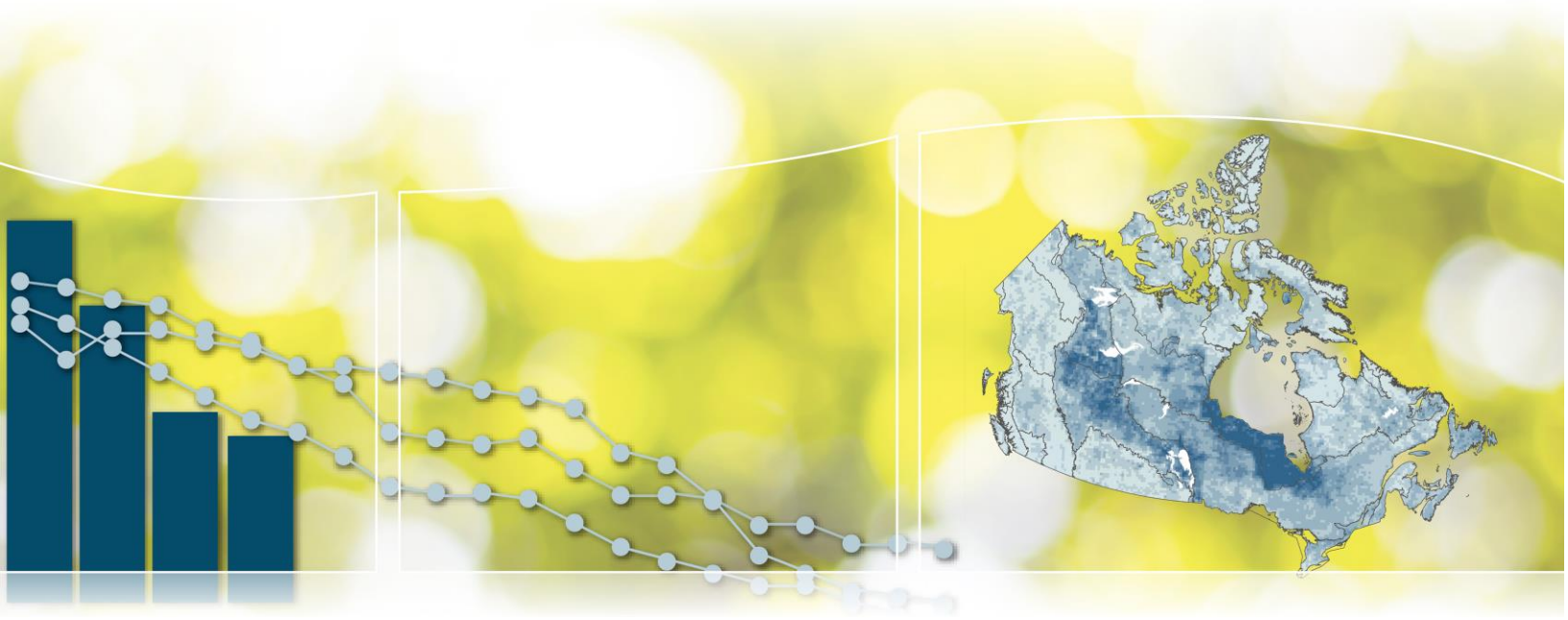
Environment and Climate Change Canada
Environnement et Changement climatique Canada

Canadian Environmental Sustainability Indicators

Greenhouse gas emissions



Canada

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Greenhouse gas emissions

April 2018

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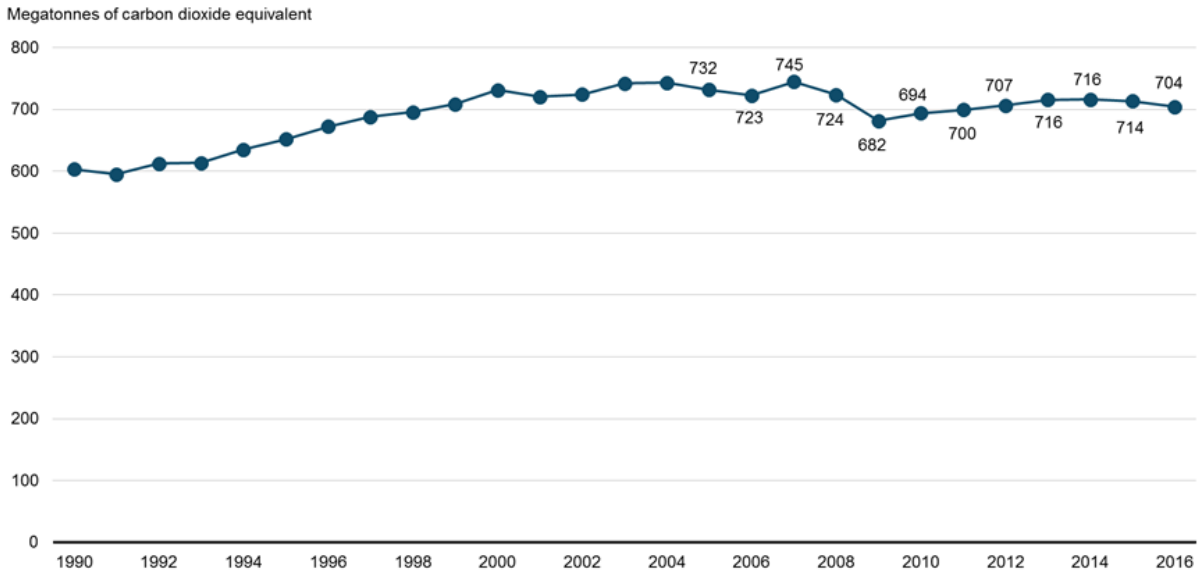
Greenhouse gas emissions

Climate change is one of the most important environmental issues of our time. Climate change is caused by the increase in concentrations of greenhouse gases in the atmosphere. These increases are primarily due to human activities such as the use of fossil fuels or agriculture. The indicators report estimates of Canada's emissions and removals of greenhouse gases.

Key results

- Canada's total greenhouse gas emissions in 2016 were 704 megatonnes (Mt) of carbon dioxide equivalent (CO_2 eq).
- The recent decrease in emissions was primarily driven by reduced emissions from the electricity generation sector.

