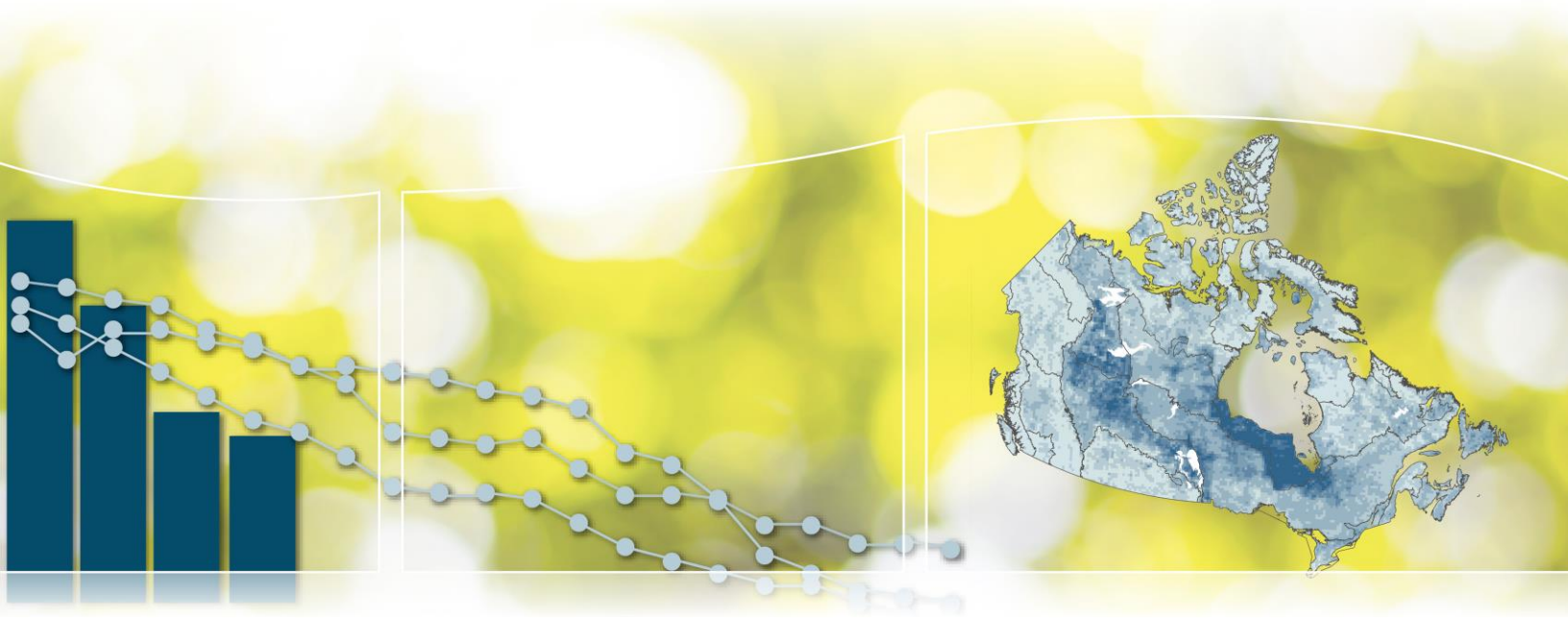
Environment and Climate Change Canada
Environnement et Changement climatique Canada

Canadian Environmental Sustainability Indicators

Greenhouse Gas Emissions



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Canadian Environmental Sustainability Indicators

Greenhouse Gas Emissions

April 2016

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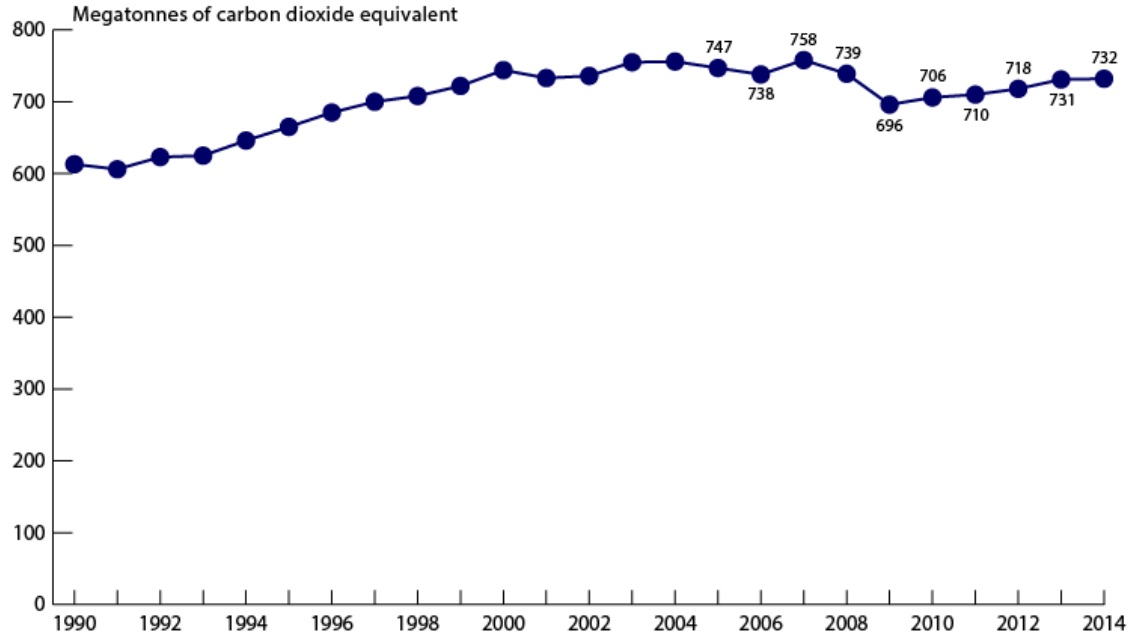
Part 1. Greenhouse Gas Emissions Indicators

Canada's total greenhouse gas (GHG) emissions[1] in 2014 were 732 megatonnes (Mt) of carbon dioxide equivalent (CO_2 eq), or 20% (120 Mt CO_2 eq) above the 1990 emissions of 613 Mt CO_2 eq. Steady increases in annual emissions characterized the first 10 years of this period, followed by fluctuating emission levels between 2000 and 2008, a steep decline in 2009, and a gradual increase thereafter.

Canada's emissions growth between 1990 and 2014 was driven primarily by increased emissions from mining and upstream oil and gas production as well as transport. Emission reductions from 2005 to 2014 were driven primarily by reduced emissions from the public electricity and heat production category.

Figure 1. Greenhouse gas emissions, Canada, 1990 to 2014



Data for Figure 1

Note: The national indicator tracks seven GHGs, carbon dioxide (CO_2), methane (CH_4), nitrous oxide (N_2O), sulphur hexafluoride (SF_6), perfluorocarbons (PFCs), hydrofluorocarbons (HFCs) and nitrogen trifluoride (NF_3), released by human activity (reported in Mt CO_2 eq). Emission levels for some previous years have been revised in light of improvements to estimation methods and availability of new data.
Source: Environment and Climate Change Canada (2016) National Inventory Report 1990–2014: Greenhouse Gas Sources and Sinks in Canada.

