



## Data Sources and Methods for the National Greenhouse Gas Emissions Indicators

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## 1 Introduction

The national greenhouse gas (GHG) emissions indicator is part of the Canadian Environmental Sustainability Indicators (CESI) program, which provides data and information to track Canada's performance on key environmental sustainability issues.

The GHG emissions indicator is used to track the progress of Canada's efforts to lower emissions and reach environmental performance objectives. Use of the GHG indicators in conjunction with economic performance indicators such as the gross domestic product (GDP) will help to support national-level decision making on sustainable development.

# 2 Description and rationale of the national greenhouse gas emissions indicator

#### 2.1 Description

The GHG emissions indicators report trends in anthropogenic (human-made) GHG emissions at a national level (total emissions, per capita and per GDP) for the six main GHGs in Canada: carbon dioxide, methane, nitrous oxide, sulphur hexafluoride, perfluorocarbons and hydrofluorocarbons.

Emissions from natural sources (material decay, plant and animal respiration, volcanic and thermal venting, etc.), and absorption of emissions by natural sinks (forests, oceans), are not measured by these indicators.

#### 2.2 Rationale

As an Annex I Party (Annex 1 Parties include industrialized countries and economies in transition) to the United Nations Framework Convention on Climate Change (UNFCCC), Canada is required to prepare and submit a national inventory of anthropogenic sources and sinks of GHGs on an annual basis.

Since direct measurement of emissions from all sources is not practical, the UNFCCC requires that countries develop, update, publish and maintain national inventories using comparable emissions estimation methods.

Canada's inventory follows the internationally approved methods developed by the Intergovernmental Panel on Climate Change (IPCC) to estimate emissions for the six GHGs, available from: http://www.ipcc-nggip.iges.or.jp/public/gl/invs1.html.

The IPCC guidelines are approved and developed through an international process that includes comments from national experts, testing of methods through preliminary inventory development, country studies, technical and regional workshops, and informal expert groups.

#### 2.3 Changes since last report

The national GHG emissions indicators have not undergone any further changes from the last reporting year.

Other changes to the data and methodologies used to develop the indicator are recorded in the Caveats and Limitations section of this report and in Chapter 9 of Environment Canada's National Inventory Report 1990-2009: Greenhouse Gas Sources and Sinks in Canada Available from

http://www.ec.gc.ca/Publications/default.asp?lang=En&xml=A07097EF-8EE1-4FF0-9AFB-6C392078D1A9.

## 3 Data

#### 3.1 Data source

The GHG emissions indicators are based on GHG emissions data taken from Environment Canada's National Inventory Report 1990-2099: Greenhouse Gas Sources and Sinks in Canada Available from http://www.ec.gc.ca/Publications/default.asp?lang=En&xml=A07097EF-8EE1-4FF0-9AFB-6C392078D1A9. Data used to develop the National Inventory Report (NIR) are drawn from published and non-published sources from various government departments, scientific papers and internationally accepted Intergovernmental Panel on Climate Change (IPCC) reference documents. Figures 1-4 of the NIR illustrate the data collection system and the partners involved in preparing the annual inventory. A comprehensive list detailing all data sources (disaggregated by sector and sub-sector) can be found in chapters 3 through 8 of the NIR.

#### 3.2 Spatial coverage

GHG emission estimates for the indicators are provided at the national level.

#### 3.3 Temporal coverage

GHG emissions are compiled annually and reported for the period 1990 to 2009. NIR data used to develop the indicators are almost completely compiled by the end of October of each reporting year by Environment Canada's Pollutant Inventories and Reporting Division. In the period from November through March, draft estimates of the NIR, along with accompanying data tables, are prepared, reviewed by experts and internally by Environment Canada, and finally submitted electronically to the UNFCCC prior to April 15. At that time, the NIR and accompanying data tables are also submitted to Environment Canada's CESI program.

A comprehensive detailing of the temporal coverage for each data source used for the indicators can be found in chapter 1(section 1.3) and chapters 3 through 8 of the NIR.