Figure 1. Greenhouse gas emissions, Canada, 1990 to 2016



Data for Figure 1

Note: The national indicator tracks 7 greenhouse gases released by human activity: carbon dioxide, methane, nitrous oxide, sulphur hexafluoride, perfluorocarbons, hydrofluorocarbons and nitrogen trifluoride. Emission levels for some years have been revised in light of improvements to estimation methods and availability of new data. Emissions and removals from the land use, land use change and forestry sector (LULUCF) are excluded from national totals.
Source: Environment and Climate Change Canada (2018) National Inventory Report 1990-2016: Greenhouse Gas Sources and Sinks in Canada.

Between 1990 and 2016, emissions increased by 17%, or 101 Mt CO_2 eq. Canada's emissions growth over this period was driven primarily by increased emissions from mining and upstream oil and gas production as well as transport.

Since 2005, emissions decreased by 28 Mt CO_2 eq or 3.8%. The decrease was driven primarily by reduced emissions from public electricity and heat production utilities.

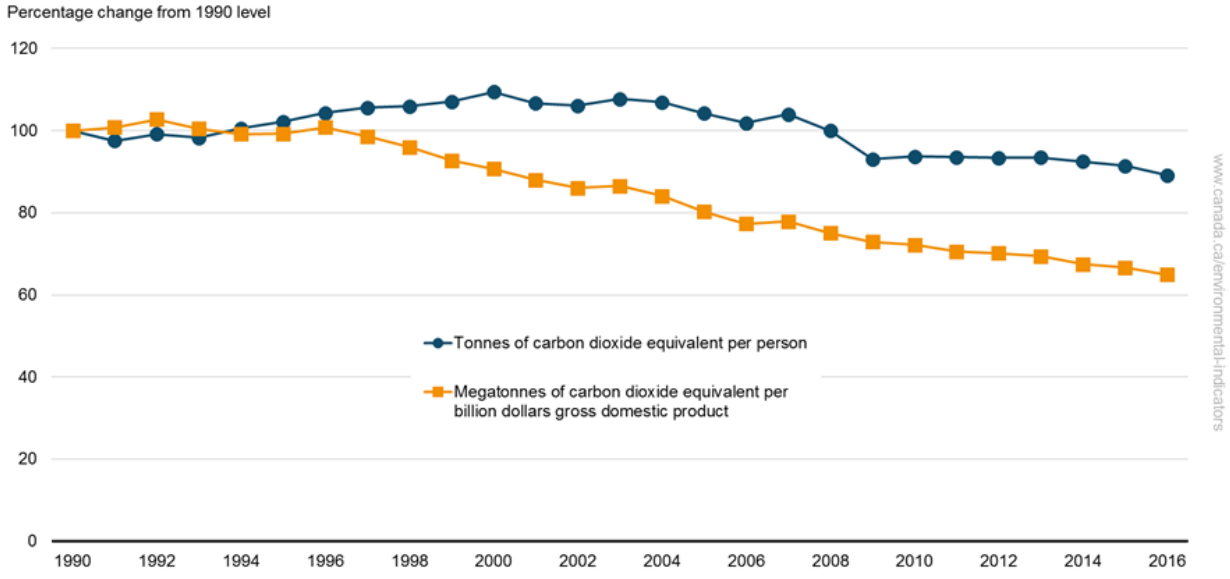
Greenhouse gas emissions per person and per unit of gross domestic product

These indicators show the relationship between the size of Canada's population and the amount of greenhouse gases (GHGs) emitted. They also show how efficiently sectors in the economy are minimizing GHG emissions while producing goods and services for our consumption and export.

Key results

- Between 1990 and 2016, GHG per unit of gross domestic product decreased 35% from 0.61 to 0.39 megatonnes (Mt) of carbon dioxide equivalent (CO_2 eq) per billion dollars gross domestic product.
- The amount of GHGs emitted per person decreased 11% over the same period, from 21.8 to 19.4 tonnes CO_2 eq.

Figure 2. Indexed trend in greenhouse gas emissions per person and per unit of gross domestic product, Canada, 1990 to 2016



Data for Figure 2

Note: The chart presents the ratio of annual greenhouse gas emissions per person and per unit of gross domestic product relative to those values in 1990 (that is the values are indexed to 1990). Greenhouse gas per unit of gross domestic product is calculated using real inflation-adjusted gross domestic product in 2007 dollars. 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 (2018) National Inventory Report 1990-2016: Greenhouse Gas Sources and Sinks in Canada. Statistics Canada Table 051-0001 - Estimates of population, by age group and sex for July 1, Canada, provinces and territories, annual. Statistics Canada Table 380-0106 - Gross domestic product at 2007 constant prices, expenditure-based, annual.

Improvements in emissions per person and per unit of gross domestic product are attributable to a number of factors. More efficient industrial processes, a shift to a more service-based economy and a decrease in the emissions associated with energy generation are all contributing to the decrease of emissions.

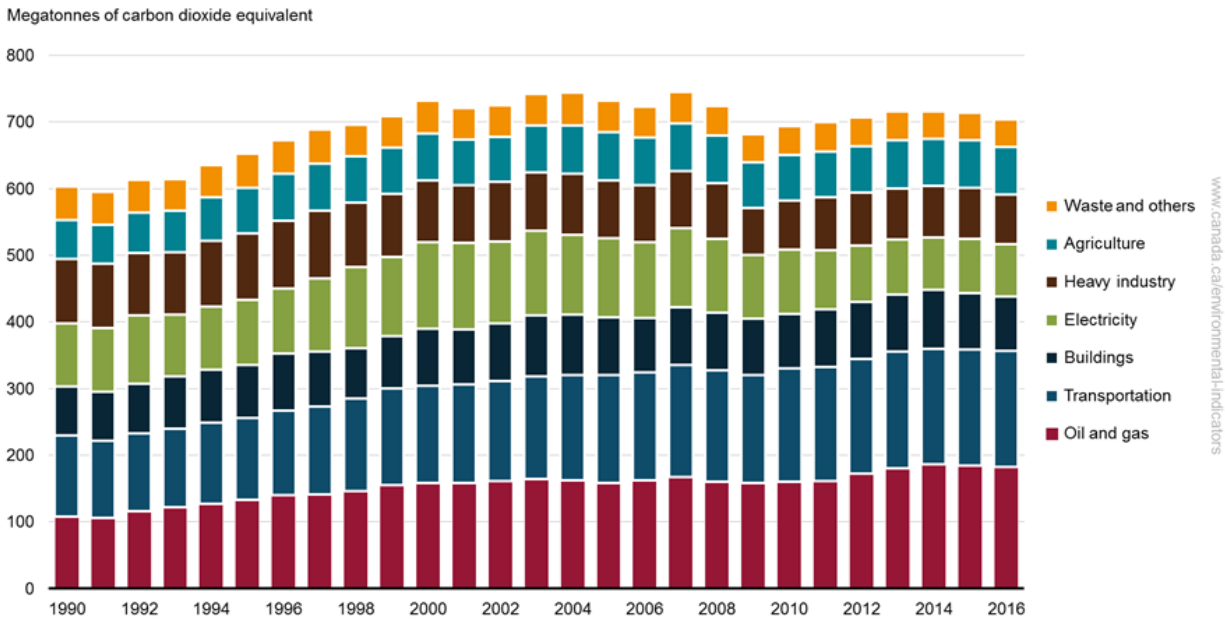
Greenhouse gas emissions by economic sector