Greenhouse gases trap heat in the Earth's atmosphere, just as the glass of a greenhouse keeps warm air inside. Human activity increases the amount of GHGs in the atmosphere, contributing to a warming of the Earth's surface. This is called the enhanced greenhouse effect.

[1] Greenhouse gas emissions from the National Inventory Report were estimated with the help of the new United Nations Framework Convention on Climate Change (UNFCCC) reporting guidelines. These new guidelines include the adoption of revised methodologies in accordance with Intergovernmental Panel on Climate Change (IPCC) guidelines and the use of revised global warming potentials.

Over the past 200 years in particular, humans have released GHGs into the atmosphere primarily from burning fossil fuels. As a result, more heat is being trapped and the temperature of the planet is increasing. Sea levels are rising as Arctic ice melts, and there are changes to the climate, such as more severe storms and heat waves. All of this impacts the environment, the economy and human health.

These indicators are used to measure progress toward Goal 1: Climate Change – In order to mitigate the effects of climate change, reduce greenhouse gas emission levels and adapt to unavoidable impacts of the Federal Sustainable Development Strategy 2013–2016.

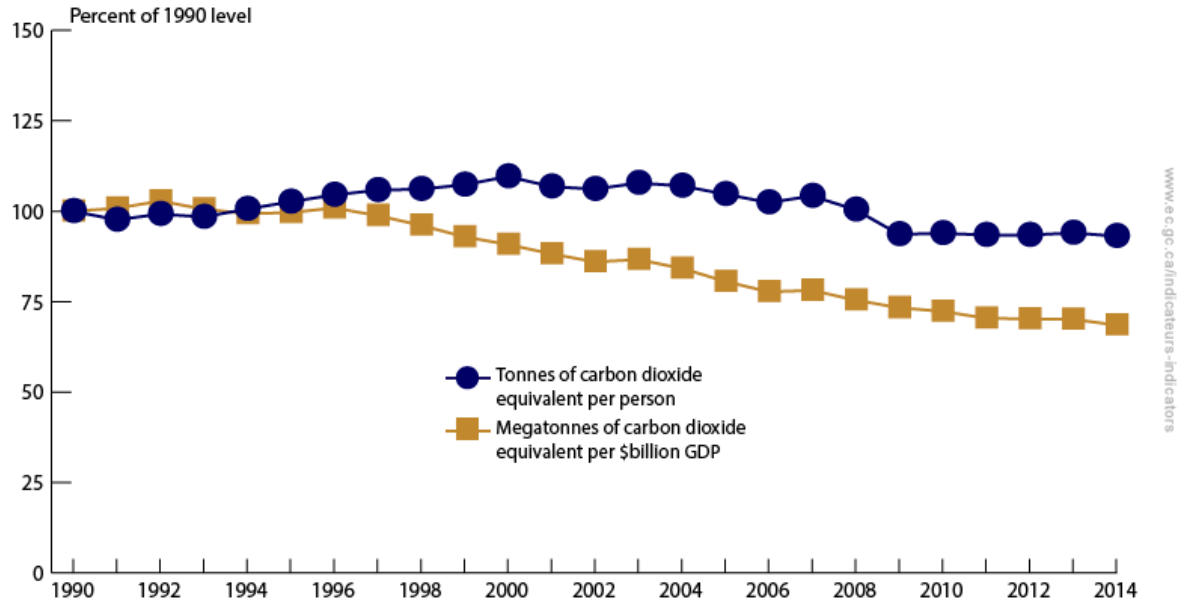
Greenhouse Gas Emissions per Person and per Unit Gross Domestic Product

Two ways to analyze how greenhouse gas (GHG) emissions relate to socio-economic developments in Canada are: the amount of GHGs emitted per person (GHGs per capita), and the amount of GHGs per unit of gross domestic product (GDP) (GHG intensity of the economy). These indicators show the relationship between the size of Canada's population and the amount of GHGs emitted, and how efficiently sectors in the economy are minimizing GHG emissions while producing goods and services for our consumption and export.

The level of emissions per unit of GDP was 32% lower in 2014 than 1990. Over that period, GHG per unit of GDP decreased from 0.62 megatonnes (Mt) of carbon dioxide equivalent (CO_2 eq) per $billion GDP[2] in 1990 to 0.42 Mt CO_2 eq per $billion GDP in 2014. The amount of GHGs emitted per person in Canada decreased to 20.6 tonnes CO_2 eq in 2014, compared with 22.1 tonnes CO_2 eq in 1990.

These improvements are attributable to a number of factors such as more efficient industrial processes, a shift to a more service-based economy and improvements in the emissions associated with energy generation (such as those realized through fuel switching).

Figure 2. Indexed trend in greenhouse gas emissions per person and per unit of gross domestic product, Canada, 1990 to 2014



Data for Figure 2

Note: The graph presents the ratio of annual GHG emissions per person and per unit of GDP relative to those values in 1990, i.e., the values are indexed to 1990. Greenhouse gas per unit of GDP is calculated using the real inflation-adjusted GDP in 2007 dollars. Emission levels for some previous years have been revised in light of improvements to estimation methods and availability of new data.
Source: Environment and Climate Change Canada (2016) National Inventory Report 1990–2014: Greenhouse Gas Sources and Sinks in Canada.

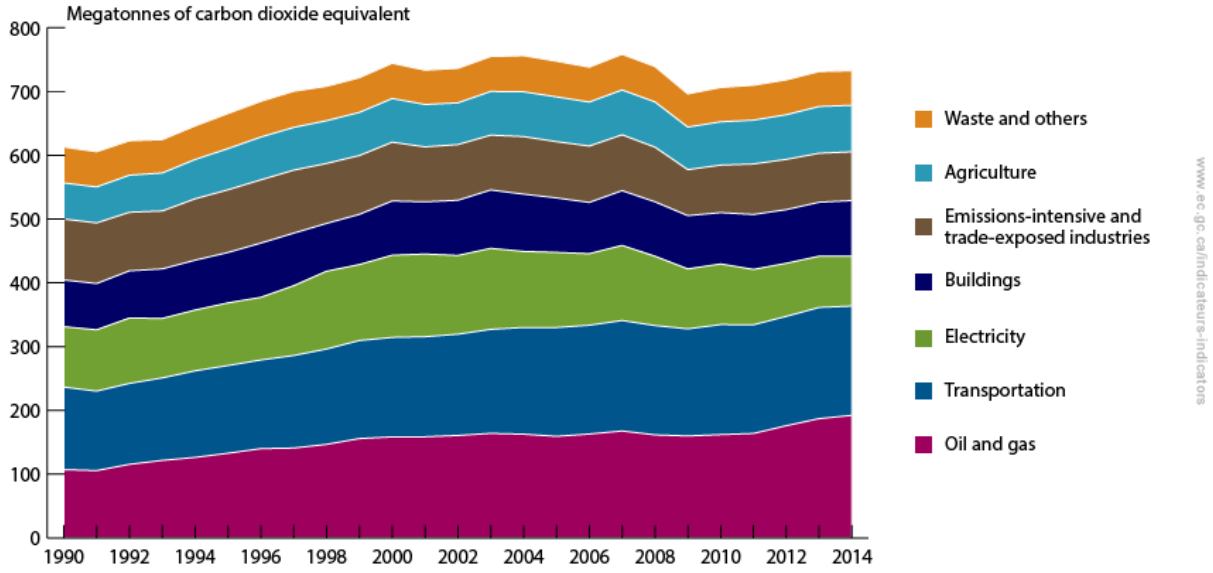
[2] Greenhouse gas intensity per unit of GDP is calculated using the real inflation-adjusted GDP in 2007 dollars.

