and national communications by Parties included in Annex I to the Convention". Annex to decision 13/CP.20. Available at <http://unfccc.int/resource/docs/2014/cop20/eng/10a03.pdf#page=6>.

Annual status report for Canada for 2015. Available at <http://unfccc.int/resource/docs/2015/asr/can.pdf>.

FCCC/ARR/2014/CAN. Report on the individual review of the annual submission of Canada submitted in 2014. Available at <http://unfccc.int/resource/docs/2015/arr/can.pdf>.

FCCC/ARR/2013/CAN. Report of the individual review of the annual submission of Canada submitted in 2013. Available at <http://unfccc.int/resource/docs/2014/arr/can.pdf>.

FCCC/ARR/2012/CAN. Report of the individual review of the annual submission of Canada submitted in 2012. Available at <http://unfccc.int/resource/docs/2013/arr/can.pdf>.

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

FCCC/ARR/2010 CAN. Report of the individual review of the annual submission of Canada submitted in 2010. Available at <http://unfccc.int/resource/docs/2011/arr/can.pdf>.

FCCC/ARR/2009/CAN. Report of the individual review of the annual submission of Canada submitted in 2009. Available at <http://unfccc.int/resource/docs/2010/arr/can.pdf>.

FCCC/ARR/2008/CAN. Report of the individual review of the greenhouse gas inventories of Canada submitted in 2007 and 2008. Available at <http://unfccc.int/resource/docs/2009/arr/can.pdf>.

FCCC/ARR/2007/CAN. Report of the individual review of the greenhouse gas inventory of Canada submitted in 2006. Available at <http://unfccc.int/resource/docs/2008/arr/can.pdf>.

Statistics Canada. January 2014. Report on Energy Supply and Demand in Canada: 2012 Preliminary. Published by the Minister responsible for Statistics Canada. Available at

<http://www5.statcan.gc.ca/olc-cel/olc.action?objId=57-003-X&objType=2&lang=en&limit=0>.

B. Additional information provided by the Party

Responses to questions during the review were received from Ms. Jackie Mercer and Mr. Lindsay Pratt (Environment Canada), including additional material on the methodology and assumptions used. The following documents[1] were also provided by Canada:

Aluminium Association of Canada. January 2002. Framework Agreement on Voluntary Greenhouse Gas Reductions in Quebec. Entered into between the government of Quebec and the Aluminium Association of Canada.

Boudewyn, P., X. Song, S. Magnussen, M.D. Gillis. 2007. *Model-based, volume-to-biomass conversion for forested and vegetated land in Canada*. Natural Resources Canada, Canadian Forest Service, Pacific Forestry Centre, Victoria, BC. Information Report BC-X-411. Available at <http://sbisrvntweb.uqac.ca/archivage/030078750.pdf>.

Dyk, Andrew, D. Leckie, S. Tinis and S. Ortlepp. 2015. *Canada's National Deforestation Monitoring System: System Description.* Canadian Forest Service, Pacific Forestry Centre, Victoria, British Columbia. Information report BC-X-439. Available at <http://cfs.nrcan.gc.ca/publications?id=36042>.

DeGroot, W. *et al.* 2007. *Estimating direct carbon emissions from Canadian Wildland Fires.* International Journal of Wildland Fire, 16, 593–606.

Environment Canada. August 2015. Quality Assurance and Quality Control Plan for Canada's Greenhouse Gas Inventory. Version 3.6.

Graham, Lisa 2006. *Greenhouse Gas Emissions from 1997–2005 Model Year Light Duty* Vehicles. ERMD Report #04–44. Unpublished report of the Environmental Technology Advancement Directorate. Environment Canada.

Graham, Lisa, G. Rideout, D. Rosenblatt and J. Hendren January 2008. *Greenhouse Gas Emissions from Heavy–Duty Vehicles.* Atmospheric Environment 42, 4665–4681. Environment Canada.

Hassani, Nadia, Rock Radovan, Caitlin Tretter, Warren Baker, Kristine Tracey & Chia Ha. October 2012. A Statistical Approach to Carbon Dioxide Emission Factors for Coal Consumed in Canada.