These indicators show the greenhouse gas emissions (GHG) reported by economic sector in which they are generated. They show how efficiently sectors in the economy are minimizing GHG emissions while producing goods and services for our consumption and export.

Key results

- In 2016, the oil and gas sector and transportation sectors were the largest GHG emitter in Canada. Together, they accounted for almost 50% of total emissions.
- The other Canadian economic sectors each accounted for between 6% and 12% of total GHG emissions in Canada.

Figure 3. Greenhouse gas emissions by economic sector, Canada, 1990 to 2016



Data for Figure 3

Note: The Waste and others sector consists of emissions from light manufacturing, construction, forest resources, waste and coal production. The Heavy industry 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 (2018) National Inventory Report 1990-2016: Greenhouse Gas Sources and Sinks in Canada.

In 2016, the oil and gas sector accounted for 183 Mt CO_2 eq (26% of total emissions), followed closely by the transportation sector, which emitted 173 Mt CO_2 eq (25%).

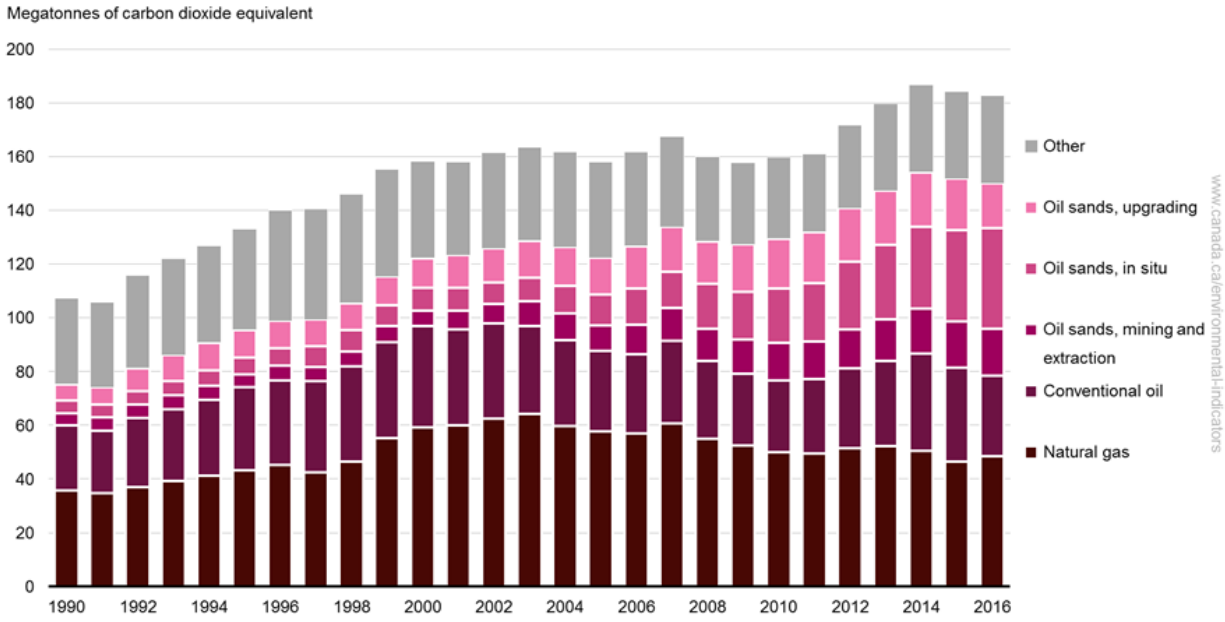
The increase in total GHG emissions between 1990 and 2016 was mostly due to a 70% (75 Mt CO_2 eq) increase in emissions in the oil and gas sector and a 42% (51 Mt CO_2 eq) increase in the transportation sector. These increases were offset by a 16 Mt CO_2 eq decrease in emissions in the electricity sector and a 22 Mt CO_2 eq decrease in emissions from heavy industry.

Greenhouse gas emissions from the oil and gas sector

Key results

- In 2016, the oil and gas sector was the largest source of GHG emissions, accounting for 26% of total national emissions.
- Emissions of GHGs from the oil and gas sector have increased 70% from 107 Mt CO_2 eq in 1990 to 183 Mt CO_2 eq in 2016. This increase is mostly attributable to the increased production of crude oil and the expansion of the oil sands industry.

Figure 4. Oil and gas sector greenhouse gas emissions, Canada, 1990 to 2016



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 (2018) National Inventory Report 1990-2016: Greenhouse Gas Sources and Sinks in Canada.

Between 1990 and 2016, GHG emissions from conventional oil production have increased by 23%, while emissions from oil sands production have increased by 367%. More than half of the increase in emissions from oil sands production over this period came from the growth of in situ production. A temporary decrease in GHG emissions between 2008 and 2011 is mostly attributable to the world economic downturn that resulted in a lower global demand for petroleum products.

Between 1990 and 2016, 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 (that is, more GHG are emitted per unit cubic meters of oil produced). This change thus had a major impact on total GHG emissions from the sector.