Greenhouse Gas Emissions by Economic Sector

In 2014, Canada's total greenhouse gas (GHG) emissions[3] were 732 megatonnes (Mt) of carbon dioxide equivalent (CO_2 eq). The oil and gas sector was the largest GHG emitter in Canada, accounting for 192 Mt CO_2 eq (26% of total emissions), followed closely by the transportation sector, which emitted 171 Mt CO_2 eq (23%). The other economic sectors (i.e., electricity, buildings, emissions-intensive and trade-exposed industries,[4] agriculture, and waste and others), each accounted for between 7% and 12% of total GHG emissions in Canada.

The increase in GHG emissions between 1990 and 2014 was mostly due to a79% (85 Mt CO_2 eq) increase in emissions in the oil and gas sector and a 32% (42 Mt CO_2 eq) increase in the transportation sector. These increases were offset by a 17 Mt CO_2 eq decrease in emissions in the electricity sector and a 19 Mt CO_2 eq decrease in emissions from emissions-intensive and trade-exposed industries.

Figure 3. Greenhouse gas emissions by economic sector, Canada, 1990 to 2014



Data for Figure 3

Note: The "Waste and others" sector consists of emissions from light manufacturing, construction, forest resources, waste, and coal production. The "Emissions-intensive and trade-exposed industries" sector consists of emissions from mining, smelting and refining, pulp and paper, iron and steel, cement, lime and gypsum, and chemicals and fertilizers.
Source: Environment and Climate Change Canada (2016) National Inventory Report 1990–2014: Greenhouse Gas Sources and Sinks in Canada.

[3] Greenhouse gas emissions from the National Inventory Report were estimated with the help of the new United Nations Framework Convention on Climate Change (UNFCCC) reporting guidelines. These new guidelines include the adoption of revised methodologies in accordance with Intergovernmental Panel on Climate Change (IPCC) guidelines and the use of revised global warming potentials.

[4] This sector consists of mining, smelting and refining, pulp and paper, iron and steel, cement, lime and gypsum, and chemicals and fertilizers.

Greenhouse gas emissions from the oil and gas sector

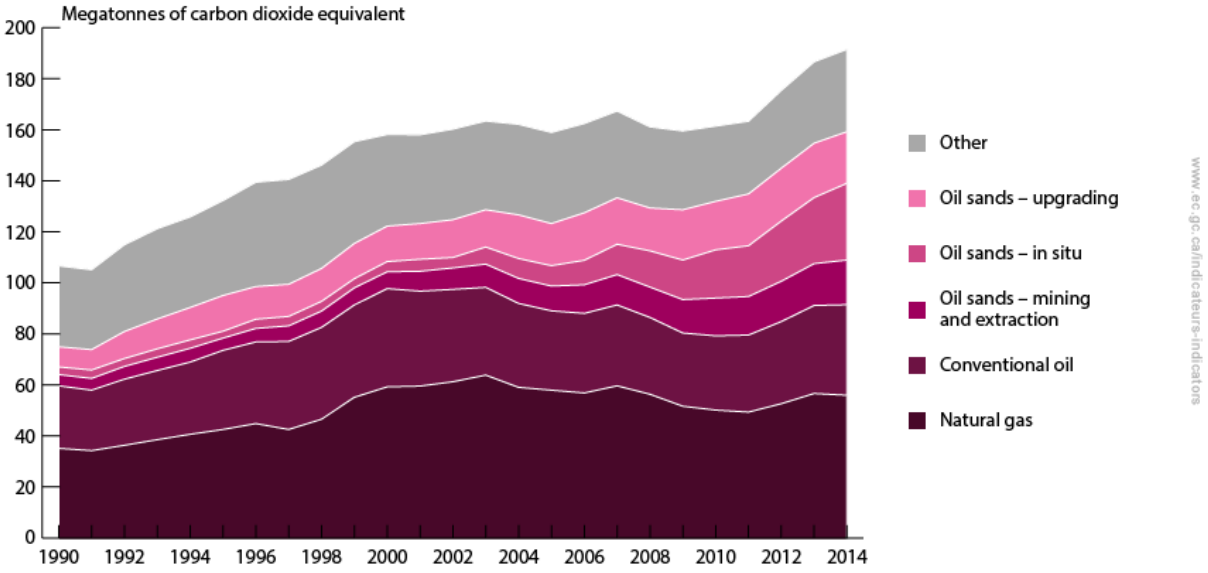
In 2014, the oil and gas sector was the largest source of greenhouse gas (GHG) emissions, accounting for 26% of total national emissions.

Emissions of GHGs from the oil and gas sector have increased 79% from 107 megatonnes (Mt) of carbon dioxide equivalent (CO_2 eq) in 1990 to 192 Mt CO_2 eq in 2014. This increase is mostly attributable to the increased production of crude oil and the expansion of the oil sands industry.

Greenhouse gas emissions from conventional oil production have increased by 45%, while emissions from oil sands production have increased more than fourfold. About half of the increase in emissions from oil sands production between 1990 and 2014 came from the growth of in-situ production.

A temporary decrease in GHG emissions in the sector between 2008 and 2011 is mostly attributable to the world economic downturn that resulted in a lower global demand for petroleum products.

Figure 4. Oil and gas sector greenhouse gas emissions, Canada, 1990 to 2014



Data for Figure 4

Note: Conventional oil includes production from frontier, light and heavy oil fields. The "Other" category includes downstream oil and gas emissions (combustion and fugitive emissions from the production of refined petroleum products and the distribution of natural gas to end consumers) and oil and gas transmission emissions (combustion and fugitive emissions from transmission, storage and delivery activities).
Source: Environment and Climate Change Canada (2016) National Inventory Report 1990–2014: Greenhouse Gas Sources and Sinks in Canada.

Between 1990 and 2014, crude oil production more than doubled in Canada. This was mostly driven by a rapid increase in production from the oil sands, which are more GHG-intensive than conventional sources. This change thus had a major impact on total GHG emissions from the sector.