#### 3.4 Data completeness

Although the GHG emissions indicators are comprehensive, some emission sources have not been included due to exclusions within the NIR. Owing to their relatively small contributions to the total emissions, these exclusions do not significantly affect the overall completeness of the inventory. A detailed discussion of the emission sources not included can be found in Annex 5 of the NIR.

#### 3.5 Data timeliness

The data are current up to 2009. The GHG emissions indicators have less than a two year time lag due to the time needed to collect, validate, calculate and interpret the data for reporting.

### 4 Methods

In general, GHG emissions are estimated by multiplying activity data by specific emission factors.

Emissions = activity data × emission factor

Activity data refer to the quantitative amount of human activity resulting in emissions during a given period of time. The annual activity data for fuel combustion sources, for example, are the total amounts of fuel burned.

Emission factors are based on samples of measurement data and are representative rates of emissions for a given activity level under a given set of operating conditions. They are the estimated average emission rate of a given pollutant for a given source, relative to units of activity.

Guidelines produced by the IPCC for countries reporting to the UNFCCC provide various methods for calculating a given GHG emission from a human activity. The methods for estimating the gases are divided into "tiers", encompassing different levels of activity and technological detail. The same general structure is used, but the level of detail at which the calculations are carried out can vary. Annexes 2 and 3 of the NIR describe the methods used to estimate Canada's GHG emissions, and illustrate that the selection of IPCC method type is highly dependent on the availability of data.

The GHG emissions are reported in carbon dioxide equivalents, determined by multiplying the amount of emissions of a particular gas by the global warming potential (GWP) of that gas. GHGs differ in their ability to absorb heat in the atmosphere due to their differing chemical properties and atmospheric lifetimes. For example, over a period of 100 years, methane's potential to trap heat in the atmosphere is 21 times greater than carbon dioxide's potential, and thus it is considered to have a GWP of 21. The IPCC publishes the GWPs and atmospheric lifetimes for each GHG which can be found in Table 1-1 of the NIR.

## 5 Caveats and limitations

Annex 7 of the NIR presents the uncertainty assessment for Canada's GHG emissions. Further details on uncertainty related to specific sectors can be found in the uncertainty sections in chapters 3 to 8 of the NIR.

The application of quality assurance and quality control (QA/QC) procedures is an essential requirement of the GHG inventory development and submission process. QA/QC procedures ensure and improve transparency, consistency, comparability, completeness and confidence in the national emissions for the purpose of meeting Canada's reporting commitments under the UNFCCC. Annex 6 of the NIR provides a complete discussion of the QA/QC procedures.

Chapter 9 of the NIR provides a summary of the recalculations implemented in Canada's GHG inventory since the 2010 submission to the UNFCCC, and a description of planned improvements for future inventories.

## 6 References and further reading

#### 6.1 References

Environment Canada. (2011) National Inventory Report, 1990-2009: Greenhouse Gas Sources and Sinks in Canada. Available from: http://www.ec.gc.ca/ges-ghg/default.asp?lang=En&n=83A34A7A-1.

#### 6.2 Further reading

[IPCC] Intergovernmental Panel on Climate Change (2006) Guidelines for National Greenhouse Gas Inventories. Available from: http://www.ipcc-nggip.iges.or.jp/public/2006gl/index.html (not yet adopted for use by the UNFCCC)

[IPCC] Intergovernmental Panel on Climate Change (2003) Good Practice Guidance for Land Use, Land-Use Change and Forestry. Available from: http://www.ipcc-nggip.iges.or.jp/public/gpglulucf/gpglulucf\_contents.html

[IPCC] Intergovernmental Panel on Climate Change (2000) Good Practice Guidance and Uncertainty Management in National Greenhouse Gas Inventories. Available from: http://www.ipcc-nggip.iges.or.jp/public/gp/english/

[IPCC] Intergovernmental Panel on Climate Change (1996) Revised 1996 Guidelines for National Greenhouse Gas Inventories. Available from: http://www.ipcc-nggip.iges.or.jp/public/gl/invs1.html