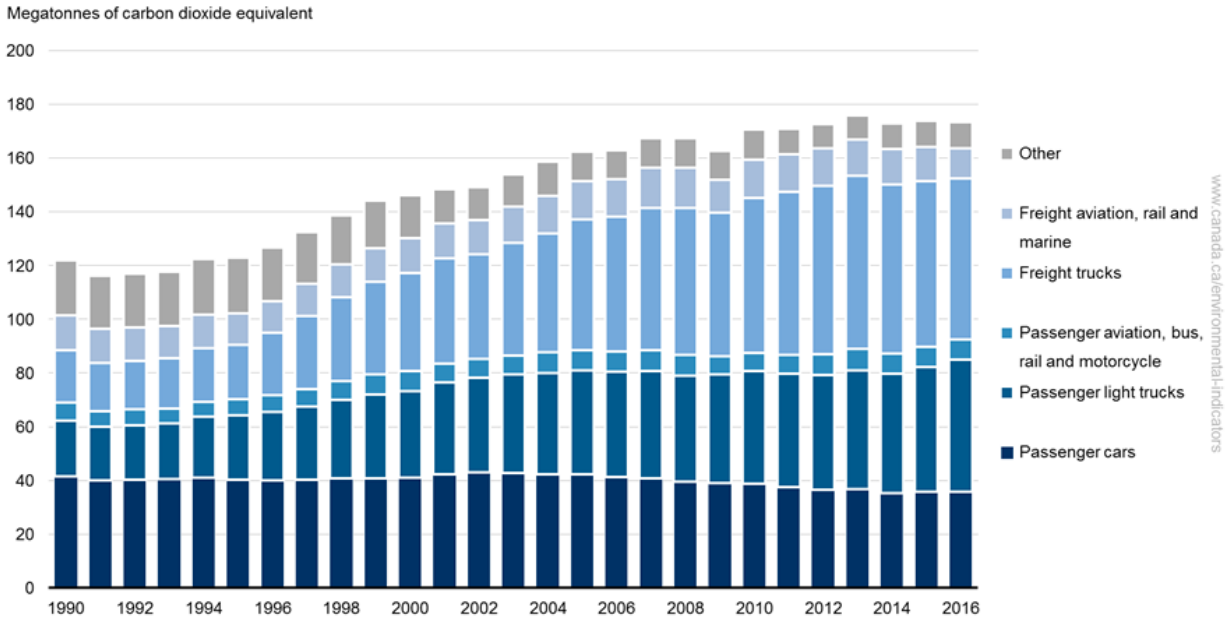
During the same period, production of natural gas from unconventional sources, such as those requiring the use of multi-stage fracturing techniques, also increased significantly.

Greenhouse gas emissions from the transportation sector

Key results

- In 2016, the transportation sector was the second largest source of GHG emissions, accounting for 25% (173 Mt CO_2 eq) of total national emissions.
- Between 1990 and 2016, GHG emissions from the transportation sector grew by 42%. The growth in emissions was driven by increases from freight trucks and passenger light trucks.

Figure 5. Transportation sector greenhouse gas emissions, Canada, 1990 to 2016



Data for Figure 5

Note: The Other category includes other recreational, commercial and residential uses.
Source: Environment and Climate Change Canada (2018) National Inventory Report 1990-2016: Greenhouse Gas Sources and Sinks in Canada.

Between 1990 and 2016, part of the GHG emissions increase was due to a higher number of vehicles on the road and to changes in vehicle type used. Although total passenger emissions grew by 34%, emissions from cars declined by 14%, while emissions from light trucks (including trucks, vans and sport utility vehicles) more than doubled. Freight travel emissions grew by 119% between 1990 and 2016. Specifically emissions from freight trucks tripled and emissions from other modes of freight transportation decreased by 14%.

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 for light trucks rather than more fuel-efficient passenger cars, played an important role in shaping the evolution of GHG emissions.

Since 1990, the number of light trucks increased much faster than the increase of other 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.[1] However, these improvements were not sufficient to offset the increases in emissions due to the change in composition of the vehicle fleet.

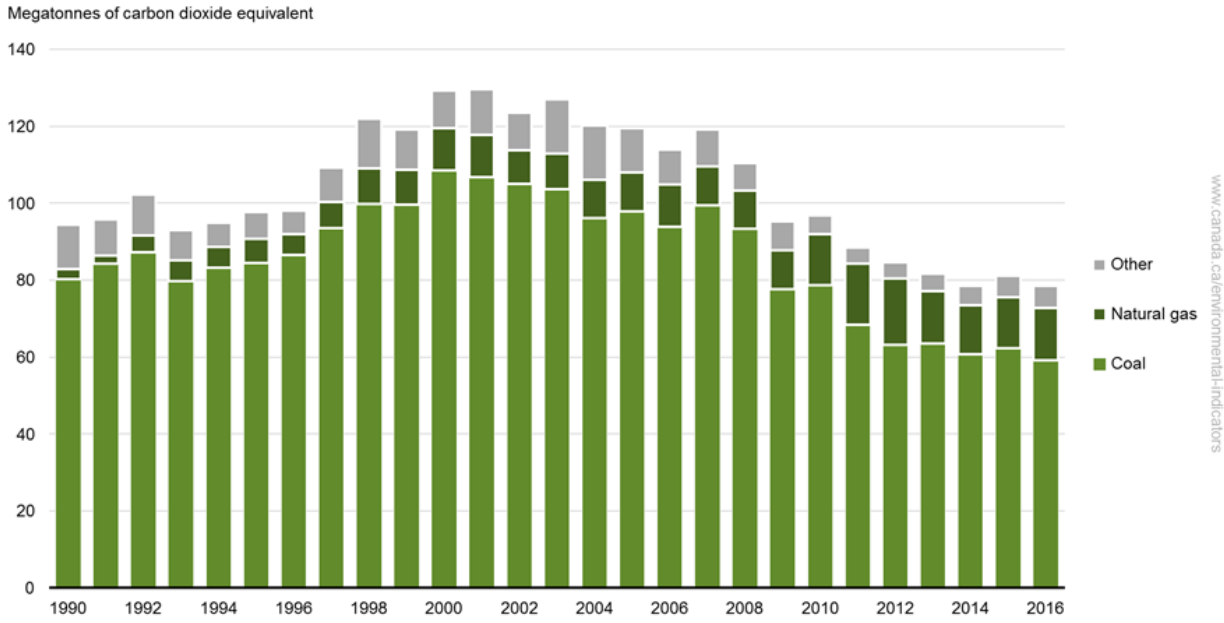
[1] Natural Resources Canada (2015) Energy Efficiency Trends Analysis Tables - Transportation Sector - Energy Use Analysis.