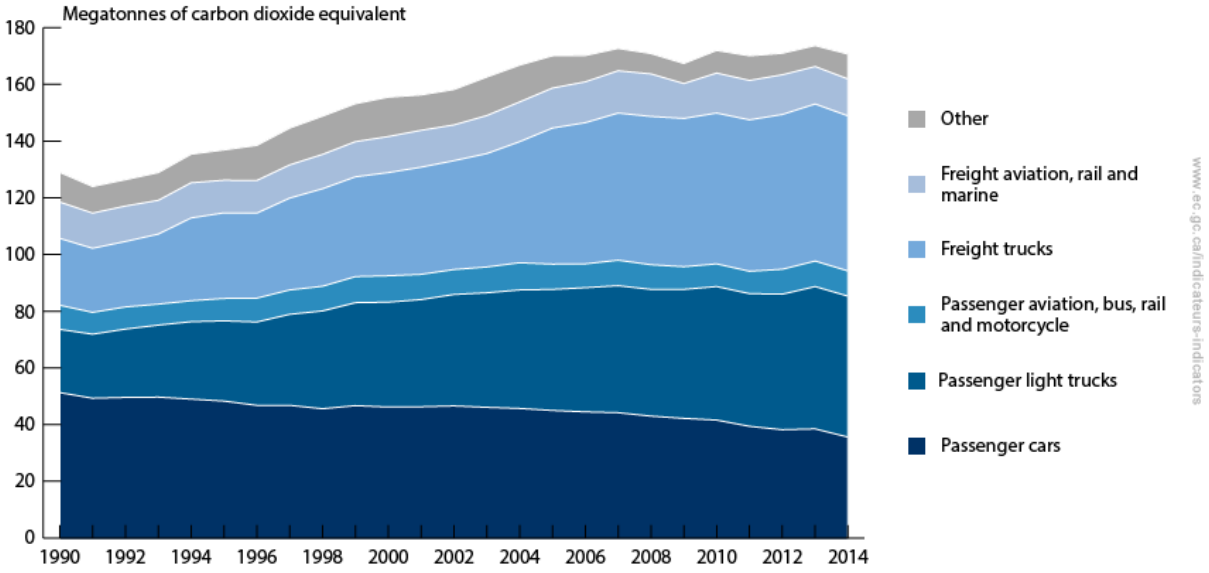
During the same period, production of natural gas from unconventional sources, such as those requiring the use of multi-stage fracturing techniques, also increased significantly.

Greenhouse gas emissions from the transportation sector

In 2014, the transportation sector was the second largest source of greenhouse gas (GHG) emissions, accounting for 23% (171 megatonnes [Mt] of carbon dioxide equivalent [CO_2 eq]) of total national emissions. Emissions from passenger and freight travel amounted to 95% of these emissions, or 95 Mt CO_2 eq and 68 Mt CO_2 eq of transportation emissions, respectively.

Between 1990 and 2014, GHG emissions from the transportation sector grew by 32%. Part of this increase was due to changes in vehicle type used. While total passenger emissions grew by 15%, emissions from cars declined by 30%, while emissions from light trucks (including trucks, vans and sport utility vehicles) increased by 123%. Freight travel emissions grew by 86% between 1990 and 2014, with emissions from freight trucks increasing by 132% and emissions from other modes of freight transportation increasing by 2%.

Figure 5. Transportation sector greenhouse gas emissions, Canada, 1990 to 2014



Data for Figure 5

Note: The "Other" category includes other recreational, commercial and residential uses.
Source: Environment and Climate Change Canada (2016) National Inventory Report 1990–2014: Greenhouse Gas Sources and Sinks in Canada.

Passenger and freight travel emissions are influenced by a variety of factors, including population and economic growth, vehicle type, fuel efficiency, and fuel type. Changes in the mix of vehicle type used, such as the increasing preference of passenger vehicle owners to choose light trucks rather than more fuel-efficient passenger cars, played an important role in shaping the evolution of GHG emissions. Since 1990, the increase in the number of light trucks has been more than three times greater than the increase in the numbers of the overall fleet of passenger on-road vehicles.

At the same time, there have been continual improvements in the fuel efficiency of both passenger cars and light trucks over the last few decades.[5] However, these improvements were not sufficient to offset the increases in emissions due to the change in composition of the vehicle fleet.

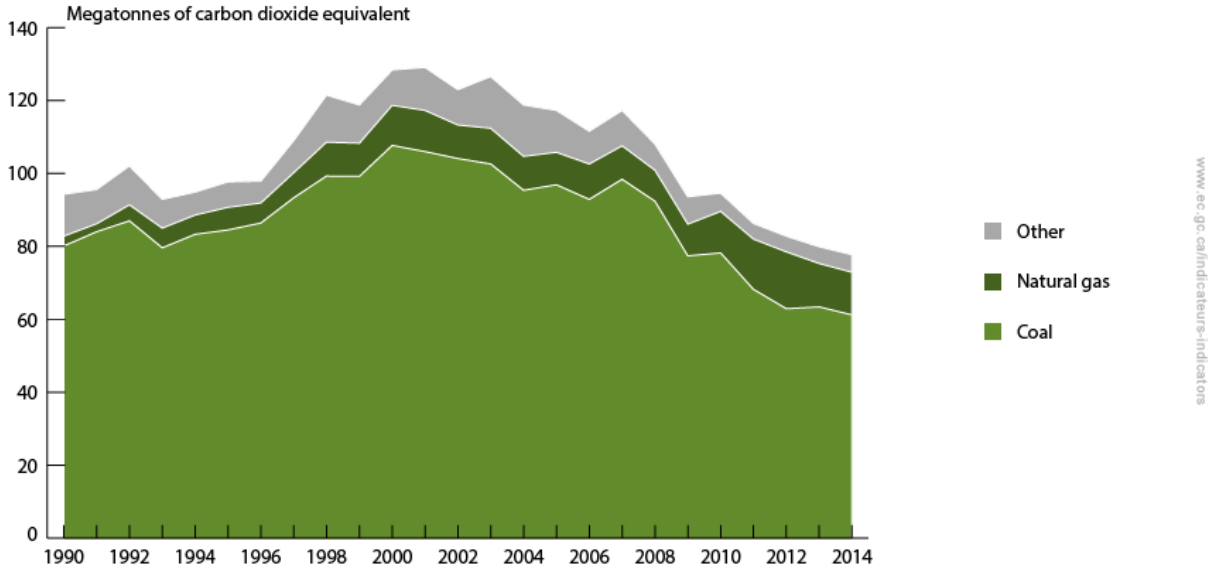
[5] Natural Resources Canada (2015) Energy Efficiency Trends Analysis Tables – Transportation Sector – Energy Use Analysis.

Greenhouse gas emissions from the electricity sector

In 2014, the electricity sector was the fourth largest source of greenhouse gas (GHG) emissions, accounting for 11% of total national emissions.