King, Brian G. March 1994. *Management of Methane Emissions from Coal Mines: Environmental, Engineering, Economic and Institutional Implications of Options*. Prepared for Greenhouse Gas Program Air Issues Branch, Environmental Protection, Environment Canada.

Loiselle, A, M. Christienson and J. Hendren. 2009. *N_2O Emissions from In-Use Canadian Tier 1 Vehicles Report A: Greenhouse Gas Emission Rates*. ERMS Report No 07–14A. Unpublished report of the Air Quality Research, Science and Technology Branch, Environment Canada.

McGovern, Mark. 2014. *GHG Spatial Reporting Structure for Canada's Land Use, Land-Use Change and Forestry Sector: Reporting Zones and Reconciliation Units.* Environment Canada.

[1] Reproduced as received from the Party.

Nowak, D. E. Greenfield, R. Hoehn and El Lapoint. 2013. *Carbon Storage and Sequestration by Trees in Urban and Community Areas of the United States.* Environmental Pollution, 178, 229-236.

Stinson, G., T. White, W. Kurz and C. Dymond. 2006. *Delineating Canada's Managed Forest for NIR 2007.* Natural Resources Canada, Canadian Forest Service.

Stinson, G., W.A. Kurz, C.E. Smyth, E.T. Neilson, C.C. Dymond, J.M. Metsarantaz, C. Boisvenue, G.J. Rampley, Q. Li, T.M. White and D. Blain. 2011. *An inventory-based analysis of Canada's managed forest carbon dynamics, 1990 to 2008.* Global Change Biology. 17, 2227–2244, doi: 10.1111/j.1365-2486.2010.02369.x.

T.J. McCann and Associates Ltd and Clearstone Engineering, Ltd. March 2000. *1998 Fossil Fuel and Derivative (CO_2 per Unit of Fuel and Heating Values) Factors*. Prepared for Pollution Data Branch, Environment Canada. Final Draft.

SGA Energy Limited. August 2000. Emission Factors and Uncertainties for CH_4 and N_2O from Fuel Combustion. Prepared for Greenhouse Gas Division, Pollution Data Branch, Environment Canada.

Kurz, W.A., et al. 2009. *CBM-CFS3: A model of carbon-dynamics in forestry and land-use change implementing IPCC standards*. Ecological Modelling. 220, pages. 480–504.

Annex IV

Acronyms and abbreviations

AD	activity data
BOD	biochemical oxygen demand
C	confidential
CH_4	methane
CKD	cement kiln dust
CO_2	carbon dioxide
CO_2 eq	carbon dioxide equivalent
COP	Conference of the Parties
CRF	common reporting format
DOC	degradable organic carbon
ECF	energy conversion factor
EF	emission factor
ERT	expert review team
GCV	gross calorific value
GHG	greenhouse gas; unless indicated otherwise, total GHG emissions are the sum of CO_2 (including indirect CO_2 emissions if reported by the Party), CH_4, N_2O, HFCs, PFCs and SF_6 without GHG emissions and removals from LULUCF
GHGRP	GHG Reporting Program
HFCs	hydrofluorocarbons
HWP	harvested wood products
IE	included elsewhere
IEA	International Energy Agency
IEF	implied emission factor
IPCC	Intergovernmental Panel on Climate Change
IPPU	Industrial processes and product use
k	decay rate
kg	kilogram (1 kg = 1,000 grams)
kt	kilotonne (1 kt = 1 gigagram (Gg))
LPG	liquefied petroleum gas
LULUCF	land use, land-use change and forestry
MCF	methane conversion factor
MMS	manure management system
MSW	municipal solid waste
N	nitrogen
N_2O	nitrous oxide
NA	not applicable
NCV	net calorific value
NE	not estimated
NF_3	nitrogen trifluoride
NGL	natural gas liquid
NIR	national inventory report
NO	not occurring
PFCs	perfluorocarbons
QA/QC	quality assurance/quality control
SF_6	sulphur hexafluoride
t	tonne
TJ	terajoule (1 TJ = 10^{12} joule)
UNFCCC	United Nations Framework Convention on Climate Change