Greenhouse gas emissions from the electricity sector

Key results

- In 2016, the electricity sector was the fourth largest source of GHG emissions, accounting for 11% of total national emissions.
- Between 1990 and 2016, greenhouse gas emissions from combustion-based electricity generation have decreased by 17%.

Figure 6. Electricity sector greenhouse gas emissions, Canada, 1990 to 2016



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 (2018) National Inventory Report 1990-2016: Greenhouse Gas Sources and Sinks in Canada.

Greenhouse gas emissions from combustion-based electricity generation have decreased from 94 Mt CO_2 eq in 1990 to 79 Mt CO_2 eq in 2016. 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 the decline in GHG emissions from electricity.

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. The general decline in the GHG intensity of electricity generation of public electric utilities from 1990 to 2016 can be attributed partly to a reduction in the use of coal and increases in other power plant types.

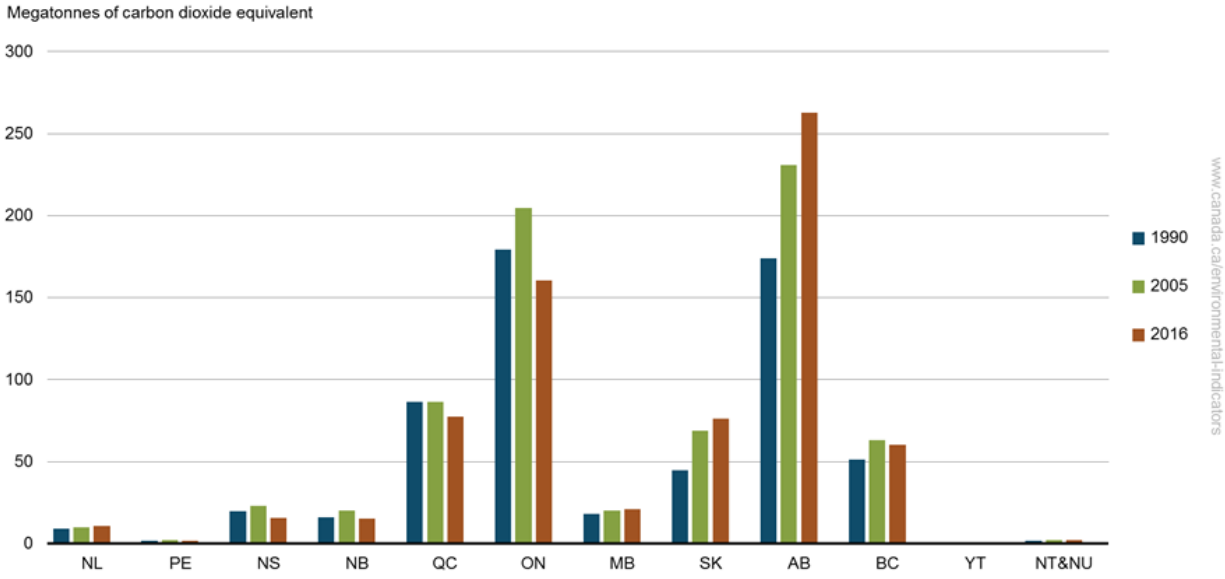
Greenhouse gas emissions by province and territory

Emissions vary significantly by province. The level of emissions depends on factors such as population, energy sources and economic base. Provinces and territories that are the most populated, have economies based on resource extraction or are relying on fossil fuels to generate electricity will tend to have higher emission levels.

Key results

- In 2016, the top 5 emitters (Alberta, Ontario, Quebec, Saskatchewan and British Columbia) together released 90% of Canada's national total GHG emissions.
- Greenhouse gas (GHG) emissions for Ontario and Quebec were lower in 2016 than in 1990.
    - For Quebec, emissions were lower by 9.4 megatonnes (Mt) of carbon dioxide equivalent (CO_2 eq).
    - For Ontario, emissions were lower by 18.6 Mt CO_2 eq.
- Emissions in Saskatchewan, Alberta and British Colombia were higher in 2016 than in 1990.

Figure 7. Greenhouse gas emissions by province and territory, Canada, 1990, 2005 and 2016



Data for Figure 7

Note: 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 (2018) National Inventory Report 1990-2016: Greenhouse Gas Sources and Sinks in Canada.

In 1990, Ontario's GHG emissions were higher than those from the other provinces because of its large manufacturing industry. Alberta's emissions subsequently surpassed Ontario's, with an increase of 51% since 1990, primarily due to the increase in the oil and gas industry for export markets. Ontario's emissions decreased between 1990 and 2016 primarily because of the closure of coal-fired electricity generation plants. In 2016, the combined emissions from Alberta and Ontario represented 60% (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 over time and a decreasing pattern since 2005. Quebec had an 11% (9 Mt CO_2 eq) decrease from its 2005 emissions level; while British Columbia had a decline of 5% (3 Mt CO_2 eq). In contrast to these decreases, emissions in

Saskatchewan increased by 11% (7 Mt CO_2 eq) between 2005 and 2016, primarily due to increases in activity from sectors such as transportation, oil and gas, and mining.

About the indicators

What the indicators measure

The indicators show trends in anthropogenic (human-made) greenhouse gas (GHG) emissions. It includes emissions for 7 greenhouse gases (carbon dioxide, methane, nitrous oxide, sulphur hexafluoride, perfluorocarbons, hydrofluorocarbons and nitrogen trifluoride). Emissions are presented:

- at the national level (total emissions, emissions per person and emissions per unit of gross domestic product)[2]
- at the provincial/territorial level
- by economic sector

The indicators do not capture:

- emissions from natural processes (for example, material decay, plant and animal respiration, volcanic and thermal venting)
- removal of emissions from the atmosphere by natural sinks (for example, forests, oceans)

Why these indicators are important

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.

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.

The Greenhouse gas emissions indicators are used to track the progress of Canada's efforts to lower emissions and reach environmental performance objectives. They also support decision making on sustainable development.

As an Annex I Party to the United Nations Framework Convention on Climate Change, Canada is required to prepare and submit a national inventory of anthropogenic sources and sinks of GHGs on an annual basis.