Greenhouse gas emissions from combustion-based electricity generation have decreased from 95 megatonnes (Mt) of carbon dioxide equivalent (CO_2 eq) in 1990 to 78 Mt CO_2 eq in 2014, a decrease of 17% over the period. The growing share of electricity generated from non-GHG-emitting sources (such as hydro, nuclear and other renewables) and from fuels less GHG-intensive than coal contributed to this decline in GHG emissions.

Figure 6. Electricity sector greenhouse gas emissions, Canada, 1990 to 2014



Data for Figure 6

Note: The "Other" category includes diesel fuel oil, heavy fuel oil, light fuel oil, motor gasoline, petroleum coke, own use of primary electricity, solid wood waste and still gas.
Source: Environment and Climate Change Canada (2016) National Inventory Report 1990–2014: Greenhouse Gas Sources and Sinks in Canada.

Electricity generation technologies have various levels of GHG emission intensity (which is defined as the quantity of GHGs emitted per unit of electricity produced). Hydroelectricity and nuclear power emit no GHGs when generating electricity, while coal-burning power plants have a higher GHG intensity than natural gas-burning power plants. A change in the mix of plant types used to produce electricity contributed to a decline in the GHG intensity of electricity generation from 220 to 150 grams of CO_2 eq per kilowatt-hour from 1990 to 2013.

Greenhouse Gas Emissions by Province and Territory

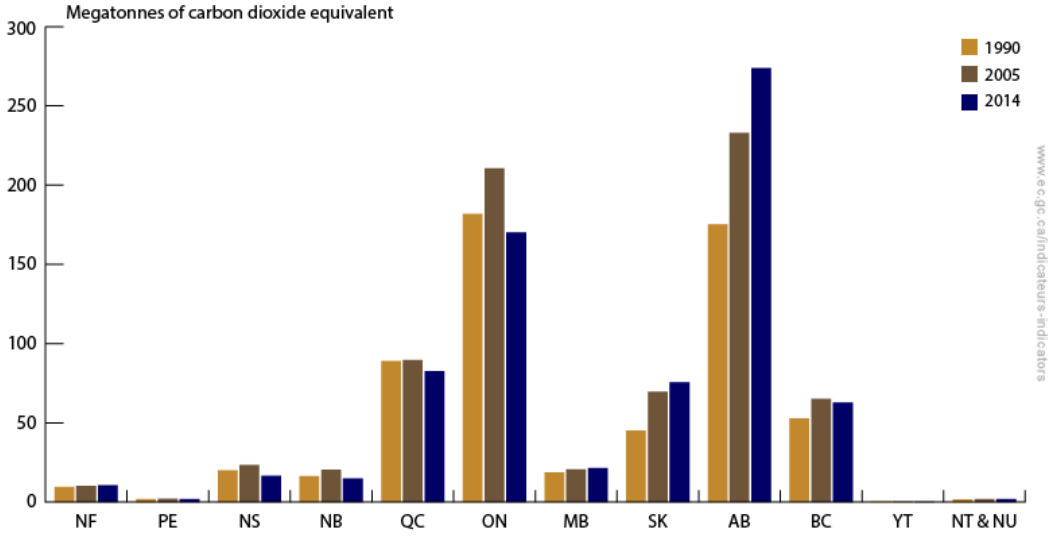
Emissions vary significantly by province, owing to factors such as population, energy sources and economic base. Everything else being equal, economies based on resource extraction will tend to have higher emission levels than service-based economies. Similarly, provinces that rely on fossil fuels for their electricity generation will have higher emissions than provinces relying more on renewable sources.

Greenhouse gas (GHG) emissions for Ontario and Quebec were lower in 2014 than in 1990 by a total of about 18 megatonnes (Mt) of carbon dioxide equivalent (CO_2 eq) (6 Mt CO_2 eq for Quebec and 12 Mt CO_2 eq for Ontario). Emissions in Saskatchewan, Alberta and British Colombia were higher in 2014 than in 1990 by 30 Mt CO_2 eq, 99 Mt CO_2 eq and 10 Mt CO_2 eq respectively. The top five emitters (Alberta, Ontario, Quebec, Saskatchewan and British Columbia) together released 665 Mt CO_2 eq or 91% of Canada's national total GHG emissions of 732 Mt CO_2 eq in 2014.

Ontario's GHG emissions were higher than those from the other provinces in 1990 because of its large manufacturing industry. Alberta's emissions subsequently surpassed Ontario's, increasing 56% since 1990, primarily because of the increase in the oil and gas industry for export markets. Ontario's emissions decreased between 1990 and 2014 primarily because of the closure of coal-fired electricity generation plants. In 2014, the combined emissions from Alberta and Ontario represented 61% (37% and 23%, respectively) of the national total.

The provinces of Quebec and British Columbia, which rely on abundant hydroelectric resources for their electricity production, show more stable emission patterns across the time series and a decreasing pattern since 2005. Quebec exhibits an 8% (7.0 Mt CO_2 eq) decrease from its 2005 emissions level; while British Columbia shows a decline of 3% (2.2 Mt CO_2 eq). In contrast to these decreases, emissions in Saskatchewan increased by 9% (6.0 Mt CO_2 eq) between 2005 and 2014, primarily due to increases from the transportation sector and activities in the oil and gas industry as well as mining.

Figure 7. Greenhouse gas emissions by province and territory, Canada, 1990, 2005 and 2014



Data for Figure 7

Note: 1990 emissions data for the Northwest Territories include emissions for Nunavut, which was part of the Northwest Territories until 1999. Emission levels for some years have been revised in light of improvements to estimation methods and availability of new data.
Source: Environment and Climate Change Canada (2016) National Inventory Report 1990–2014: Greenhouse Gas Sources and Sinks in Canada.

Part 2. Data Sources and Methods for the Greenhouse Gas Emissions Indicators

Introduction

The Greenhouse Gas Emissions indicators are part of the Canadian Environmental Sustainability Indicators (CESI) program, which provides data and information to track Canada's performance on key environmental sustainability issues. This indicator is also used to measure progress towards the goals and targets of the Federal Sustainable Development Strategy 2013–2016.

Description and rationale of the Greenhouse Gas Emissions indicators

Description

The Greenhouse Gas Emissions indicators report trends in anthropogenic (human-made) greenhouse gas (GHG) emissions at the national level (total emissions, emissions per person and emissions per unit of gross domestic product [GDP]),[6] at the provincial/territorial and at the economic sector level for seven GHGs: carbon dioxide (CO_2), methane (CH_4), nitrous oxide (N_2O), sulphur hexafluoride (SF_6), perfluorocarbons (PFCs), hydrofluorocarbons (HFCs) and nitrogen trifluoride (NF_3).

Emissions from natural processes (e.g., material decay, plant and animal respiration, volcanic and thermal venting) and removal of emissions from the atmosphere by natural sinks (forests, oceans), are not captured by these indicators.