The indicators support the measurement of progress towards the 2016–2019 Federal Sustainable Development Strategy target: "By 2030, reduce Canada's GHG emission by 30%, relative to 2005 emission levels." They also contribute to the Sustainable Development Goals of the 2030 Agenda for Sustainable Development. They are among the measures used against Target 9.4: "By 2030, upgrade infrastructure and retrofit industries to make them sustainable, with increased resource-use efficiency and greater adoption of clean and environmentally sound technologies and industrial processes, with all countries taking action in accordance with their respective capabilities."

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

Related indicators

The Greenhouse gas emissions from large facilities indicator reports GHG emissions from the largest GHG emitters in Canada (industrial and other types of facilities).

The Global greenhouse gas emissions indicator provides a global perspective on Canada's share of global GHG emissions.

The Carbon dioxide emissions from a consumption perspective indicator shows the impact of Canada's consumption of goods and services, regardless of where they are produced, on the levels of carbon dioxide released into the atmosphere.

The Progress towards Canada's greenhouse gas emissions reduction target indicator provides an overview of Canada's projected GHG emissions up to 2030.

Effective action on climate change

These indicators support the measurement of progress towards the following 2016–2019 Federal Sustainable Development Strategy long-term goal: A low-carbon economy contributes to limiting global average temperature rise to well below 2 degrees Celsius and supports efforts to limit the increase to 1.5 degrees Celsius.

Data sources and methods

Data sources

The Greenhouse gas emissions indicators are based on greenhouse gas (GHG) emissions data taken from Environment and Climate Change Canada's National Inventory Report 1990-2016: Greenhouse Gas Sources and Sinks in Canada.

More information

Data used to develop the emission and removal estimates presented in the National Inventory Report are drawn from published and unpublished sources from various government departments, industry sources and scientific papers.

Greenhouse gas emission estimates are provided at the national and provincial/territorial levels and by economic sector. The greenhouse gas emission and removal estimates are compiled annually and reported for the period from 1990 to 2016. Complete details of the temporal coverage for each data source used for the indicators can be found in chapters 3 through 7 of the National Inventory Report.

Preparation of the GHG emissions inventory takes almost 16 months from the end of the 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 National Inventory Report text and accompanying emissions 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, typically by mid-April.

Methods

The National Inventory Report is prepared using a "top-down" approach, providing estimates at a sectoral and provincial/territorial level without attribution to individual emitters. The emissions estimates are developed using guidelines produced by the Intergovernmental Panel on Climate Change. Annex 3 of the National Inventory Report describes the methods used to estimate Canada's greenhouse gas (GHG) emissions.

More information

Since direct measurement of emissions from all sources is not possible, the United Nations Framework Convention on Climate Change requires that countries develop, update, publish and maintain national inventories using internationally approved and comparable emissions and removals estimation methods for the 7 GHGs. Canada's inventory is developed in accordance with the recently revised United Nations Framework Convention on Climate Change Annex I Inventory Reporting Guidelines (PDF; 1.67 MB) which require the use of the 2006 methodological guidance developed by the Intergovernmental Panel on Climate Change. The Intergovernmental Panel on Climate Change 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.

Emissions calculation

In general, 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 over a year.

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. It is 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 for countries reporting to the United Nations Framework Convention on Climate Change provide various methods for calculating GHG emissions 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 describes the methods used to estimate Canada's GHG emissions and illustrates that the selection of Intergovernmental Panel on Climate Change method type is highly dependent on the importance of each category and the availability of data.

Carbon dioxide equivalents

Greenhouse gas emissions are reported in carbon dioxide equivalents (CO_2 eq), determined by multiplying the amount of emissions of a particular greenhouse gas by the global warming potential 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 potential to trap heat in the atmosphere is 25 times greater than carbon dioxide's potential. Therefore, methane is considered to have a global warming potential of 25. The Intergovernmental Panel on Climate Change publishes the global warming potentials and atmospheric lifetimes for each GHG; these can be found in Table 1-1 of the National Inventory Report.

Greenhouse gas emissions by economic sector

The Greenhouse gas emissions by economic sector indicator represents a different classification than the activity sector emissions prescribed by the Intergovernmental Panel on Climate Change's methodological guidance and United Nations Framework Convention on Climate Change's 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 (for example, 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 and Annex 10 of the National Inventory Report.

Quality assurance, quality control and uncertainty

Quality assurance and quality control procedures are 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 United Nations Framework Convention on Climate Change. Chapter 1 (section 1.3) of the National Inventory Report provides a complete description of the quality assurance and quality control procedures.

Uncertainty analysis helps to prioritize improvements and to guide decisions on methodological choices. Annex 2 of the National Inventory Report 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 National Inventory Report.

Recent changes

Recalculations are performed annually on Canada's previously reported greenhouse gas emissions estimates to reflect updates to source data and estimation methodology. Chapter 8 of the National Inventory Report provides a summary of the recalculations that occurred due to methodological changes and/or refinements since the previous submission. The summary includes:

- brief description, justification and summary of individual impacts on previously reported emission estimates
- details on specific inventory improvements implemented in 2018 as well as planned improvements

Caveats and limitations

The Greenhouse gas emissions indicators are comprehensive but some emission sources have not been included in the indicators because they are not reported in the National Inventory Report. 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 National Inventory Report.

Although reported in the National Inventory Report, 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.

Resources

References

Environment and Climate Change Canada (2018) National Inventory Report 1990-2016: Greenhouse Gas Sources and Sinks in Canada. Retrieved on April 16, 2018.

Related information

Environment and Climate Change Canada (2017) Greenhouse gas emissions: drivers and impacts. Retrieved on March 2, 2018.

Environment and Climate Change Canada (2018) Canada's action on climate change. Retrieved on March 2, 2018.

Environment and Climate Change Canada (2018) Climate change. Retrieved on March 2, 2018.

Intergovernmental Panel on Climate Change (2006) Guidelines for National Greenhouse Gas Inventories. Retrieved on March 2, 2018.

Annex

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

Table A.1 Data for Figure 1. Greenhouse gas emissions, Canada, 1990 to 2016

Year	Total greenhouse gas emissions (megatonnes of carbon dioxide equivalent)
1990	603
1991	596
1992	613
1993	614
1994	635
1995	652
1996	673
1997	688
1998	696
1999	709
2000	732
2001	721
2002	725
2003	742
2004	744
2005	732
2006	723
2007	745
2008	724
2009	682
2010	694
2011	700
2012	707
2013	716
2014	716
2015	714
2016	704

Note: The national indicator tracks 7 greenhouse gases released by human activity: carbon dioxide, methane, nitrous oxide, sulphur hexafluoride, perfluorocarbons, hydrofluorocarbons and nitrogen trifluoride. Emission levels for some years have been revised in light of improvements to estimation methods and availability of new data. Emissions and removals from the land use, land use change and forestry sector (LULUCF) are excluded from national totals.
Source: Environment and Climate Change Canada (2018) National Inventory Report 1990-2016: 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 2016

Year	Greenhouse gases per capita (tonnes of carbon dioxide equivalent per person)	Indexed greenhouse gases per capita (percentage change from 1990 level)	Greenhouse gas intensity (megatonnes of carbon dioxide equivalent per billion dollars gross domestic product)	Indexed greenhouse gas intensity (percentage change from 1990 level)
1990	21.8	100.0	0.61	100.0
1991	21.2	97.5	0.61	100.8
1992	21.6	99.2	0.62	102.8
1993	21.4	98.3	0.61	100.5
1994	21.9	100.6	0.60	99.2
1995	22.3	102.2	0.60	99.2
1996	22.7	104.3	0.61	100.8
1997	23.0	105.6	0.60	98.6
1998	23.1	106.0	0.58	96.0
1999	23.3	107.1	0.56	92.7
2000	23.8	109.4	0.55	90.7
2001	23.2	106.6	0.53	88.0
2002	23.1	106.1	0.52	86.0
2003	23.5	107.7	0.53	86.5
2004	23.3	106.9	0.51	84.1
2005	22.7	104.3	0.49	80.2
2006	22.2	101.9	0.47	77.3
2007	22.6	104.0	0.47	77.9
2008	21.8	100.0	0.46	75.0
2009	20.3	93.0	0.44	72.9
2010	20.4	93.7	0.44	72.2
2011	20.4	93.5	0.43	70.5
2012	20.3	93.4	0.43	70.1
2013	20.4	93.5	0.42	69.4
2014	20.2	92.5	0.41	67.5
2015	19.9	91.4	0.40	66.7
2016	19.4	89.2	0.39	64.9

Note: Greenhouse gas per unit of gross domestic product is calculated using real inflation-adjusted gross domestic product in 2007 dollars. 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 (2018) National Inventory Report 1990-2016: Greenhouse Gas Sources and Sinks in Canada. Statistics Canada Table 051-0001 - Estimates of population, by age group and sex for July 1, Canada, provinces and territories, annual. Statistics Canada Table 380-0106 - Gross domestic product at 2007 constant prices, expenditure-based, annual.

Table A.3 Data for Figure 3. Greenhouse gas emissions by economic sector, Canada, 1990 to 2016

Year	Oil and gas (megatonnes of carbon dioxide equivalent)	Transportation (megatonnes of carbon dioxide equivalent)	Buildings (megatonnes of carbon dioxide equivalent)	Electricity (megatonnes of carbon dioxide equivalent)	Heavy industry (megatonnes of carbon dioxide equivalent)	Agriculture (megatonnes of carbon dioxide equivalent)	Waste and others (megatonnes of carbon dioxide equivalent)
1990	107.4	122.0	73.7	94.5	96.8	58.0	51.0
1991	105.9	116.1	72.9	95.9	96.7	58.2	49.8
1992	115.8	116.9	74.3	102.3	94.0	60.3	49.2
1993	122.1	117.8	78.2	92.9	93.3	62.3	47.5
1994	126.8	122.4	78.7	94.9	98.9	65.1	48.4
1995	133.1	123.0	79.4	97.8	99.8	68.3	50.9
1996	140.0	126.7	85.5	97.9	102.1	69.8	50.7
1997	140.6	132.3	82.8	109.2	102.0	70.1	51.2
1998	146.2	138.7	75.2	121.9	96.5	69.8	47.7
1999	155.4	144.2	78.9	119.1	93.9	69.8	47.7
2000	158.2	146.3	85.3	129.3	93.4	70.4	48.7
2001	158.2	148.4	81.9	129.6	87.3	68.3	47.0
2002	161.4	149.3	86.7	123.5	88.8	67.7	47.3
2003	163.7	154.0	91.6	127.0	87.7	70.5	47.7
2004	161.8	158.7	90.0	120.2	91.6	72.2	49.0
2005	158.0	162.4	85.9	119.5	86.2	72.6	47.6
2006	161.7	163.0	80.7	114.0	86.1	70.9	46.5
2007	167.6	167.5	86.4	119.2	85.1	71.5	47.5
2008	160.2	167.5	86.1	110.5	83.5	71.4	45.1
2009	157.9	162.7	84.3	95.3	70.8	68.5	42.1
2010	159.8	170.6	81.6	96.9	73.3	68.6	43.1
2011	161.1	170.8	87.0	88.4	79.7	68.7	43.8
2012	171.9	172.8	85.3	84.6	79.2	70.1	42.9
2013	179.9	175.9	85.6	81.7	77.0	72.6	43.2
2014	186.7	172.9	88.3	78.6	77.2	71.3	41.1
2015	184.3	174.0	85.2	81.1	76.1	71.6	41.6
2016	182.7	173.4	81.4	78.6	74.7	72.0	41.4

Note: Totals may not add up due to rounding. The Waste and others sector consists of emissions from light manufacturing, construction, forest resources, waste and coal production. The Heavy industry 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 (2018) National Inventory Report 1990-2016: Greenhouse Gas Sources and Sinks in Canada.