Rationale

The Greenhouse Gas Emissions indicators are 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 GDP supports national-level decision making on sustainable development.

As an Annex I Party 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 possible, the UNFCCC requires that countries develop, update, publish and maintain national inventories using internationally approved and comparable emissions and removals estimation methods for the seven GHGs. Canada's inventory is developed in accordance with the recently revised UNFCCC Annex I Inventory Reporting Guidelines (PDF; 1.6 MB) which require the use of the 2006 methodological guidance developed by the Intergovernmental Panel on Climate Change (IPCC). The IPCC guidelines are based on the best available science and developed through an international process that involves testing of methods through ongoing inventory development, country studies, technical and regional workshops, and national and international experts consultations.

[6] Greenhouse gas intensity per unit of GDP is calculated using the real inflation-adjusted GDP in 2007 dollars.

Recent changes to the indicator

The development of Canada's GHG inventory is based on a continuous process of data collection, methodological refinement and review. Changes in the 2016 National Inventory Report include those implemented for the continuous improvement of Canada's inventory and changes that address recommendations made by the expert review team during the annual review of previous inventories.

Data

Data source

The Greenhouse Gas Emissions indicators are based on greenhouse gas (GHG) emissions data taken from Environment and Climate Change Canada's National Inventory Report 1990–2014: Greenhouse Gas Sources and Sinks in Canada. Data used to develop the emission and removal estimates presented in the National Inventory Report (NIR) are drawn from published and unpublished sources from various government departments, industry sources and scientific papers. The methods used to prepare the emission and removal estimates are consistent with internationally accepted Intergovernmental Panel on Climate Change (IPCC) methodologies and reference documents. Figures 1-2 and 1-3 of the NIR illustrate the inventory preparation process and show the main partners involved in preparing the annual inventory. A comprehensive discussion of emissions from all data sources (disaggregated by sector and sub-sector) can be found in chapters 3 through 7 of the NIR.

Spatial coverage

Greenhouse gas emission estimates are provided at the national and provincial/territorial levels and by economic sector.

Temporal coverage

Greenhouse gas emission and removal estimates are compiled annually and reported for the period 1990 to 2014. Complete details of the temporal coverage for each data source used for the indicators can be found in chapters 3 through 7 of the NIR.

Data completeness

Although the Greenhouse Gas Emissions indicators are comprehensive, some emission sources have not been included in the indicators because they are not reported in the NIR. Owing to their relatively small contributions to the total emissions, these excluded sources do not significantly affect the overall completeness of the inventory. A detailed explanation of the excluded emission sources can be found in Annex 5 of the NIR.

Data timeliness

The data included in the indicators cover the period from 1990 through the end of 2014. Preparation of the GHG emissions inventory takes almost 16 months from the end of the last reporting year because of the time needed to collect, validate, calculate and interpret the data.

Between November and January, emission estimates are prepared by Environment and Climate Change Canada's Pollutant Inventories and Reporting Division with input from numerous experts and scientists across Canada. From January through March, the NIR text and accompanying emission data tables are developed. This material is reviewed by external experts and Environment and Climate Change Canada officials, and finally submitted electronically to the United Nations Framework Convention on Climate Change (UNFCCC), typically by mid-April.

Methods

In general, greenhouse gas (GHG) emissions are estimated by multiplying activity data by emission factors.

Emissions = activity data × emission factor

Activity data refer to the quantitative amount of human activity resulting in emissions during a given time period. 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 Intergovernmental Panel on Climate Change (IPCC) for countries reporting to the United Nations Framework Convention on Climate Change (UNFCCC) provide various methods for calculating GHG emission from a given human activity. The methods for estimating emissions are divided into "tiers," each encompassing different levels of activity and technological detail. The same general structure is used for all tiers, while the level of detail at which the calculations are carried out can vary. Annex 3 of the National Inventory Report (NIR) describes the methods used to estimate Canada's GHG emissions and illustrates that the selection of IPCC method type is highly dependent on the importance of each category and the availability of data.

Greenhouse gas 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. Greenhouse gases 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 (CH_4) potential to trap heat in the atmosphere is 25 times greater than carbon dioxide's potential, and thus it is considered to have a GWP of 25. The IPCC publishes the GWPs and atmospheric lifetimes for each GHG; these can be found in Table 1-1 of the NIR.

The Greenhouse Gas Emissions by Economic Sector indicators represent a different classification than the activity sector emissions prescribed by the IPCC methodological guidance and UNFCCC Reporting Guidelines. Instead of reporting on Canada's emissions by activity, GHG emissions have been allocated to the economic sector in which they are generated (e.g., transportation emissions directly supporting an industrial activity, like off-road trucks in mining activities, have been allocated to the economic sector in which they are generated rather than to the transportation "activity" sector). A comprehensive detailing of the emissions reported by economic sector can be found in chapter 2 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. Quality assurance and quality control 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. Chapter 1 (section 1.3) of the NIR provides a complete description of the QA/QC procedures.

Uncertainty analysis helps to prioritize improvements and to guide decisions on methodological choice. Annex 2 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 of chapters 3 through 7 of the NIR.

Caveats and limitations

Although reported in the National Inventory Report (NIR), emissions and removals from the land-use, land use change and forestry sector are excluded from national totals and subsequently not reported as part of the Greenhouse Gas Emissions indicators.

As part of the continuous improvement process, recalculations are performed annually on Canada's previously reported greenhouse gas emission estimates, to reflect updates to source data and estimation methodology. Chapter 8 of the NIR provides a summary of the recalculations that occurred due to methodological changes and/or refinements since the previous submission, with a brief description, justification and summary of individual impacts on previously reported emission estimates. The chapter also provides details on specific inventory improvements implemented in 2016 as well as planned improvements.

Part 3. Annexes

Annex A. Data tables for the figures presented in this document

Table A.1. Data for Figure 1. Greenhouse gas emissions, Canada, 1990 to 2014

Year	Total greenhouse gas emissions (megatonnes of carbon dioxide equivalent)
1990	613
1991	606
1992	623
1993	625
1994	646
1995	665
1996	685
1997	700
1998	708
1999	722
2000	744
2001	733
2002	736
2003	755
2004	756
2005	747
2006	738
2007	758
2008	739
2009	696
2010	706
2011	710
2012	718
2013	731
2014	732

Note: The national indicator tracks seven greenhouse gases, carbon dioxide (CO_2), methane (CH_4), nitrous oxide (N_2O), sulphur hexafluoride (SF_6), perfluorocarbons (PFCs), hydrofluorocarbons (HFCs) and nitrogen trifluoride (NF_3), released by human activity (reported in megatonnes of CO_2 equivalent). Emission levels for some previous years have been revised in light of improvements to estimation methods and availability of new data.
Source: Environment and Climate Change Canada (2016) National Inventory Report 1990–2014: Greenhouse Gas Sources and Sinks in Canada.