Table A.4 Data for Figure 4. Oil and gas sector greenhouse gas emissions, Canada, 1990 to 2016

Year	Natural gas (megatonnes of carbon dioxide equivalent)	Conventional oil (megatonnes of carbon dioxide equivalent)	Oil sands, mining and extraction (megatonnes of carbon dioxide equivalent)	Oil sands, in situ (megatonnes of carbon dioxide equivalent)	Oil sands, upgrading (megatonnes of carbon dioxide equivalent)	Other (megatonnes of carbon dioxide equivalent)
1990	35.6	24.3	4.5	4.8	6.1	32.1
1991	34.6	23.4	4.9	4.8	6.4	31.7
1992	36.9	25.7	5.1	5.1	8.5	34.5
1993	39.2	26.9	5.1	5.3	9.6	35.9
1994	41.4	28.1	5.3	5.7	10.3	36.0
1995	43.4	30.8	4.9	6.1	10.4	37.6
1996	45.2	31.6	5.5	6.5	10.1	41.1
1997	42.6	33.9	5.3	7.7	9.9	41.2
1998	46.5	35.4	5.6	7.9	10.2	40.7
1999	55.3	35.7	5.8	7.8	10.7	40.0
2000	59.1	37.8	5.8	8.4	11.2	35.9
2001	60.0	35.7	7.0	8.5	12.1	34.8
2002	62.6	35.3	7.4	7.8	12.8	35.5
2003	64.2	32.7	9.1	8.9	13.8	34.9
2004	59.8	31.9	10.2	10.2	14.4	35.5
2005	57.7	30.1	9.5	11.3	13.8	35.7
2006	57.0	29.5	11.1	13.3	15.9	35.0
2007	60.8	30.8	12.1	13.5	16.7	33.8
2008	54.9	29.0	12.1	16.6	15.9	31.6
2009	52.4	26.9	12.8	17.7	17.6	30.4
2010	50.0	26.7	14.1	20.1	18.6	30.3
2011	49.6	27.6	14.1	21.7	19.1	29.0
2012	51.5	29.8	14.3	25.2	20.0	31.0
2013	52.1	31.7	15.5	27.8	20.2	32.6
2014	50.5	36.2	16.8	30.3	20.4	32.4
2015	46.6	34.8	17.4	33.9	19.2	32.4
2016	48.6	29.9	17.5	37.5	16.7	32.5

Note: Totals may not add up due to rounding. 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 (2018) National Inventory Report 1990-2016: Greenhouse Gas Sources and Sinks in Canada.

Table A.5 Data for Figure 5. Transportation sector greenhouse gas emissions, Canada, 1990 to 2016

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	41.6	20.7	6.6	19.5	13.0	20.6
1991	39.9	20.1	5.7	18.1	12.6	19.7
1992	40.2	20.5	5.8	18.0	12.6	19.8
1993	40.5	20.7	5.5	18.8	12.0	20.4
1994	41.0	22.8	5.6	20.0	12.5	20.6
1995	40.3	24.1	5.9	20.3	11.7	20.7
1996	39.9	25.5	6.4	23.2	11.7	20.0
1997	40.2	27.3	6.5	27.3	11.9	19.2
1998	40.7	29.3	6.9	31.3	12.3	18.3
1999	40.9	31.2	7.3	34.5	12.5	17.8
2000	41.1	32.2	7.4	36.7	12.8	16.2
2001	42.4	34.0	7.0	39.2	13.0	12.7
2002	42.9	35.4	6.8	39.2	12.6	12.4
2003	42.8	36.7	7.1	41.9	13.4	12.1
2004	42.2	37.8	7.6	44.2	14.0	12.8
2005	42.3	38.7	7.4	48.8	14.2	11.0
2006	41.3	39.2	7.4	50.3	14.0	10.8
2007	40.7	39.9	7.7	53.1	14.9	11.1
2008	39.5	39.6	7.6	54.9	15.0	10.9
2009	39.0	40.5	6.7	53.4	12.3	10.8
2010	38.8	42.0	6.8	57.7	14.2	11.2
2011	37.6	42.1	6.9	60.8	13.9	9.5
2012	36.6	42.8	7.7	62.6	14.1	9.0
2013	36.8	44.2	7.9	64.4	13.5	9.1
2014	35.4	44.4	7.5	62.8	13.2	9.5
2015	35.8	46.5	7.5	61.6	12.7	9.8
2016	35.8	49.3	7.5	60.0	11.2	9.7

Note: Totals may not add up due to rounding. The Other category includes other recreational, commercial and residential uses.
Source: Environment and Climate Change Canada (2018) National Inventory Report 1990-2016: Greenhouse Gas Sources and Sinks in Canada.

Table A.6 Data for Figure 6. Electricity sector greenhouse gas emissions, Canada, 1990 to 2016

Year	Coal (megatonnes of carbon dioxide equivalent)	Natural gas (megatonnes of carbon dioxide equivalent)	Other (megatonnes of carbon dioxide equivalent)
1990	80.2	2.7	11.5
1991	84.2	2.2	9.4
1992	87.2	4.4	10.7
1993	79.7	5.4	7.9
1994	83.3	5.3	6.3
1995	84.5	6.2	7.0
1996	86.5	5.5	6.0
1997	93.5	6.9	8.8
1998	99.8	9.3	12.9
1999	99.6	9.1	10.4
2000	108.5	11.1	9.6
2001	106.8	11.0	11.8
2002	105.1	8.7	9.7
2003	103.6	9.2	14.2
2004	96.2	9.9	14.1
2005	97.9	10.1	11.5
2006	93.8	11.1	9.0
2007	99.4	10.1	9.7
2008	93.3	10.0	7.2
2009	77.7	10.1	7.5
2010	78.7	13.2	4.9
2011	68.4	15.8	4.2
2012	63.1	17.3	4.2
2013	63.6	13.5	4.6
2014	60.7	12.8	5.1
2015	62.3	13.2	5.6
2016	59.2	13.5	5.9

Note: Totals may not add up due to rounding. 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 (2018) National Inventory Report 1990-2016: 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 2016

Province or territory	1990 greenhouse gas emissions (megatonnes of carbon dioxide equivalent)	2005 greenhouse gas emissions (megatonnes of carbon dioxide equivalent)	2016 greenhouse gas emissions (megatonnes of carbon dioxide equivalent)
Newfoundland and Labrador (NL)	9.3	9.9	10.8
Prince Edward Island (PE)	1.9	2.0	1.8
Nova Scotia (NS)	19.6	23.2	15.6
New Brunswick (NB)	16.1	20.1	15.3
Quebec (QC)	86.6	86.5	77.3
Ontario (ON)	179.2	204.7	160.6
Manitoba (MB)	18.3	20.2	20.9
Saskatchewan (SK)	44.7	68.9	76.3
Alberta (AB)	174.1	231.0	262.9
British Columbia (BC)	51.1	63.3	60.1
Yukon (YT)	0.5	0.5	0.4
Northwest Territories (NT)	1.6[A]	1.6	1.6
Nunavut (NU)	n/a	0.4	0.7

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. Totals may not add up due to rounding. 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 (2018) National Inventory Report 1990-2016: Greenhouse Gas Sources and Sinks in Canada.

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