Table A.2. Data for Figure 2. Indexed trend in greenhouse gas emissions per person and per unit of gross domestic product, Canada, 1990 to 2014

Year	GHG per capita (tonnes of carbon dioxide equivalent per person)	Indexed GHG per capita (percent of 1990 level)	GHG intensity (megatonnes of carbon dioxide equivalent per $billion GDP)	Indexed GHG intensity (percent of 1990 level)
1990	22.1	100.0	0.62	100.0
1991	21.6	97.6	0.62	100.8
1992	22.0	99.2	0.63	102.8
1993	21.8	98.4	0.62	100.6
1994	22.3	100.6	0.61	99.3
1995	22.7	102.6	0.61	99.6
1996	23.1	104.5	0.62	100.9
1997	23.4	105.8	0.61	98.8
1998	23.5	106.1	0.59	96.1
1999	23.7	107.3	0.57	92.9
2000	24.3	109.6	0.56	90.8
2001	23.6	106.8	0.54	88.2
2002	23.5	106.1	0.53	86.0
2003	23.9	107.8	0.53	86.6
2004	23.7	107.0	0.52	84.2
2005	23.2	104.7	0.50	80.6
2006	22.7	102.4	0.48	77.7
2007	23.1	104.2	0.48	78.1
2008	22.2	100.4	0.47	75.4
2009	20.7	93.6	0.45	73.3
2010	20.8	93.9	0.45	72.3
2011	20.7	93.4	0.43	70.4
2012	20.7	93.4	0.43	70.2
2013	20.8	94.0	0.43	70.1
2014	20.6	93.1	0.42	68.5

Note: The graph presents the ratio of annual greenhouse gas (GHG) emissions per person and per unit of gross domestic product (GDP) relative to those values in 1990, i.e., the values are indexed to 1990. Greenhouse gas per unit of GDP is calculated using the real inflation-adjusted GDP in 2007 dollars. Emission levels for some previous years have been revised in light of improvements to estimation methods and availability of new data.
Source: Environment and Climate Change Canada (2016) National Inventory Report 1990–2014: Greenhouse Gas Sources and Sinks in Canada.

Table A.3. Data for Figure 3. Greenhouse gas emissions by economic sector, Canada, 1990 to 2014

Year	Oil and gas (megatonnes of carbon dioxide equivalent)	Transportation (megatonnes of carbon dioxide equivalent)	Electricity (megatonnes of carbon dioxide equivalent)	Buildings (megatonnes of carbon dioxide equivalent)	Emissions-intensive and trade-exposed industries (megatonnes of carbon dioxide equivalent)	Agriculture (megatonnes of carbon dioxide equivalent)	Waste and others (megatonnes of carbon dioxide equivalent)
1990	107.2	129.4	94.7	73.3	95.5	56.5	56.3
1991	105.7	124.6	96.1	72.5	95.1	56.4	55.3
1992	115.5	126.9	102.5	74.0	91.8	58.1	54.0
1993	121.7	129.3	93.2	77.7	90.8	59.6	52.3
1994	126.4	135.7	95.3	78.2	96.2	61.6	52.7
1995	132.9	137.5	98.2	79.0	98.3	64.6	55.0
1996	140.1	139.0	98.2	85.1	99.1	67.1	56.0
1997	141.1	145.0	109.4	82.4	98.8	67.0	56.7
1998	146.8	149.5	121.9	75.0	94.0	67.0	53.9
1999	155.9	153.7	119.1	78.7	92.2	67.6	54.5
2000	158.6	155.9	128.8	85.1	92.1	68.5	55.3
2001	158.7	156.9	129.6	81.8	86.2	66.5	53.8
2002	160.8	158.7	123.5	86.5	87.3	65.4	54.1
2003	164.0	163.1	127.0	91.5	86.0	68.5	54.8
2004	162.8	167.3	119.2	89.8	90.2	70.2	56.7
2005	159.4	170.6	117.8	85.4	88.2	70.2	55.9
2006	163.0	170.6	112.1	80.4	88.4	69.0	54.7
2007	167.8	173.2	117.7	85.9	87.5	70.3	56.0
2008	161.7	171.4	108.6	85.4	85.7	70.9	55.5
2009	160.0	167.9	94.0	83.5	72.1	66.7	52.1
2010	162.1	172.5	95.0	80.5	74.5	67.9	53.8
2011	163.9	170.4	86.8	86.1	79.2	68.7	54.7
2012	176.1	171.4	83.2	84.1	78.8	70.0	54.7
2013	187.2	174.3	80.3	84.6	76.8	73.3	54.9
2014	192.3	171.3	78.2	87.2	76.5	72.9	54.1

Note: The "Waste and others" sector consists of emissions from light manufacturing, construction, forest resources, waste, and coal production. The "Emissions-intensive and trade-exposed industries" sector consists of emissions from mining, smelting and refining, pulp and paper, iron and steel, cement, lime and gypsum, and chemicals and fertilizers.
Source: Environment and Climate Change Canada (2016) National Inventory Report 1990–2014: Greenhouse Gas Sources and Sinks in Canada.

Table A.4. Data for Figure 4. Oil and gas sector greenhouse gas emissions, Canada, 1990 to 2014

Year	Oil sands – upgrading (megatonnes of carbon dioxide equivalent)	Oil sands – in situ (megatonnes of carbon dioxide equivalent)	Oil sands – mining and extraction (megatonnes of carbon dioxide equivalent)	Conventional oil (megatonnes of carbon dioxide equivalent)	Natural gas (megatonnes of carbon dioxide equivalent)	Other (megatonnes of carbon dioxide equivalent)
1990	7.9	3.0	4.4	24.5	35.7	31.7
1991	8.0	3.3	4.6	23.7	34.8	31.3
1992	10.6	3.1	5.0	25.9	36.9	34.0
1993	11.7	3.3	5.2	27.1	39.1	35.4
1994	12.7	3.3	5.4	28.3	41.2	35.5
1995	14.0	2.7	4.8	31.0	43.1	37.2
1996	12.8	3.6	5.3	32.0	45.4	40.9
1997	12.6	3.7	6.1	34.5	43.1	41.1
1998	12.9	3.8	6.4	36.0	47.1	40.5
1999	13.8	3.6	6.7	36.2	55.7	39.9
2000	13.9	4.0	6.6	38.5	59.8	35.9
2001	14.0	4.7	7.8	37.2	60.1	34.8
2002	14.8	4.1	8.4	36.2	61.8	35.5
2003	14.6	6.7	9.1	34.4	64.4	34.8
2004	17.1	7.8	9.8	32.9	59.6	35.5
2005	16.5	8.0	9.7	31.1	58.5	35.7
2006	18.6	9.6	11.2	31.2	57.4	35.0
2007	18.2	11.9	11.9	31.7	60.2	34.0
2008	16.8	14.2	11.9	30.1	56.9	31.8
2009	19.7	15.5	13.1	28.7	52.2	30.9
2010	19.0	18.9	14.8	29.1	50.7	29.5
2011	20.3	19.9	15.1	30.2	49.9	28.5
2012	20.7	23.6	15.8	32.2	53.2	30.5
2013	21.3	25.9	16.4	34.5	57.2	31.9
2014	20.2	30.1	17.5	35.5	56.5	32.3

Note: Conventional oil includes production from frontier, light and heavy oil fields. The "Other" category includes downstream oil and gas emissions (combustion and fugitive emissions from the production of refined petroleum products and the distribution of natural gas to end consumers) and oil and gas transmission emissions (combustion and fugitive emissions from transmission, storage and delivery activities). Totals may not add up due to rounding.
Source: Environment and Climate Change Canada (2016) National Inventory Report 1990–2014: Greenhouse Gas Sources and Sinks in Canada.

Table A.5. Data for Figure 5. Transportation sector greenhouse gas emissions, Canada, 1990 to 2014

Year	Passenger cars (megatonnes of carbon dioxide equivalent)	Passenger light trucks (megatonnes of carbon dioxide equivalent)	Passenger aviation, bus, rail and motorcycle (megatonnes of carbon dioxide equivalent)	Freight trucks (megatonnes of carbon dioxide equivalent)	Freight aviation, rail and marine (megatonnes of carbon dioxide equivalent)	Other (megatonnes of carbon dioxide equivalent)
1990	51.8	22.3	8.5	23.6	12.8	10.5
1991	49.8	22.6	7.7	22.6	12.4	9.4
1992	50.1	24.1	7.8	23.1	12.5	9.3
1993	50.2	25.4	7.4	24.7	11.9	9.8
1994	49.5	27.3	7.4	29.2	12.4	10.1
1995	48.8	28.3	7.9	30.2	11.5	10.7
1996	47.3	29.4	8.4	30.0	11.5	12.4
1997	47.3	32.1	8.6	32.4	11.7	13.0
1998	46.1	34.5	8.7	34.4	12.1	13.5
1999	47.2	36.3	9.2	35.2	12.4	13.4
2000	46.7	37.0	9.3	36.4	12.7	13.9
2001	46.8	37.8	8.9	37.8	13.0	12.5
2002	47.1	39.3	8.8	38.4	12.6	12.5
2003	46.6	40.4	9.1	40.0	13.4	13.6
2004	46.2	41.8	9.6	42.7	14.0	13.0
2005	45.5	42.7	8.9	48.0	14.1	11.4
2006	45.0	43.8	8.4	49.8	14.4	9.3
2007	44.7	44.8	9.0	51.9	14.9	7.9
2008	43.5	44.7	8.7	52.3	15.0	7.2
2009	42.7	45.5	8.0	52.3	12.3	7.1
2010	42.1	47.1	8.0	53.2	14.1	8.0
2011	39.9	46.8	7.9	53.4	13.9	8.7
2012	38.7	47.8	8.8	54.6	14.0	7.6
2013	39.0	50.2	9.0	55.4	13.2	7.4
2014	36.1	49.7	8.9	54.7	13.0	8.8

Note: The "Other" category includes other recreational, commercial and residential uses. Totals may not add up due to rounding.
Source: Environment and Climate Change Canada (2016) National Inventory Report 1990–2014: Greenhouse Gas Sources and Sinks in Canada.

Table A.6. Data for Figure 6. Electricity sector greenhouse gas emissions, Canada, 1990 to 2014

Year	Coal (megatonnes of carbon dioxide equivalent)	Natural gas (megatonnes of carbon dioxide equivalent)	Other (megatonnes of carbon dioxide equivalent)
1990	80.5	2.7	11.5
1991	84.4	2.2	9.4
1992	87.4	4.4	10.7
1993	80.0	5.4	7.9
1994	83.7	5.3	6.3
1995	84.9	6.2	7.0
1996	86.8	5.5	6.0
1997	93.7	6.9	8.8
1998	99.7	9.3	12.9
1999	99.6	9.1	10.5
2000	108.1	11.0	9.7
2001	106.4	11.3	11.8
2002	104.5	9.2	9.7
2003	103.0	9.8	14.2
2004	95.8	9.3	14.1
2005	97.3	8.9	11.5
2006	93.3	9.7	9.0
2007	98.8	9.2	9.7
2008	92.8	8.5	7.2
2009	77.8	8.7	7.5
2010	78.6	11.4	5.0
2011	68.6	13.8	4.3
2012	63.3	15.6	4.3
2013	63.8	11.9	4.6
2014	61.6	11.7	4.8

Note: The "Other" category includes diesel fuel oil, heavy fuel oil, light fuel oil, motor gasoline, petroleum coke, own use of primary electricity, solid wood waste and still gas.
Source: Environment and Climate Change Canada (2016) National Inventory Report 1990–2014: Greenhouse Gas Sources and Sinks in Canada.

Table A.7. Data for Figure 7. Greenhouse gas emissions by province and territory, Canada, 1990, 2005 and 2014

Province or Territory	1990 greenhouse gas emissions (megatonnes of carbon dioxide equivalent)	2005 greenhouse gas emissions (megatonnes of carbon dioxide equivalent)	2014 greenhouse gas emissions (megatonnes of carbon dioxide equivalent)
Newfoundland and Labrador (NL)	9.6	10.2	10.6
Prince Edward Island (PE)	2.0	2.1	1.8
Nova Scotia (NS)	20.0	23.5	16.6
New Brunswick (NB)	16.4	20.5	14.9
Quebec (QC)	89.1	89.7	82.7
Ontario (ON)	181.8	210.6	170.2
Manitoba (MB)	18.7	20.7	21.5
Saskatchewan (SK)	45.1	69.6	75.5
Alberta (AB)	175.2	233.0	273.8
British Columbia (BC)	52.9	65.2	62.9
Yukon (YT)	0.5	0.5	0.3
Northwest Territories (NT)	1.6[A]	1.7	1.5
Nunavut (NU)	n/a	0.3	0.3

Note: [A] 1990 emissions data for the Northwest Territories include emissions for Nunavut, which was part of the Northwest Territories until 1999. n/a = not applicable. Emission levels for some years have been revised in light of improvements to estimation methods and availability of new data.
Source: Environment and Climate Change Canada (2016) National Inventory Report 1990–2014: Greenhouse Gas Sources and Sinks in Canada.

Annex B. References and additional information

References and further reading

Environment and Climate Change Canada (2016) National Inventory Report 1990–2014: Greenhouse Gas Sources and Sinks in Canada.

Intergovernmental Panel on Climate Change (2006) 2006 IPCC Guidelines for National Greenhouse Gas Inventories.

Related information

Canada's Action on Climate Change

Drivers and Impacts of Greenhouse Gas Emissions

Environment and Climate Change Canada – Climate Change

Global Greenhouse Gas Emissions

Greenhouse Gas Emissions from Large Facilities

www.ec.gc.ca

Additional information can be obtained at:

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